AN ASSESSMENT OF MUSCULOSKELETAL MEDICINE DEFICIENCIES IN CHIROPRACTIC EDUCATION: A SURVEY OF CHIROPRACTIC CLINICAL CLERKS

A Thesis Presented to the
Faculty of the College of Education
University of Houston

In Partial Fulfillment
of the Requirements for the Degree

Doctor of Education

by

Michael Ramcharan, MPH, DC

December 2015

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Approved by Thesis Committee:

Dr. Bernard Robin, Chairperson

Dr. Sara McNeil, Committee Member

Dr. Margaret Watson, Committee Member

Dr. Dorrie Talmage, External Committee Member

Dr. Robert H. McPherson, Dean

College of Education

December 2015

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Abstract

Multiple medical disciplines receive inadequate education in musculoskeletal medicine throughout their training. The purpose of this study was to investigate whether chiropractic clinical clerks in their clinical clerkship year of training, exhibit any particular area of educational deficiencies in musculoskeletal medicine using a validated questionnaire by Freedman and Bernstein (1998). This observational study examined a convenience sample of chiropractic clinical clerks in the south central part of Texas. Statistical analyses were computed using PASW Statistics 23 software (v. 23 SPSS Inc. Chicago, IL, USA). Descriptive statistics and a two-sample t-test were used to identify the demographics of the study population and the 25 item open-ended questionnaire. Sixty-seven clinical clerks participated in the study with 57% being male. According to the standard basic competency benchmark mean score of 73% suggested by the program chairs of orthopedic residency departments, 94% of chiropractic clinical clerks failed to demonstrate basic competency in musculoskeletal medicine. Only four clinical clerks met the standardized basic competency benchmark in musculoskeletal medicine, however most were deficient in upper and lower extremity diagnosis, low back examination and diagnosis, pediatrics examination, bone joint conditions and common malignancies. Using a t-test, the aggregate scores between trimester seven and trimester ten clinical clerks revealed no statistical significance on the 25-item questionnaire. To our knowledge, this is the first study assessing chiropractic clinical clerks basic competency in musculoskeletal medicine using the Freedman and Bernstein questionnaire. The

deficient questionnaire items in pediatrics, spinal/extremity diagnosis and special imaging with a mean less than 73% will be shared with the curriculum committee and further investigation is warranted to fully assess the current training provided by chiropractic colleges in musculoskeletal medicine.

Keywords: Assessment, Musculoskeletal Medicine, Freedman and Bernstein, Musculoskeletal Deficiencies, Chiropractic education

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Chapter I

Introduction

Are chiropractic clinical clerks academically prepared to diagnose and treat musculoskeletal disorders? Musculoskeletal symptoms are common reasons for patients seeking medical attention. Musculoskeletal symptoms rank alongside respiratory symptoms as the most common reason for a patient to seek medical attention. According to the 2004 National Ambulatory Medical Care Survey, musculoskeletal symptoms accounted for approximately 92.1 million cases seen by physicians annually and were the number-one reason for visits to physicians' offices. (Hing, Cherry, & Woodwell, 2006) Musculoskeletal conditions have also been reported to account for about one-fifth of the symptoms and injuries that are encountered in the emergency room setting, during non-routine pediatric visits, and during other primary care visits. (Yeh, Franko, & Day, 2008).

The economic burden of musculoskeletal conditions is massive, accounting for two to seven percent of the Gross National Product of many Western nations (Reginster, 2002). In the United States, musculoskeletal conditions cost the healthcare system approximately $850 billion a year. These costs account for a substantial portion of the country's health-care expenditures ("United States Bone and Joint Initiative", 2011). The increasing prevalence of musculoskeletal conditions in a growing and aging population has resulted in a more than 47% increase in total aggregate direct cost to treat persons with a musculoskeletal condition. It has been estimated that by the year 2030, the number of individuals in the United States older than the age of sixty-five will double, with persons aged eighty-five and over the most rapidly expanding segment of society ("United States Bone and Joint Initiative", 2011). As a result of the expanding

population, a study conducted by Walker has indicated that this expansion can lead to a considerable socioeconomic burden in both direct and indirect medical costs (Walker, Muller, & Grant, 2004) as well as a considerable workload increase across all medical disciplines for musculoskeletal conditions.

A variety of medical disciplines are involved in the care of individuals with musculoskeletal conditions including physicians, chiropractors, nurse practitioners, physician assistants, occupational therapists, physical therapists and massage therapists. Each of these medical disciplines may serve as the portal of entry for an individual seeking care for a musculoskeletal condition and have undergone training in assessing various competencies in their respective academic programs (Childs et al., 2005; Day & Yeh, 2008; Schmale, 2005), however the educational training and clinical exposure will vary. It is widely recognized globally that the period of time devoted to teaching musculoskeletal medicine during medical school is disproportionately small. In the United States and Canada, the time devoted to musculoskeletal conditions can range anywhere from two weeks to three weeks, with up to one-third of students receiving no exposure at all (Freedman & Bernstein, 1998; Pinney & Regan, 2001). In the United Kingdom, it has previously been shown that the average length of time during medical school spent in orthopedics is five weeks, much of which is combined with training in other specialties, thereby reducing the length of orthopedic attachments to an average of 2.7 weeks, accounting for only two percent of the available time in the clinical years of undergraduate training (Williams, 2000).

Despite these facts, many educational institutions lack musculoskeletal clerkship rotations or electives. Competence in musculoskeletal medicine in graduating medical

students from single medical schools is poor in the United States and Canada (Freedman & Bernstein, 1998; Pinney & Regan, 2001). A study by DiCaprio, Covey and Bernstein (2003) found that only 20% of allopathic schools in the United States had a dedicated musculoskeletal clerkship, making the quality of musculoskeletal training for medical school graduates inadequate and pass rates on standardized testing for musculoskeletal medicine ranges from two to 25% for medical students (DiCaprio, Covey, & Bernstein, 2003). Additionally, Clawson, Jackson, and Ostergaard (2001) surveyed 5487 second-year medical residents in the United States and found that most reported being ill prepared in the area of musculoskeletal medicine. Another survey of pediatric residents identified orthopedics as the main area in which they believed that their medical school education had been deficient (Camp, Gitterman, Headley, & Ball, 1997).

Childs et al. (2005) conducted a study to determine if physical therapists were competent in the management of musculoskeletal problems by administering a survey developed by Freedman and Bernstein. The survey consists of forty open-ended questions that were selected based on commonly encountered musculoskeletal diagnoses encountered in the primary care setting (i.e. fractures, low back pain, sciatica and arthritis). The survey was administered to physical therapy students as well as physical therapy practitioners. Physical therapist groups were sub-classified into Orthopedic Clinical Specialists, non-Orthopedic Clinical Specialists, Doctor of Physical Therapy students, and Master of Science in Physical Therapy students. Scores were compared to previously reported scores achieved by medical students, residents, interns and physicians. The licensed and student physical therapist groups scored higher on the exam than the physician and medical student groups with the exception of the orthopedists who

scored above all other groups. Very little is reported in the literature regarding the adequacy of the educational preparation of nurse practitioners. Similar to Child et al.'s report, a 2007 survey of nurse practitioners reported that only ten percent of its respondents felt competent in the management of musculoskeletal problems following their nurse practitioner education; while more than 50% reported feeling only somewhat or minimally competent (Hart & Macnee, 2007).

Research Purpose

Despite the high prevalence and expected increase of healthcare cost for musculoskeletal conditions due to the aging of the population, serious concerns remain about the education and training of medical doctors related to their knowledge and skills in musculoskeletal medicine (Clawson et al., 2001; Woolf & Akesson, 2001). Although there is a large body of evidence demonstrating that medical students and practicing physicians receive inadequate education in musculoskeletal medicine throughout their training, there is seemingly a lack of evidence examining deficiencies of musculoskeletal medicine in Doctoral Chiropractic curricula within the United States.

The purpose of this study was to use a validated questionnaire by Freedman and Bernstein (1998) to investigate whether chiropractic clinical clerks exhibit any particular area of educational deficiency in musculoskeletal medicine. The validated Freedman and Bernstein basic cognitive musculoskeletal questionnaire is used to assess competence of health-care providers with respect to musculoskeletal problems. It was hypothesized that chiropractic clinical clerks are exposed to more hours of clinical training in musculoskeletal medicine than medical residents; therefore chiropractic clinical clerks would be more competent in musculoskeletal medicine and perform better on the

Freedman and Bernstein (1998) questionnaire in contrast to previous studies of medical residents.

Research Question

Given the problems stated above, the following research questions were posed:

1. What are the educational deficiencies in musculoskeletal medicine for chiropractic clinical clerks during their clinical year of training?
2. How can the results of the questionnaire be mapped back to the core curriculum to identify clinical deficiencies?

Significance of the Study

The study may help identify educational deficiencies in the training of future chiropractic practitioners and facilitate instructional design to increase the acquisition of musculoskeletal education within the chiropractic curriculum. This study can also help other chiropractic institutions evaluate any educational deficiencies in musculoskeletal medicine among students and the curriculum.

Chapter II

Literature Review

A review of the existing literature reveals limited evidence examining deficiencies of chiropractic clinical clerks in musculoskeletal medicine despite this being the primary focus of clinical training. The purpose of this literature review is to provide background information on current inadequacies of musculoskeletal training, identify the importance of musculoskeletal education, explain the economic impact of musculoskeletal impairments on society, identify the scope of practice in chiropractic and finally describe an assessment instrument used to identify deficiencies in musculoskeletal medicine education.

Inadequacies of Musculoskeletal Education

Musculoskeletal education in primary care has previously been shown to be inadequate (Lanyon, Pope, & Croft, 1995). Despite the high prevalence and expected increase of musculoskeletal conditions, due to the aging of the population, serious concerns remain about the education and training of medical doctors related to their knowledge and skills in musculoskeletal medicine (Wolf & Akesson, 2001; Clawson, Jackson, & Ostergaard, 2001). The frequency of musculoskeletal complaints that arise in clinical practice dictates that all medical students should be well versed in musculoskeletal medicine. However, recent studies suggest medical schools do not provide adequate musculoskeletal education in their curricula and students failed to show cognitive mastery in musculoskeletal medicine (Day, Yeh, Franko, Ramirez, & Krupat, 2007; Matzkin, Smith, Freccero, & Richardson, 2005; Schmale, 2005). In 2002, only

forty 40% of US medical schools had a required preclinical musculoskeletal course and less than 20% required a clinical clerkship (DiCaprio, Covey, & Bernstein, 2003).

Musculoskeletal problems are a major source of pain and disability in our society, which led twenty-eight countries and the United States to designate the years 2000 to 2010 as "The Bone and Joint Decade Initiative". The National Bone and Joint Decade (USBJD) 2002–2010 was one of the first unified attempts at undergraduate musculoskeletal curriculum reform in the United States. President George W. Bush introduced this initiative on March 21, 2002 as a multidisciplinary coalition of organizations and sponsors concerned with the deficit in knowledge and resources pertaining to musculoskeletal medicine. The broad goal of this initiative was "to improve the health related quality of life for people who have musculoskeletal disorders" (Pinney & Regan, pg. 3, 2001). The Bone and Joint Decade Initiative (2000 – 2010), housed in the World Health Organization, in Geneva, Switzerland, is an organization that aimed to improve the health related quality of life for people with musculoskeletal disorders throughout the world. It addressed medical education within its specific goals and strategic planning. With the primary aim of advancing education and research of musculoskeletal problems, the Bone and Joint Decade provided its target goal to influence medical schools' training programs to include at least six months of training on musculoskeletal disorders. The secondary aim was to improve the practitioners' diagnostic skills, accurate referrals and institute similar programs for other medical groups ("United States Bone and Joint Initiative", 2011).

The most important aspect of the United States Bone and Joint Decade as it related to medical-student musculoskeletal education was a subcommittee called Project

100. Project 100, chaired by Dr. Joseph Bernstein of the University of Pennsylvania, was created to improve medical education by encouraging 100% of American medical schools to offer dedicated instruction in musculoskeletal medicine. The project has greatly improved the awareness of this educational deficiency, but schools' commitments toward actual reform and incorporation of musculoskeletal education as a required element of the curriculum continues to be a struggle (Skelley, Tanaka, Skelley, & LaPorte, 2012). In fact, 17% of United States medical schools in 2011 did not have any requirement for musculoskeletal instruction (Bernstein, Garcia, Guevara, & Mitchell, 2011).

On an international level, several studies have expressed concern that physicians lack the competency to adequately identify musculoskeletal disorders seen in everyday practice. An Australian study revealed that only ten percent of 166 medical inpatients had undergone a musculoskeletal examination, even though 40% had a documented history of musculoskeletal symptoms on admission (Ahern, Soden, Schultz, & Clark, 1991). A survey of Ontario primary care physicians also found the unnecessary use of diagnostic tests, inappropriate prescription of non-steroidal anti-inflammatory drugs and lack of diagnostic suspicion of dangerous musculoskeletal conditions to be common problems (Glazier et al., 1998). Furthermore, a study of Canadian family medicine practitioners found that 27% of their practice involved musculoskeletal disorders, while less than three percent of the typical Canadian medical school curriculum hours were devoted to musculoskeletal education (Pinney & Reagan, 2001). Another study on pediatric patients in the United Kingdom found that the majority of its respondents had little or no confidence in the musculoskeletal assessment, while most respondents were confident or

very confident in most aspects for cardiovascular, respiratory, and abdominal systems (Jandial, Rapley, & Foster, 2009). In addition, only half of the respondents recalled any teaching of pediatric musculoskeletal medicine at the undergraduate level.

The Importance of Musculoskeletal Education

Musculoskeletal education has been recognized as a national and global topic with an identified gap in education of physicians and thus the service of patients with musculoskeletal disorders (AAMC Report VII Musculoskeletal Medicine Education, 2005). A good understanding of musculoskeletal medicine is therefore essential for the future good practice of medical school graduates. The knowledge base in musculoskeletal medicine needs to be acquired in medical school and then refined during postgraduate residency training. However, throughout the world, undergraduate curricula are decreasing time to teach the musculoskeletal system, both in basic science and in clinical training (Pinney & Regan, 2001). For example, pre-clinical curricula in North America and the United Kingdom devote on average only three percent of their time to the teaching of musculoskeletal injuries and diseases (Williams, 2000).

In the United States and Canada, musculoskeletal education and treatment of musculoskeletal diseases have been identified as a weakness of medical school graduates (Bernstein et al., 2003). In response, the Association of American Medical Colleges (AAMC, 2005) released a report regarding educational strategies for identifying learning objectives on musculoskeletal conditions and suggested ways to incorporate learning experience into a medical school's curriculum. Wadey et al. (2007) described 94 key objectives, identified by Canadian content experts in musculoskeletal medicine that are essential for undergraduate students and post graduate trainees to appreciate and use

in the care of patients who have musculoskeletal concerns. The AAMC report provided guidelines and recommendations for medical schools to enact curriculum reform. Musculoskeletal conditions are treated by a variety of medical specialties including rheumatologists, orthopedists, family practitioners, emergency physicians, pediatricians, and others. The report advocated for interdisciplinary course instructors (AAMC, 2005). A successful interdisciplinary team can integrate learning experiences throughout the curriculum and identify the material as part of a coherent curriculum component. The report noted that explicitly identifying musculoskeletal content in the curriculum will prevent fragmentation and help reinforce the importance and relevance of this information in students' future careers (Skelley et al., 2012).

The majority of the literature on educational strategies for musculoskeletal medicine is purely descriptive, i.e., describing curriculum implementation and/or reform at individual institutions. These usually involve individual courses (most commonly in the first and second years) as opposed to more longitudinal interventions across multiple years.

Economic Impact of Musculoskeletal Impairments

Musculoskeletal conditions are prevalent, and their impact is pervasive. At any one time, 30% of American adults are affected by joint pain, swelling, or limitation of movement and are linked anatomically by their association with pain and impaired physical function (Woolf & Pfleger, 2003). According to the Bone and Joint Initiative, (2011) there are many significant statistics that indicate the prevalence and cost of these health care issues. Persons with musculoskeletal diseases account for a large and growing share of health care utilization. In any given year, about 85% of persons with

musculoskeletal diseases have at least one ambulatory care visit to a physician's office, averaging just under six such visits per year. Between 1996-1998 and 2002-2004, ambulatory physician visits increased from 425.5 million to 507.9 million (Bernstein et al., 2003)

Musculoskeletal conditions are one important reason patients consult primary care professionals including general practitioners and chiropractors. Musculoskeletal conditions (spinal pain, consequences of injuries, osteoporosis, and arthritis) result in enormous social, psychological, and economic burden to society. They are a leading cause of pain and disability, resulting in extensive utilization of health care resources. In Canada, the total economic burden of musculoskeletal conditions ranks second only to cardiovascular disease and are the most costly disease for women and third most costly for men. The total economic burden has been estimated to be about $16.4 billion when considering both indirect costs ($13.7 billion) and direct costs ($2.6 billion) per year. The largest component of these expenditures is related to morbidity and long-term disability. The substantial burden associated with musculoskeletal disorders is compounded by suboptimal clinical management and the risk of clinical iatrogenesis (Bussières et al., 2014). Recognition of the burden of musculoskeletal conditions will result in greater awareness of the pervasive effects they have on individuals and of their cost to society. Measuring the burden should ensure they receive higher priority in health strategies (Woolf & Akesson, 2001).

Scope of Practice in Chiropractic

Chiropractic is an evidence-based regulated health profession currently serving approximately ten percent of the population annually with the aim to improve health and

well-being, primarily of patients with musculoskeletal disorders (Bussières et al., 2014). Chiropractic is the largest, most regulated, and best recognized of the professions that have traditionally functioned outside of mainstream medical institutions and, in the new lexicon, have fallen into the category of "complementary and alternative medicine (CAM)." It is unique in the United States (U.S.) as the most widely disseminated indigenous U.S. system of healing. Its steadily increasing acceptance and use by the public and reimbursement by insurance indicate that chiropractic is no longer the "marginal" or "deviant" profession it was once considered. By this definition, chiropractic currently stands on the bridge between CAM and mainstream medicine (Meeker & Haldeman, 2002). Moreover, chiropractic services are covered by most U.S. health insurance policies and are available in over two hundred U.S. hospitals. However, chiropractic procedures are not taught to medical students for use in their practices, although general presentations by chiropractors to medical students are common (Redwood, 2000).

According to surveys of patients seeking alternative care, chiropractors are used more often than any other alternative provider group and the satisfaction with chiropractic care is very high (Carey et al., 1995; Cherkin & MacCornack, 1989; Eisenberg et al., 1998). One indicator of chiropractic mainstreaming is the steadily increasing use by patients in the United States, which has tripled in the past two decades from about three percent to an estimated ten percent according to a 1997 national random telephone survey (Von Kuster, 1997). This translates to an estimated 190 million patient visits to chiropractors in a year, or about 30% of visits to all complementary and alternative practitioners (Eisenberg et al., 1998). Several studies have confirmed that

most patients go to chiropractors for musculoskeletal problems: about sixty percent with low back pain, and the remainder with head, neck, and extremity symptoms (Coulter, Hurwitz, Adams, Genovese, Hays, & Shekelle, 2002; Hurwitz, Coulter, Adams, Genovese, & Shekelle, 1998).

In the United States, the Council on Chiropractic Education, an agency certified by the U.S. Department of Education, accredits chiropractic doctoral programs. Each program requires four academic years of professional post-undergraduate education before students can qualify for national and state licensure examinations (Meeker & Haldeman, 2002). A recent study described U.S. chiropractic curricula as an average of 4820 classroom and clinical hours, with about thirty percent spent in the basic sciences and seventy percent in clinical sciences and internship (Coulter, Adams, Coggan, Wilkes, & Gonyea, 1998). Chiropractic curricula provide relatively little instruction in pharmacology, critical care, and surgery but emphasize biomechanics, musculoskeletal function, and manual treatment methods.

The primary intervention used by all chiropractors is spinal manipulation. The procedure in its broadest definition describes the application of a load (force) to specific body tissues with therapeutic intent. This load, which has traditionally been delivered by hand, can vary in its velocity, amplitude, duration, and frequency, as well as anatomic location, choice of levers, and direction of force (Meeker & Haldeman, 2002).

The approach used in chiropractic clinical training and practice for clinical diagnosis is similar to that of all health care disciplines: a history, physical, orthopedic, neurological examination, and specialty-specific assessments. However, more time is dedicated to musculoskeletal diagnosis, technique and interpretation of musculoskeletal

radiographs (Bergmann, Peterson, & Lawrence, 1993; Coulter, Adams, Coggan, Wilkes, & Gonyea, 1998; Taylor, Clopton, Bosch, Miller, & Marcelis, 1995).

Assessment Instrument

In an attempt to quantify the perceived lack of musculoskeletal competence among medical graduates, Freedman and Bernstein (1998) designed a basic competency questionnaire in musculoskeletal medicine. The purpose of the questionnaire is to assess whether recently graduated medical doctors had an adequate knowledge of basic musculoskeletal topics.

The questionnaire consists of 25 open-ended, short-answer questions about topics in musculoskeletal medicine, with which all physicians should be familiar. The open-response format was selected to eliminate the possibility of the examinees scoring points on the basis of random guessing. A formal answer key and scoring system were developed prior to administration of the examination. Each question on the 25-item questionnaire was scored on a scale of 0 to 100 percent. One hundred twenty-four chairs of orthopedic and internal medicine residency programs in the United States validated the questionnaire (Said Al-Nammari et al., 2015). The program chairs were asked to rate the importance of each question on a visual analog scale ranging from "not important" to "very important." Their responses were converted to an "importance score" for each question, ranging from 0 (not important) to 10 (very important).

After reviewing the examination, the orthopedic and internal medicine residency chairs were asked to "suggest a passing score (as a percentage) for all medical school graduates to demonstrate basic competency in musculoskeletal medicine on this examination." The orthopedic program chairs weighted the questions according to

importance and recommended a passing benchmark score of 73%; whereas, the internal medicine program, chairs recommended a passing benchmark score of 70% (Freedman & Bernstein, 2002). It's important to note; the orthopedic and internal medicine residents that were surveyed in the original study had completed medical school and entered year one of their respective residency. The orthopedic and internal medicine chairs wanted to capture baseline knowledge of musculoskeletal medicine at the beginning of the residency to minimize questionnaire response error.

Currently, there is limited evidence examining deficiencies of musculoskeletal medicine in doctoral chiropractic curricula within the United States. Chiropractic education has emphasized musculoskeletal medicine with its curricula and the training of future musculoskeletal practitioners; consequently it was hypothesized that chiropractic clinical clerks are exposed to more hours of clinical training in musculoskeletal medicine than medical residents; therefore chiropractic clinical clerks would be more competent in musculoskeletal medicine and perform better on the Freedman and Bernstein (1998) questionnaire in contrast to previous studies of medical residents.

This study was used to assess the baseline knowledge of chiropractic clinical clerks for areas of educational deficiencies on musculoskeletal medicine during their clinical training year. The next decade projects an increased aging population, which correlates with increased musculoskeletal conditions. Healthcare providers must be able to demonstrate competency diagnosing and providing treatment to this population. The next chapter identifies the methodology used in this study.

Chapter III

Methodology

The methodology chapter identifies the rationale for the study, the hypothesis, the statement of purpose, the research question, measure of the study, data collection and analysis procedures.

Musculoskeletal education in primary care has previously been shown to be inadequate (Lanyon, Pope, & Croft, 1995). Despite the high prevalence and expected increase of musculoskeletal conditions due to the aging of the population, serious concerns remain about the education and training of medical students related to their knowledge and skills in musculoskeletal medicine (Clawson, 2001; Wolf & Akesson, 2001). After an extensive review of the existing literature, the author has concluded there is limited evidence examining deficiencies of musculoskeletal medicine education in doctoral chiropractic curricula within the United States. Chiropractic education focuses predominantly on evaluating and diagnosing a variety of musculoskeletal conditions that are commonly seen in clinical practice. As a result, the educational clinical training of chiropractic clerks in evaluating and diagnosing musculoskeletal conditions exceeds medical students' training related to spinal and extremity pain during the clinical clerkship years.

Hypothesis

For the purpose of this study, it was hypothesized that chiropractic clinical clerks are exposed to more hours of clinical training in musculoskeletal medicine than medical residents; therefore chiropractic clinical clerks would be more competent in

musculoskeletal medicine and perform better on the Freedman and Bernstein (1998) questionnaire in contrast to previous studies of medical residents.

Statement of Purpose

The purpose of this study was to investigate whether chiropractic clinical clerks in their clinical years of training (trimester seven to trimester ten) exhibit particular areas of deficiency in musculoskeletal medicine using a 25-item, validated, open-ended questionnaire. The study will help identify deficiencies in the training of future practitioners and facilitate instructional design to increase the acquisition of musculoskeletal education within the chiropractic curriculum. Finally, this study can assist the chiropractic curriculum committee to identify areas of content deficiency in the pre-clinical science courses and help faculty improve instructional pedagogy in deficient areas. This study serves as a baseline for future studies in chiropractic education examining deficiencies among chiropractic clinical clerks and examine curricular weaknesses related to course content.

Research Questions

1. What are the educational deficiencies in musculoskeletal medicine for chiropractic clinical clerks during their clinical year of training?
2. How can the results of the questionnaire be mapped back to the core curriculum to identify clinical deficiencies?

Measure

The Freedman and Bernstein (1998) basic competency questionnaire in musculoskeletal medicine was utilized in the study. One hundred twenty-four chairs of orthopedic and internal medicine residency programs in the United States validated the questionnaire. The questionnaire consists of 25 open-ended, short-answer questions about topics in musculoskeletal medicine. The open-response format was selected to eliminate the possibility of the examinees scoring points on the basis of random guessing and a validated formal answer key and scoring system was used. Each question on the 25-item questionnaire was scored on a scale of 0 to 100 percent (Said Al-Nammari et al., 2015). The basic competency benchmark used in the study was determined by orthopedic and internal medicine residency chairs with an established mean percentage score of 70% for internal medicine residents and 73% for orthopedic residents. The original questionnaire was tested with 240 medical residents and mean correct scores were calculated for the entire cohort (Freedman & Bernstein, 2002; Said Al-Nammari et al., 2015).

This study used a competency benchmark mean passing score of 73% on the questionnaire for chiropractic clinical clerks. The benchmark passing score of 73% was selected because the orthopedic chairs would be more positioned to due scope of practice to validate an instrument on musculoskeletal medicine. The questionnaire consisted of two sections; section one consisted of study demographics and section two had 25 open-ended short-answer questions. Each question was awarded a maximum one point and responses were ranged from either 0 for incorrect, 0.5 for partially correct or one for correct, for a total of 25 questionnaire points. The total score for each questionnaire was calculated and then converted into a total percentage to determine if the chiropractic

clinical clerk met the established basic competency benchmark of 73%. The correct aggregate mean percentage was also calculated for the entire group of chiropractic clinical clerks and compared to the aggregate mean score of internal medicine residents.

The demographic section of the questionnaire included questions about age, gender, race/ethnicity, current grade point average, current semester, undergraduate degree obtained prior to enrolling in the Doctor of Chiropractic program and the name of the course that each clinical clerk perceived to be the most challenging in the chiropractic curriculum. The questionnaire is a 25 item open-ended, short-answer responses that are region-specific questions about musculoskeletal diagnosis, examination or management from the upper extremities, lower extremities, low back, pediatrics and systemic bone and joint conditions/malignancies.

Validity

The Freedman and Bernstein basic competency questionnaire in musculoskeletal medicine has been internally validated by 124 directors of orthopedic and internal medicine residency programs in the United States (Freedman & Bernstein, 2002; Skelley et al., 2012). The Freedman and Bernstein basic competency questionnaire is a good example of predictive validity with an established benchmark mean for achieving basic competency in musculoskeletal medicine.

Research Design

Participants: This study was based on a convenience sample of third year chiropractic clinical clerks in the south central part of Texas. All participants were self-identified as clinic clerks who have completed pre-clinical science courses from trimester one to trimester six (Appendix A) and were enrolled in the clinical clerkship from trimester seven to trimester ten. The chiropractic curriculum has a total of ten trimesters which is divided into two sections; pre-clinical and clinical courses. The pre-clinical sciences courses are from trimester one to trimester eight and the clinical courses occur from trimester seven to trimester ten. Hence, there was an overlap of pre-clinical and clinical courses in trimester seven and eight.

The study eligibility criteria included being 18 years or older, able to read English, must have completed pre-clinical sciences coursework from trimester one to trimester six and were enrolled in clinical courses from trimester seven to trimester ten. The questionnaire by Freedman and Bernstein (2002) was provided in English to 85 eligible chiropractic clinical clerks who have either started their clinical clerkship course in trimester seven or currently engaged in a clinical clerkship course in trimester eight, nine or ten at the Moody Clinic of Texas Chiropractic College. The clinical clerks entered clinic in trimester seven and complete four trimesters of clinical training focusing on musculoskeletal medicine. All clinical clerks were eligible to participate in the questionnaire. No personal health information or any personal identifiers on any of the participants were collected during the study. Human subjects' approval for the study was obtained from the University of Houston and Texas Chiropractic College (TCC) Institutional Review Boards.

Study Design: This observational study design examined a convenience sample of chiropractic clinical clerks in the south central part of Texas.

Internal Validity: To reduced bias that may influence the outcome of the study, an independent faculty was recruited by the principle investigator (PI) to evaluate the open-ended responses on the questionnaires, rating each response either 0 for incorrect, 0.5 for partially correct or one for correct. The PI and the independent faculty member then came to a consensus on what was an accepted response for each question on each questionnaire. The PI and the independent faculty member decided to use the standardized grading rubric provided to limit response bias interjected into the study by the reviewers.

Data Collection Procedures: The clinical administrative assistant administered the Freedman and Bernstein basic competency questionnaire in musculoskeletal medicine to trimester seven, eight, nine and ten chiropractic clinical clerks during a grand round session. Grand rounds are a formal, mandatory weekly meeting where the "attending" (lead Chiropractic Physician) meets with all clinical clerks to discuss any unique clinical encounters of one or more patients for one hour. Those who did not wish to participate were free to leave the classroom with no risk for not participating in the study.

To maintain the privacy and confidentiality of those who participated and those who did not during this study, neither the principle investigator nor any clinic faculty were present during the recruitment of study participants during the grand round session; therefore, the participants would not feel pressured into completing the survey. In addition, no attendance was taken on the day of the grand round session for the participants' protection, privacy and confidentiality; however, other students were aware

of who participated in the study since they all completed the questionnaire in the same classroom and at the same time. The informed consent (Appendix B) and questionnaire took approximately 45 minutes to complete.

The questionnaire was administered and collected by the clinic administrative assistant, and each questionnaire remained unidentified. The administrative assistant left the questionnaires on a table at the front of the classroom and let the clerks know that she would return in 55 minutes to collect the sealed box. This way the administrative assistant did not know who opted out and who participated in the questionnaire, in order to reduce the perception of coercion.

Data Analysis Procedures: Statistical analyses were computed using PASW Statistics 23 software (v. 23 SPSS Inc. Chicago, IL, USA). Descriptive statistics were used to identify the demographics of the study population and the scores of the 25-item questionnaire; additional a two-sample t-test was calculated for trimester seven and trimester ten.

Chapter IV

Discussion of the Results

The intent of this study was to investigate whether chiropractic clinical clerks in during the clinical years of musculoskeletal training would perform better than medical residents on the 25-item, validated, open-ended questionnaire by Freedman and Bernstein. Furthermore, identify specific categories of musculoskeletal medicine deficiencies and report deficiencies to the chiropractic curriculum committee. This chapter identifies the study demographics, the overall scores on the Freedman and Bernstein questionnaire, the established benchmark scores and the overall categorical questionnaire scores.

The study population consisted of 57% males and 43% females. Table 1 shows participant demographics.

Table 1

Descriptive Statistics of the Study Demographic

Variables		Frequency (N=67)	Percentage
Age	20 – 30	50	74.6
	31-40+	16	23.9
Gender	Male	38	56.7
	Female	29	43.3
Race	White	45	67.2
	African American	7	10.4
	Mixed	6	9

Table 1 Continued

Descriptive Statistics of the Study Demographic

Variables		Frequency (N=67)	Percentage
Grade Point Average	2.1 – 3.0	28	41.8
	3.1 – 4.0	39	58.2
Trimester Level	TR-7	22	32.8
	TR-8	15	22.4
	TR-9	9	13.4
	TR-10	21	31.3
Prior degree to the DC Program	Yes	55	82.1
Most challenging course in the curriculum	Orthopedics	42	62.7

Seventy-five percent were between the ages of 20 and 30 and 24% were older than 31 years of age. The majority of chiropractic students tend to enter Chiropractic College in there twenties after earning a bachelors degree, which reflected our study population. Eleven percent of the participants in the study were of Latino origin or descent, and six percent were from a mixed race; 62% were White and ten percent were Black. A consistent observation among chiropractic college campuses across the United States is a higher percentage of white students, which would explain the higher percentage of white clinical clerks found in this study.

The self-reported grade point average (GPA) of the participants ranged from 42% with a GPA less than 3.0 to 58% with a GPA more than 3.1. The clinical clerks consisted of participants from four trimesters in the curriculum: trimester seven – 33%, trimester eight – 22%, trimester nine – 13% and trimester 10 – 32%. Eighty-two percent of the participants had earned a bachelor's degree prior to chiropractic school, which is typical for the majority of our graduate students. Sixty-three percent of the participants felt that the two orthopedic courses were the most challenging courses in the curriculum, which

isn't a surprising trend because these two courses are heavily focused on musculoskeletal medicine diagnosis and clinical management. In addition, these courses tend to have a higher failure rate for students on the first attempt compared to other courses in the curriculum.

The chiropractic clinical clerks completed 67 questionnaires. Table 2 shows the Freedman and Bernstein 25-item questionnaires with the marking scheme (grading rubric) for each question. It also indicates the mean correct score for the entire group for each question from 0 to 100 percent and provides a rank score for each question from 1 to 25. The rank score is rated from 1 as the highest mean correct scored question to 25 as the lowest mean scored question for the study.

Table 2

Freedman and Bernstein Questionnaire Mean Score and Rank Score

Questions	Marking Scheme	Mean Correct Score for Entire Group	Rank Score
1. What common problem must all newborns be examined for?	Congenital dislocation of the hip (CDH, dislocation, subluxation also accepted): 1 point	40.3%	18
2. What is a compartment syndrome?	Increased pressure in a closed fascial space: 1 point	34.3%	19
3. Acute septic arthritis of the knee may be differentiated from inflammatory arthritis by which laboratory test?	Any analysis of fluid from aspiration (cell count, Gram stain, culture): 1 point	44.3%	17
4. A patient dislocates his knee in a car accident. What structure(s) is/are at risk for injury and therefore must be evaluated?	Must mention popliteal artery: 1 point	23.9%	22
5. A patient punches his companion in the face and sustains a fracture of the 5th metacarpal and a 3-mm break in the skin over the fracture. What is the correct treatment, and why?	Irrigation and debridement; risk of infection: 1/2 point each	0.0%	25
6. A patient comes to the office complaining of low-back pain that wakes him up from sleep. What two diagnoses are you concerned about?	Tumor and infection: 1/2 point each	54.5	14
7. How is compartment syndrome treated?	Fasciotomy (surgery also accepted): 1 point	52.2	15
8. A patient lands on his hand and is tender to palpation in the "snuff box" (the space between the thumb extensor and abductor tendons). Initial radiographs do not show a fracture. What diagnosis must be considered?	Scaphoid fracture (carpal bone fracture also accepted): 1 point	58.2	13

Table 2 Continued

Questions	Marking Scheme	Mean Correct Score for Entire Group	Rank Score
9. A 25-year-old male is involved in a motor-vehicle accident. His left limb is in a position of flexion at the knee and hip, with internal rotation and adduction of the hip. What is the most likely diagnosis?	Hip dislocation: 1 point	80.6%	5
10. What nerve is compressed in carpal tunnel syndrome?	Median nerve: 1 point	97.0%	1
11. A patient has a disc herniation pressing on the 5th lumbar nerve root. How is motor function of the 5th lumbar nerve root tested?	Dorsiflexion of the great toe (toe extensors also accepted): 1 point	49.3%	16
12. How is motor function of the median nerve tested in the hand?	Any median function flexion; (metacarpophalangeal finger thumb opposition, flexion, or abduction): 1 point	65.7%	9
13. A 12-year-old boy severely twists his ankle. Radiographs show only soft-tissue swelling. He is tender at the distal aspect of the fibula. What are two possible diagnoses?	Ligament sprain and Salter-Harris I fracture (sprain, fracture also accepted): 1/2 point each	67.9%	8
14. A patient presents with new-onset low back pain. Under what conditions are radiographs indicated? Please name 5 (example: history of trauma).	Age >50; neurological deficit; bowel or bladder changes; history of cancer, pregnancy, drug use, or steroid use; systemic symptoms (night pain, fever); pediatric population: 1/4 point each, full credit for 4 correct	34.3%	19
15. A patient has a displaced fracture near the fibular neck. What structure is at risk for injury?	Common peroneal nerve (peroneal nerve also accepted): 1 point	83.6%	4

Table 2 Continued

Questions	Marking Scheme	Mean Correct Score for Entire Group	Rank Score
16. A 20-year-old man injured his knee while playing football. You see him on the same day, and he has a knee effusion. An aspiration shows frank blood. What are the three most common diagnoses?	Ligament tear, fracture, peripheral meniscal tear (capsular tear patellar dislocation also accepted): 1/2 point each, full credit for 2 correct responses	61.2%	12
17. What are the five most common sources of cancer metastatic to bone?	Breast, prostate, lung, kidney, thyroid: 1/4 point each, full credit for 4 correct responses	74.6	7
18. Name two differences between rheumatoid arthritis and osteoarthrosis	Any two correct statements (i.e., inflammatory versus degenerative, proximal interphalangeal joint versus distal interphalangeal joint, etc.): 1/2 point each	19.4	24
19. Which malignancy may be present in bone yet typically is not detected with a bone scan?	Myeloma (full credit for hematological malignancies-leukemia, lymphoma): 1 point	65.7%	10
20. What is the function of the normal anterior cruciate ligament at the knee?	To prevent anterior displacement of the tibia on the femur: 1 point	77.6%	6
21. What is the difference between osteoporosis and osteomalacia?	Osteoporosis-decreased bone density; osteomalacia-decreased bone mineralization (any true statement about epidemiology, pathophysiology-e.g. estrogen versus vitamin D-also accepted): 1 point	29.9%	21
22. In elderly patients, displaced fractures of the femoral neck are typically treated with joint replacement, whereas fractures near the trochanter are treated with plates and screws. Why?	Blood supply to femoral head (osteonecrosis or nonunion also accepted): 1 point	23.9%	23

Table 2 Continued

Questions	Marking Scheme	Mean Correct Score for Entire Group	Rank Score
23. What muscle(s) is/are involved in lateral epicondylitis (tennis elbow)?	Wrist extensors (full credit for any wrist extensor: extensor carpi radialis brevis, extensor carpi radialis longus, extensor digitorum communis): 1 point	85.1%	2
24. Rupture of the biceps at the elbow results in weakness of both elbow flexion and_?	Supination: 1 point	85.1%	3
25. What muscle(s) control(s) external rotation of the humerus with the arm at the side?	Infraspinatus or teres minor accepted (full credit for rotator cuff): 1 point	64.2%	11

The number one ranked question with the highest mean score performed by the clinical clerks was "What nerve is compressed in carpal tunnel syndrome?" This earned the clinical clerks a group mean score of ninety-seven percent. In contrast, the lowest ranked question and mean score was "A patient punches his companion in the face and sustains a fracture of the 5th metacarpal and a 3-mm break in the skin over the fracture. What is the correct treatment, and why?" None of the clinical clerks correctly answered this question. The poor performance for this question is possibly explained by the scope of practice for chiropractors and chiropractic education. Chiropractic is considered a complementary and alternative approach to medicine hence limited or no curricular emphasis on surgical interventions for medical conditions is taught.

Table 2 shows that only seven questions were ranked above the established benchmark mean of 73% for the entire group. Three of those questions were related to upper extremity diagnosis, three were related to lower extremity diagnosis and one to

systemic bone malignancies. Eighteen questions failed to demonstrate basic competency in musculoskeletal medicine for the chiropractic clinical clerks. In ranking the categories, overall the clinical clerks performed the lowest on the pediatric question and ranked the highest on the aggregate of upper extremity diagnosis questions. The results are possibly reflective of the curricular structure when only one pediatric course is taught early in the curriculum and more emphasis is placed on shoulder, elbow and hand musculoskeletal conditions which are taught in several courses in the pre-clinical science curriculum. Also the placement of these courses in the curriculum (trimesters one to six) and the administration of the questionnaire could possibly explain the underperformance of the clinical clerks.

According to the standard basic competency benchmark mean score of seventy-three percent suggested by the program chairs of orthopedic residency departments (Freedman & Bernstein, 2002); ninety-four percent of all chiropractic clinical clerks failed to demonstrate basic competency in musculoskeletal medicine. Only four clinical clerks met the standardized benchmark when examining the aggregate mean scores of the questionnaire (Table 3).

Table 3

Standard Benchmark for Passing Freedman and Bernstein Questionnaire

	Frequency	Percent
Benchmark met	*4	6.0
Benchmark not met	63	94.0
Total	67	100.0

Note. * Benchmark mean of 73 percent

Two trimester ten clinical clerks, one trimester nine clinical clerks and one trimester eight clinical clerks met the suggested benchmark of 73%. A possible explanation for no clerks in trimester seven meeting or exceeding the benchmark could be due to their current enrollment in a diagnostic imaging and internal diagnosis course that covered some of the pre-clinical sciences content on the questionnaire, and at the time of data collection, these topics had not been covered. Trimester ten clinical clerks that met the basic competency benchmark was only nine percent of the 21 clinical clerk cohort which concludes the majority of these soon to be graduates lack the necessary basic competency in musculoskeletal medicine. Overall no single trimester of clinical clerks displayed superior competence in the management of musculoskeletal conditions.

The questionnaire was categorized into five sections: lower extremity diagnosis questions, upper extremity diagnosis questions, low back examination and diagnosis questions, pediatric examination question and systemic bone and joint conditions/malignancies (Table 4).

Table 4

Region Specific Questionnaire Deficient Scores

	Number of Questions	Mean Percentage
Upper extremity diagnosis	7	**65.0
Lower extremity diagnosis	10	**55
Low back examination and diagnosis	3	**46.0
Pediatrics examination	1	**40.3
Systemic bone and joint conditions/malignancies	4	**47.4
DC Aggregate mean		43.7
MD Aggregate mean		43.6
Probability 0.05 2-tailed		*0.98

Note. **Benchmark mean of 73 percent not achieved; *Not statistically significant

The lower extremity diagnosis questions showed the clinical clerks failing seven of the ten questions achieving an aggregate mean score of 55%. The upper extremity diagnosis questions showed the clinical clerks failing four of the seven questions achieving an aggregate mean score of 65%. The low back diagnosis and management questions showed the clinical clerks failing all three questions achieving an aggregate mean score of 46%. The pediatric examination question showed the clinical clerks failed to demonstrate competency in screening for congenital hip dysplasia in all newborns achieving an aggregate mean score of 40%. Finally, when diagnosis systemic bone and joint conditions/malignancies the clinical clerks failed to meet the benchmark of 73% for three of the four questions achieving an aggregate mean score of 47%. An aggregate mean percentage comparing chiropractic clinical clerks to medical residents demonstrated no statistically significant difference between the two groups (DC aggregate mean percent = 43.7, MD aggregate mean percent = 43.6, $p = 0.98$) for the deficient (benchmark not achieved) questions possibly indicating regardless of curricular pedagogy both professions failed to demonstrate competency in musculoskeletal medicine knowledge.

A two-sample t-test (Table 5) was calculated to determine if there were any differences between the correct mean score on the questionnaire among the trimester seven cohorts compared to the trimester ten cohorts. The correct mean score was calculated by adding up the total correct responses on the 25-item questionnaire for each clinical clerk and then calculating the overall mean score for each cohort. The trimester ten clerks correct mean score was 14.55/25 whereas, the correct mean score for the trimester seven clerks was 13.29/25 The results indicated a minimal trend in

musculoskeletal medicine knowledge toward increasing scores as a clinical clerk spent more time in the clinic; however, t-tests done on such a small sample size will have significant type I and type II errors. This trend was not statistically significant ($p < 0.133$) indicating no true difference between the two cohorts.

Table 5
Two-Sample t-test between Trimester 7 and 10

t-Test: Two-Sample	*TR-7 Correct Mean Score*	*TR-10 Correct Mean Score*
Mean Score 25-Item Questionnaire	13.2952381	14.55238095
Variance	7.58647619	6.533619048
Observations	21	21
df	40	
t Stat	-1.53311759	
P(T<=t) two-tail	*0.133118955	

Note. ($p \leq 0.05$) * not statistically significant

The primary scope of practice for chiropractic clinical clerks is treating spine-related pain. Table 6 shows a comparison of the three low back examination and diagnosis questions between the chiropractic clinical clerks and the medical residents. The results revealed a statistical difference between the mean percentage score among the three questions ($p < 0.001$).

Table 6

Deficient Low Back Examination and Diagnosis Questions

	N	Mean Percentage
Q6. A patient comes to the office complaining of low-back pain that wakes him up from sleep. What two diagnoses are you concerned about?	67	54.5
Q11. A patient has a disc herniation pressing on the 5th lumbar nerve root. How is motor function of the 5th lumbar nerve root tested?	67	49.3
Q14. A patient presents with new-onset low back pain. Under what conditions are radiographs indicated? Please name 5 (example: history of trauma).	67	34.3
DC Aggregate mean		56.5
MD Aggregate mean		34.3
Probability 0.05 2-tailed		*0.001

Note. * Statistical Significance = $p \leq 0.05$

The statistical difference between the groups on the low back questions might be due to the fact that clinical clerks are slightly better at recognizing common red flags associated with low back pain (i.e. tumor and infection) since this concept is taught and reinforced in several of the pre-clinical sciences courses. In contrast, the clinical clerks had a very difficult time recognizing under what conditions radiographs are indicated with the new onset of low back pain. An explanation for this underperformance may be that at the time of data collection, a larger portion of the clinical clerks were in a radiology course and the instructor had not yet discussed the conditions that warranted a radiograph (i.e. steroid use, drug use, night pain, fever, etc.). An aggregate mean percentage comparing chiropractic clinical clerks to medical residents indicated a statistically significant difference in mean percentage (DC aggregate mean percent = 56.5, MD aggregate mean percent = 34.3, $p = 0.001$) for the three low back questions.

Chapter V

Discussion

The intent of this study was to investigate whether chiropractic clinical clerks in during the clinical years of musculoskeletal training would perform better than medical residents on the 25-item, validated, open-ended questionnaire by Freedman and Bernstein. Furthermore, identify specific categories of musculoskeletal medicine deficiencies and report deficiencies to the chiropractic curriculum committee. This chapter will explain the significance of the results, the limitations of the study and suggestions for future studies.

It was hypothesized that chiropractic clinical clerks were exposed to more hours of clinical training in musculoskeletal medicine than medical residents; therefore chiropractic clinical clerks would be more competent in musculoskeletal medicine and perform better on the Freedman and Bernstein (1998) questionnaire in contrast to previous studies of medical residents. The majority of chiropractic clinical clerks at Texas Chiropractic College did not achieve the basic competency score in musculoskeletal medicine with only six percent scoring greater than or equal to the 73% that is required to achieve a passing score on the Freedman and Bernstein questionnaire. Given the high prevalence of musculoskeletal conditions seen by chiropractors, this result is concerning.

The competency deficiencies identified in the five categories of the questionnaire will be shared with the curriculum committee; charging them with the responsibility of reviewing pre-clinical science syllabi to determine if the deficiently scored questions are

covered in the curriculum. It will be recommended that the curriculum committee examine deficiencies found in the areas of pediatrics, spinal and extremity diagnosis, special imaging and clinical reasoning and share those finding with individual faculty members. In contrast, the clinical clerks seemed to demonstrate a basic competency of upper and lower body basic anatomy but poor competency in surgical diagnosis and interventions related to the lower body musculoskeletal system. A rationale for the poor competency on surgical diagnosis and intervention may be due to the chiropractic professions focus on a non-surgical approach to musculoskeletal conditions. In addition, chiropractic education does not emphasize surgical diagnosis and interventions as part of the core curriculum.

Some could argue that the Freedman and Bernstein questionnaire is medically biased and the outcome for chiropractic clinical clerks is not reflective of the chiropractic curriculum and clinical training. All chiropractic clinical clerks who want to practice in the United States are required to pass all four parts of the National Board of Chiropractic Examiners (NBCE) competency exams. Part I consists of examination questions on basic sciences, Parts II and III consists of examination questions on clinical sciences and Part IV is a hand-on practical examination assessing history taking skills, physical examination, orthopedic, neurological and technique procedures. These examinations are held twice per year and cover a breath of competencies that are applicable to clinical practice.

The Spring 2015 competency board results from the NBCE do not reflect musculoskeletal medicine deficiencies among Texas Chiropractic clinical clerks. The aggregate mean scores on the Part II and Part III examination which includes general

diagnosis (TCC mean = 95%, all chiropractic schools mean = 90%), neuromusculoskeletal diagnosis (TCC mean = 95%, all chiropractic schools mean = 90%),), and diagnostic imaging (TCC mean = 92%, all chiropractic schools mean = 90%), are all well above the national mean; concluding that chiropractic clinic clerks have a basic competency of musculoskeletal medicine and in some areas are exceeding the basic competency level compared to other chiropractic colleges. Part III specifically comprises of history, orthopedic examination, neurological examination and clinical diagnosis. Texas Chiropractic College clerks scored a 95% overall mean compared to all schools combined earning a mean of 83%.

This study had several limitations. The study findings were limited by the validity of Freedman and Bernstein questionnaire itself. The questionnaire is limited by the distribution of topics, the open-response format, the phrasing of the questions and the limited accepted answers. Those validating the instrument also limited the questionnaire; it could be argued that physiatrists rather than academic residency chairpersons would have been the best group to validate this instrument. It was also conceivable that since, no real incentive was given to the clinical clerks to complete the questionnaire or to score highly; therefore they may have underperformed due to the lack of effort. This study captured data across four trimesters hence the variability of scores and lack of clinical knowledge from the clinical clerks on radiology and malignancy questions. Future research should compare the clinical clerks from final trimesters only and recruit clinical clerks from other chiropractic programs. Another limitation showed several of the Freedman and Bernstein questions focused on surgical interventions and the chiropractic curriculum does not provide surgical clinical experience to our student as part of their

clinical clerkship emphasizing a more medically biased questionnaire. Finally the study sample size might have been too small to draw any statistical inferences, which suggests the need for collecting data from chiropractic clinical clerks recruited from other chiropractic institutions.

According to the existing literature, this is the first study assessing chiropractic basic competency using the Freedman and Bernstein questionnaire. A possible future study would include validating a questionnaire that is more clinically relevant for chiropractic clinical clerks' education. The author suggests arranging a Delphi panel of experts to rate the Freedman & Bernstein questionnaire for accuracy to chiropractic pedagogy and then create a new questionnaire that is tested for validity among chiropractic educators. Once the questionnaire is validated; reproduce the study with a cohort of chiropractic clinical clerks and compare the results.

Further investigation may be warranted to fully assess the current competency of chiropractic clinical clerks in musculoskeletal medicine. With an increased aging population and prevalence of bone and joint diseases; patients will look towards chiropractors as a possible option for care, thus clinical clerks must master the topic of musculoskeletal medicine. The results of this questionnaire suggest that chiropractic clinical clerks are not achieving minimal competency in musculoskeletal medicine.

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Appendix A.

Schedule of Classes—Doctor of Chiropractic Degree Program

Trimester 1:

COURSE #	COURSE NAME	LEC	LAB	HRS	CR
AN1330	Spinal Anatomy	3	0	45	3
AN1441	Histology	4	1	75	4.5
AN1746	Gross Anatomy & Embryology I	4	6	150	7
CH1110	Chiropractic Principles I	1	0	15	1
CH1213	Palpation I	1	3	60	2.5
CM1550	Human Biochemistry	5	0	75	5
TOTAL		18	10	420	23.0

Trimester 2:

COURSE #	COURSE NAME	LEC	LAB	HRS	CR
AN2746	Gross Anatomy & Embryology II	4	6	150	7
CH2110	Chiropractic Principles II	1	0	15	1
CH2213	Palpation II	1	3	60	2.5
CH2220	Spinal Biomechanics	2	0	30	2
CP2220	Basic Comm. & History Taking	2	0	30	2
MB2330	General Microbiology	3	0	45	3
PA2330	General Pathology	3	0	45	3
PH2762	Cellular, Muscle, Cardiovascular, and Respiratory Physiology	6	2	120	7
TOTAL		22	11	495	27.5

Trimester 3:

COURSE #	COURSE NAME	LEC	LAB	HRS	CR
AN3441	Human Neuroanatomy	4	1	75	4.5
CH3110	Chiropractic Principles III	1	0	15	1
CH3213	Adjusting Procedures I	1	3	60	2.5
CH3220	Lower Extremity Biomechanics	2	0	30	2
CP3220	Fundamentals of Clinical Reasoning	2	0	30	2
DI3220	Physics Principles of Dx. Imaging	2	0	30	2
MB3440	Pathogenic Microbiology	4	0	60	4
PA3330	Systems Pathology I	3	0	45	3
PH3762	Genitourinary, Gastroenteric, Endocrine & Neurophysiology	6	2	120	7
TOTAL		25	6	465	28.0

Trimester 4:

COURSE #	COURSE NAME	LEC	LAB	HRS	CR
CH4110	Chiropractic Principles IV	1	0	15	1
CH4220	Upper Extremity Biomechanics	2	0	30	2
CH4314	Adjusting Procedures II	1	4	75	3
CP4110	Dermatology	1	0	15	1
CP4220	Advanced Comm. & History Taking Skills	2	0	30	2
CP4330	Nutrition I	3	0	45	3
CP4543	Physical Examination & Diagnosis	4	3	105	5.5
DI4322	Introduction to Imaging Interpretation	2	2	60	3
EP4110.IL	Info Literacy in Health Sciences	1	0	15	1
PA4330	Systems Pathology II	3	0	45	3
TOTAL		20	9	435	24.5

Trimester 5:

COURSE #	COURSE NAME	LEC	LAB	HRS	CR
CH5110	Chiropractic Principles V	1	0	15	1
CH5314	Adjusting Procedures III	1	4	75	3
CH5433	Orthopedics I	3	3	90	4.5
CP5220.CP	Clinical Psychology	2	0	30	2
CP5220.TP	Toxicology & Pharmacology	2	0	30	2
CP5221	Senior Adult Health & Wellness	2	1	45	2.5
CP5441	Women & Children's Health	4	1	75	4.5
DI5433	Imaging Interpretation I	3	3	90	4.5
EP5220	Principles of Evidence Based Practice	2	0	30	2
TOTAL		20	12	480	26.0

Trimester 6:

COURSE #	COURSE NAME	LEC	LAB	HRS	CR
CH6102	Soft Tissue Mobilization	0	2	30	1
CH6213	Adjusting Procedures IV	1	3	60	2.5
CH6220	Chiropractic Principles VI	2	0	30	2
CH6322	Orthopedics II	2	2	60	3
CP6212	Physical Medicine & Rehabilitation	1	2	45	2
CP6220	Applied Clinical Reasoning	2	0	30	2
CP6330.ID	Internal Diagnosis I	3	0	45	3
CP6330.NT	Nutrition II	3	0	45	3
CP6542	Clinical Neurology	4	2	90	5
DI6103	X-Ray Positioning	0	3	45	1.5
TOTAL		18	14	480	25.0

Trimester 7:

COURSE #	COURSE NAME	LEC	LAB	HRS	CR
CH7110	Chiropractic Principles VII	1	0	15	1
CH7220	Case Management	2	0	30	2
CL7519	Chiropractic Clinical Clerkship I	1	9	150	5.5
CP7220	Health Promotion in Clinical Practice	2	0	30	2
CP7323	Rehabilitation & Active Care	2	3	75	3.5
CP7330	Clinical Lab Diagnosis	3	0	45	3
CP7330.ID	Internal Diagnosis II	3	0	45	3
DI7322	Imaging Interpretation II	2	2	60	3
TOTAL		16	14	450	23.0

Trimester 8:

COURSE #	COURSE NAME	LEC	LAB	HRS	CR
CH8110	Health Care Ethics	1	0	15	1
CH8110.CAM	Intro to Complementary & Alternative Med.	1	0	15	1
CH8440	Differential Diagnosis & Management	4	0	60	4
CL814420	Chiropractic Clinical Clerkship II (15 weeks)	4	20	360	14
CP8220	Emergency Procedures	2	0	30	2
TOTAL		12	20	480	22.0

Trimester 9:

COURSE #	COURSE NAME	LEC	LAB	HRS	CR
CL914420	Chiropractic Clinical Clerkship III (17 weeks)	4	20	408	14
TOTAL		0	20	340	12

Trimester 10:

COURSE #	COURSE NAME	LEC	LAB	HRS	CR
CL1012220	Chiropractic Clinical Clerkship IV (17 weeks)	2	20	374	12
TOTAL		0	20	340	12

	LEC	LAB	HRS	CR
GRAND TOTAL	157	136	4487	225

Appendix B

Consent to Participate

UNIVERSITY OF HOUSTON
TEXAS CHIROPRACTIC COLLEGE
CONSENT TO PARTICIPATE IN RESEARCH

Cover Letter

PROJECT TITLE: An assessment of musculoskeletal medicine deficiencies in Chiropractic: A survey of Chiropractic Clinical Clerks

You are invited to take part in a research project conducted by Michael Ramcharan, a doctoral student in the department of Curriculum and Instruction at the College of Education, University of Houston. This research project is part of the dissertation requirement for the Executive Doctor of Education Degree (Ed.D.) in Professional Leadership with an Emphasis in Health Sciences Education leadership. This study is being conducted under the supervision of Dr. Bernard Robin, a faculty member at the University of Houston.

NON-PARTICIPATION STATEMENT

Taking part in the research project is voluntary and you may refuse to take part or withdraw at any time without penalty or loss of benefits to which you are otherwise entitled. You may also refuse to answer any research-related questions that make you uncomfortable. Your decision to participate or not or to withdraw your participation will have no effect on your clinical experience and graduation at Texas Chiropractic College.

PURPOSE OF THE STUDY

The purpose of this study is to investigate whether chiropractic clinical clerks in their clinical years of training (trimester 7-10) exhibit particular areas of deficiency in musculoskeletal medicine in specific anatomical regions using a 33 item validated open-ended questionnaire. The study will help identify deficiencies in the training of future practitioners and facilitate instructional design to increase the acquisition of musculoskeletal education within the chiropractic curriculum.
You are invited to participate because you are enrolled in a chiropractic/manual medicine program and currently involved in clinical training. The entire study will take approximately 2 month - starting in November 2015 and ending in December 2015, however data collection will be completed once during the study. In addition, your participation in this study will start once I obtain your informed consent.

PROCEDURES

You will be asked to voluntarily fill out an open-ended questionnaire to help identify deficiencies in the training of future practitioners and facilitate instructional design to increase the acquisition of musculoskeletal education within the chiropractic curriculum. The eligibility criteria for the survey are the participant must be involved in clinical training (Trimester 7 to Trimester 10). The questionnaire will take 40-45 minutes to complete. There are no immediate or direct benefits/risks to you for your participation in this survey.

CONFIDENTIALITY

Every effort will be made to maintain the privacy and confidentiality of your participation in this study.
To maintain your privacy and confidentiality during this study Dr. Ramcharan nor any clinic faculty will be present during the recruitment of study participants during a grand round session; therefore as participants you will not feel pressured into completing the survey. In addition, no attendance will be taken on the day of the grand round session for your protection, privacy and confidentiality, however other students will be aware of your participation in the study since the survey is completed in the same classroom with other students.
The survey will be administered and collected by the clinic administrative assistant and each survey will remain unidentified. Your participation is voluntary and if you did not want to participate in the survey you can leave the grand round session immediately. The administrative assistant will leave the surveys on a table at the front of the classroom and let the clerks know that she will return in 55 minutes to collect the sealed box. This way the administrative assistant doesn't even know who opted out and who participated in the survey, to reduce the perception of coercion since she works directly with faculty

OTHER PEOPLE INVOLVED IN THE RESEARCH

The doctoral committee team:

Dr. Bernard Robin who is my doctoral adviser and the program director of the doctoral program.
Dr. Sara McNeil, a committee member.
Dr. Margaret Watson, a committee member.
Dr. Dorrie Talmage, a committee member. (External member)
Stephanie Johnson, research assistant (External member)

RISKS/DISCOMFORTS

There are no foreseeable risks to you in participating in this study.

BENEFITS

While you will not directly benefit from participation, benefits include an enhanced understanding of the deficiencies in the chiropractic curriculum regarding musculoskeletal medicine training and help facilitate more effective training strategies for future manual medicine practitioners.

PUBLICATION STATEMENT

The results of this study may be published in scientific journals, professional publications, or educational presentations; however, no individual subject will be identified.

STORAGE AND RETENTION OF DATA

The informed consent and questionnaires will be stored in a locked cabinet located on UH property in room 315A, Farish Hall by co-author Dr. Bernard Robin (dissertation chair).

All data will remain on the University of Houston property for a minimum of 3 years following completion of the study. The data is complete when all data analysis is finished.

All research data collected during this project is subject to the University of Houston data retention policy found at www.research.uh.edu/OCG/Guide/Post-Award_Section/Data_Retention.html

SUBJECT RIGHTS

1. I understand that informed consent is required of all persons participating in this project.
2. I have been told that I may refuse to participate or to stop my participation in this project at any time before or during the project. I may also refuse to answer any question.
   Any risks and/or discomforts have been explained to me, as have any potential benefits.
3. I understand the protections in place to safeguard any personally identifiable information related to my participation.
4. I understand that, if I have any questions, I may contact Michael Ramcharan, (281) 998-6067 email mramcharan@txchiro.edu or mramcharan@uh.edu
5. I may also contact Dr. Bernard Robin who is Michael Ramcharan's doctoral adviser. Email: brobin@central.uh.edu Phone: (713) 743-4952

6. Any questions regarding my rights as a research subject may be addressed to the Texas Chiropractic College IRB or the University of Houston Committee for the Protection of Human Subjects (713-743-9204). All research projects that are carried out by Investigators at the University of Houston are governed be requirements of the University and the federal government.