An International Survey of Gross Anatomy Courses in Chiropractic Colleges

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Purpose: The purpose of this study is to provide the first comprehensive description of gross anatomy course design in chiropractic colleges internationally and to provide baseline data for future investigation, future comparison with other health care professions, and identification of trends. **Methods:** A 72-question cross-sectional electronic survey was sent to the anatomy department chair at 36 chiropractic colleges internationally using Zoomerang, a web-based survey instrument. To augment the survey response data, public sources of data also were collected. **Results:** Forty-four percent of the electronic surveys were returned and information was gathered for 31 institutions from public sources. These results indicate (1) the most common degrees held by anatomy faculty were MS and PhD in anatomy, and DC degrees; (2) 75% of institutions utilized human cadavers and 75% presented laboratory anatomical demonstrations; (3) 62% used PowerPoint and 100% provided students with copies of lecture presentations; (4) 88% required attendance in laboratory and 50% in lecture; (5) 69% issued one grade for lecture and laboratory; (6) 100% of laboratory examinations were anatomical identification; and (7) 80% of written examinations were multiple-choice format. **Conclusions:** While individual variations existed, chiropractic institutions internationally have similar gross anatomy faculty, course design, delivery methods, and assessment methods.

Key Indexing Terms: Anatomy; Chiropractic; Cross-sectional Survey; Educational Technologies

INTRODUCTION

The core content, composition, and instructional methodologies of medical school gross anatomy courses have been the subject of numerous investigations over several decades.[1–4] These studies describe the importance of gross anatomy in medical school curricula, with anatomy courses including both traditional lecture and laboratory cadaveric dissection. Anatomy instructional methodologies in medical schools focus on anatomical structures and their clinical relevance. Results from a 2009 survey were compared with those of a 2002 survey, and the results showed an 11% decrease in curricular hours dedicated to anatomy.[4] While there have been numerous investigations of medical school gross anatomy curricula, there are only two cross-sectional surveys of physical therapy education.[5,6] Cadaveric dissection was used in the laboratory of physical therapy schools, and the results of these two studies were used to evaluate and improve the gross anatomy curricula to include more clinical relevance.

Similar to its medical counterpart, the preclinical chiropractic curriculum has included anatomy as an integral component since the early 1900s.[7] However, unlike its medical counterpart, only two reports were published that describe gross anatomy courses within chiropractic education. In 1986, the anatomy departments of 15 chiropractic colleges seeking accreditation from the Council of Chiropractic Education were analyzed to summarize anatomy curricula, to provide data to influence trends in chiropractic curricular design, and to raise public awareness of chiropractic education's emphasis on the basic sciences.[8] In 1998, Coulter[9] and colleagues published a comparative study of chiropractic and medical education. This study found significant similarities between the instructional programs in the time allotted for basic sciences and the types of basic science subjects offered. Differences existed in the types of clinical therapies offered and in the clinical training settings.[9]

More than two decades have passed since a survey was conducted of gross anatomy education in chiropractic colleges, and the previous survey conducted was limited to chiropractic colleges accredited by the Council on Chiropractic Education.[8] Since then, there have been new chiropractic colleges established, major advances in instructional technology, and changes in contact hours in anatomy, and there has been increasing scientific knowledge.[4] The previous comparison of chiropractic colleges to medical schools was of the entire curriculums, and the portions pertaining to anatomy were limited to com-

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parisons of course hours.[9] To date, there are no published comprehensive surveys of gross anatomy education in international chiropractic colleges. The purpose of this study was to provide the first comprehensive description of the design, delivery, and instructional methods in gross anatomy courses in chiropractic colleges internationally.

METHODS

This study was approved by the New York Chiropractic College Institutional Review Board. A 72-question electronic survey was administered using Zoomerang, a web-based survey instrument, and was distributed to anatomy department heads/directors of 36 chiropractic schools, 18 within the United States and 18 outside of the United States. There are currently 42 chiropractic colleges internationally. The electronic survey was developed based on previous tools administered to physical therapy,[5,6] medical,[1–4] and chiropractic institutions.[8,9] The survey questions were constructed with guidance from the American Association of Clinical Anatomy curriculum for medical schools[10] and from current trends in gross anatomy education.[11–17] This survey included six topic areas: institution, faculty, laboratory course delivery, lecture course delivery, library, and assessment techniques.

The survey was introduced in a letter sent via electronic mail with an electronic link to the survey embedded within the letter. The participants had 4 weeks to complete the survey, and a follow-up letter was sent 2 weeks prior to the deadline. The survey was voluntary, confidential, and limited to one response per computer terminal. The descriptive survey had a format of both forced-response, multiple-choice questions and open-ended questions that allowed institutions to self-report their data. When applicable, the questions contained a category "Other, please describe," allowing for narrative comments. Several open-ended questions were included to obtain further insight into the unique delivery of gross anatomy at an institution. Zoomerang tabulated the survey responses into percentages for each question.

To augment the survey response data, a literature analysis from public sources (academic calendars, course catalogs, and web sites) of chiropractic institutions was conducted. This included the number of gross anatomy courses and their placement within the curriculum, the number of hours and credits per course, the presence or absence of a separate neuroanatomy course, a separate developmental anatomy/embryology course, and a separate cell and tissue anatomy course. The public source data was tabulated into percentages by one of the authors (JJB).

RESULTS

The survey results were based on a response rate of 44% (n = 16). Of the respondents' institutions, 62% were in the United States and 75% were affiliated with the Association of Chiropractic Colleges. Due to the survey length, only a portion of the results are reported here (Table 1). The entire survey and results are available from the corresponding author (JJB) (email: jball@nycc.edu).

Table 1. Zoomerang chiropractic anatomy survey results.

1. Where is your chiropractic institution located?		
Within the United States	10	62%
Outside the United States	6	38%
Total	16	100%
2. Is your chiropractic institution affiliated with the Association of Chiropractic Colleges?		
Yes	12	75%
No	4	25%
Total	16	100%
7. How many full time and part time gross anatomy faculty hold a PhD in anatomy?		
None	5	31%
1–3	9	56%
4–6	2	12%
Total	16	100%
8. How many full-time and part-time gross anatomy faculty hold a PhD in anthropology?		
None	13	81%
1–3	3	19%
Total	16	100%
9. How many full-time and part-time gross anatomy faculty hold an MD degree?		
None	8	50%
1–3	8	50%
Total	16	100%

Table 1. Continued.

10. How many full-time and part-time gross anatomy faculty hold a DC degree?		
None	4	25%
1–3	8	50%
4–6	4	25%
Total	16	100%
11. How many full-time and part-time gross anatomy faculty hold a MA or MS degree?		
None	3	19%
1–3	9	56%
4–6	2	12%
7–10	2	12%
Total	16	100%
13. Who from the Department of Anatomy is involved in research and publishing?		
Faculty with a full-time teaching load	9	56%
Faculty with a part time-teaching load	2	12%
Other, please describe	5	31%
Total	16	100%
14. What is the average publication rate of your department?		
Publish once a year	5	31%
Publish once every two years	2	12%
Publish once every five years	2	12%
Never been published	4	25%
Define and describe a publication rate not listed	3	19%
Total	16	100%
15. In which area has your department published articles in? Check all that apply.		
Case study	5	38%
Normal variants and anatomical anomalies	8	62%
Clinical significance of anatomy	6	46%
Anatomical relationships	6	46%
Educational best practices	7	54%
Other, please describe	4	31%
16. Describe the primary method of teaching in laboratory.		
Human cadaver	10	62%
Human pre-dissected models (prosections)	2	12%
Plastic anatomical models	3	19%
Other, please describe	1	6%
Total	16	100%
17. Describe the teaching methods that are used at some time in the laboratory – check all that apply:		
Human cadaver	11	69%
Human pre-dissected models (prosections)	12	75%
Plastic anatomical models	11	69%
Problem based learning	7	44%
Self directed learning	13	81%
Surface anatomy	10	62%
Visual aids	9	56%
Radiological imaging	14	88%
Computer anatomy software	12	75%
20. Do instructors present a prosection (identify structures on a pre-dissected specimen)?		
Yes	12	75%
No	4	25%
Total	16	100%

Table 1. Continued.

22. What delivery method is utilized?		
Face-to-face	10	83%
Video students access outside of class	1	8%
Other, please describe	1	8%
Total	12	100%
23. Are students dissecting?		
Yes	11	69%
No	5	31%
Total	16	100%
35. Is attendance mandatory for the laboratory portion of the course?		
Yes	14	88%
No	2	12%
Total	16	100%
36. Are students allowed in the anatomy laboratory outside of scheduled classroom hours?		
Yes	16	100%
No	0	0%
Total	16	100%
42. Describe the primary method of teaching in lecture.		
PowerPoint slides	10	62%
Other, please describe	6	38%
Total	16	100%
43. Describe the teaching methods that are used at some time in the lecture– check all that apply:		
PowerPoint slides	10	71%
Problem based learning	7	50%
Self directed learning	5	36%
Computer anatomy software	3	21%
Other, please describe	2	14%
45. Are students provided a paper and/or electronic copy of the lecture presentation?		
Paper copy	6	38%
Electronic copy	5	31%
Both	5	31%
Total	16	100%
48. Describe the type of problem-based learning used.		
Problem based faculty moderator led sessions	1	10%
Problem based student moderator led sessions	1	10%
Clinical vignettes introduced by the instructor	6	60%
Group based case studies	6	60%
Other, please describe	1	10%
54. Is attendance mandatory for the lecture portion of the course?		
Yes	8	50%
No	8	50%
Total	16	100%
56. How many practical laboratory exams?		
2 – Midterm and cumulative final	3	19%
2 – Midterm and non-cumulative final	6	38%
3 – All cumulative	3	19%
3 – No cumulative exams	1	6%
More than 3 – All cumulative	1	6%
More than 3 – No cumulative exams	1	6%
Other, please describe	1	6%
Total	16	100%

Table 1 Continued.

57. Describe the nature of the practical exam–check all that apply.		
Student must identify anatomical structures	16	100%
There is a time limit for each station	14	88%
There is no time limit per station	1	6%
Other, please describe	1	6%
60. How many written lecture exams?		
1	2	12%
2 – Midterm and cumulative final	3	19%
3 – All cumulative	3	19%
3 – No cumulative exams	1	6%
More than 3 – All cumulative	2	12%
More than 3 – No cumulative exams	4	25%
None	1	6%
Total	16	100%
61. Describe the nature of the written exam – check all that apply.		
Multiple choice	12	80%
Matching	9	60%
Fill-in	7	47%
True-false	7	47%
Short answer	5	33%
Essay	4	27%
63. Do students receive a separate grade for lecture and laboratory?		
Yes	5	31%
No	11	69%
Total	16	100%
64. Do student receive a pass/fail grade or a letter grade for the gross anatomy courses?		
Pass/fail	3	19%
Letter grade	11	69%
Both	1	6%
Other, please describe	1	6%
Total	16	100%
65. Do student have to pass both lecture and laboratory in order to pass the entire course?		
Yes	8	50%
No	8	50%
Total	16	100%
68. Is there tutoring available for students?		
Yes	15	94%
No	1	6%
Total	16	100%
69. Who provides the tutoring?		
Full-time faculty	4	27%
Part-time faculty	4	27%
Non-faculty teaching assistants	4	27%
Student tutors	11	73%
Other, please describe	1	7%
70. Describe the method used outside of scheduled class time for licensure examination preparation?		
Institution-offered voluntary review classes free of charge	4	25%
Institution-offered mandatory review classes free of charge	1	6%
Institution-offered review classes for a fee	3	19%
None	6	38%
Other, please describe	2	12%
Total	16	100%

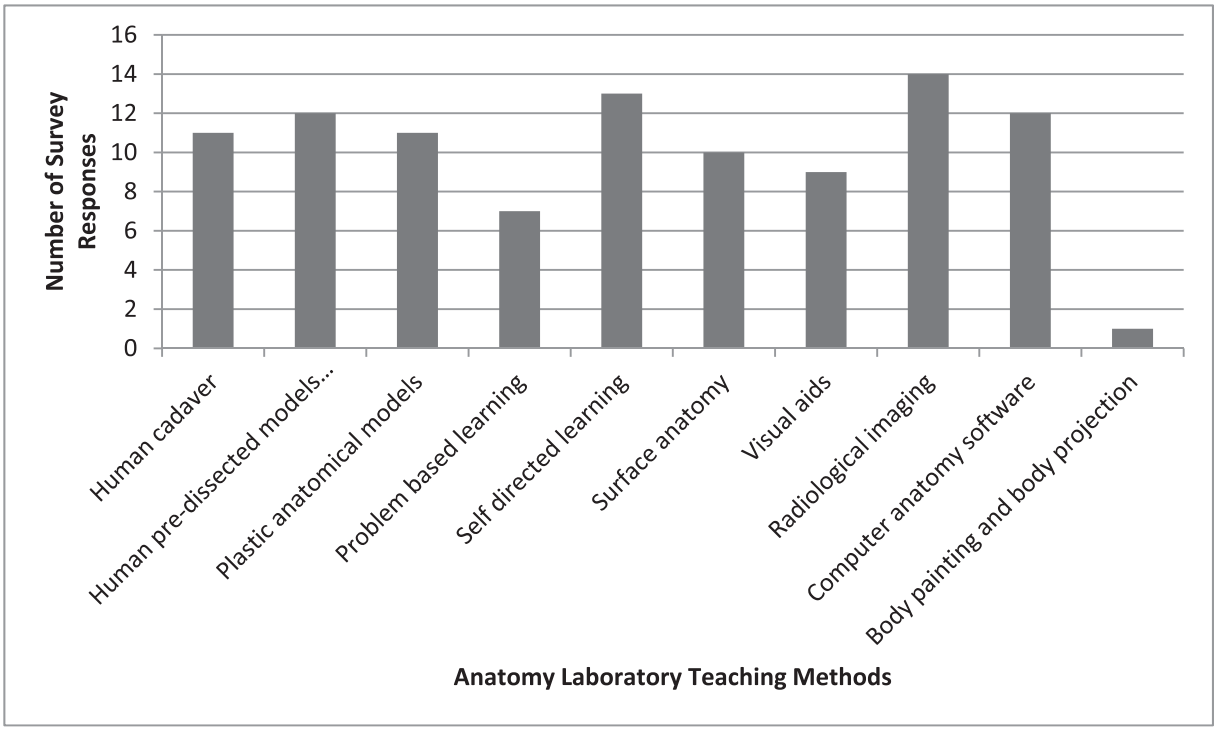

Figure 1. Teaching methods used in gross anatomy laboratories in chiropractic colleges.

The most common advanced degrees held by gross anatomy faculty in chiropractic colleges were MS (80%), DC (75%), and PhD in anatomy (68%). Advanced degrees in natural or behavioral sciences (anatomy or anthropology) were more common than clinical degrees. With one exception, respondents' schools had at least one gross anatomy faculty member with a clinical degree who was teaching gross anatomy.

Research activities were noted by 66% of the respondents. Of the respondents, 31% published once a year, 12% published once every 2 years, and 25% did not publish. The most common areas of publication were normal variants/anatomical anomalies and educational best practices.

All chiropractic programs had lecture and laboratory sections within gross anatomy classes. In the laboratory, the primary instructional method was human cadaver specimens (74%) followed by secondary methods (Fig. 1). All US schools utilized human cadavers in the gross anatomy laboratory and in 80% of these schools, the students performed cadaveric dissections. The remaining 20% used pre-dissected cadavers.

In 75% of respondents' institutions, laboratory presentations were given by an instructor identifying anatomical structures, and in 62% of respondents' institutions videotaped anatomical presentations were available to students in libraries. Attendance in anatomy laboratory was mandatory in 88% of the respondents' institutions and 100% allowed students in the anatomy laboratory outside of scheduled classroom hours.

The predominant lecture delivery method was PowerPoint presentations (62%). Students were provided with a copy of the lecture presentation (paper copies, 38%; electronic copies, 31%; or both, 31%) in 100% of the respondents' institutions. Problem-based learning, primarily through clinical vignettes and group case studies, was used in lectures by 50% of the respondents' institutions. Only 50% of the respondents' institutions mandated attendance in lecture.

Students were given separate grades for laboratory and lecture in 31% of respondents' institutions. All the chiropractic institutions within the United States administered a letter grade for each gross anatomy course as opposed to a pass/fail grade. However, only 31% of the institutions outside of the United States administered letter grades for gross anatomy courses. Practical laboratory examinations were used by 100% of the respondents' institutions, yet the number of examinations varied from two (midterm and final) to four. All institutions used identification of anatomical structures to assess student learning in the laboratory portion of gross anatomy courses. With one exception, respondents' institutions utilized written lecture examinations, yet the number of examinations ranged from one to more than three. Multiple-choice questions were used by 88% of the respondents' institutions as a primary means of assessment, yet other methods (matching, fill-in-the-blank, and true-false) were used to a lesser degree.

Of the respondents' institutions, 94% provided tutoring for students, of which most schools utilized student tu-

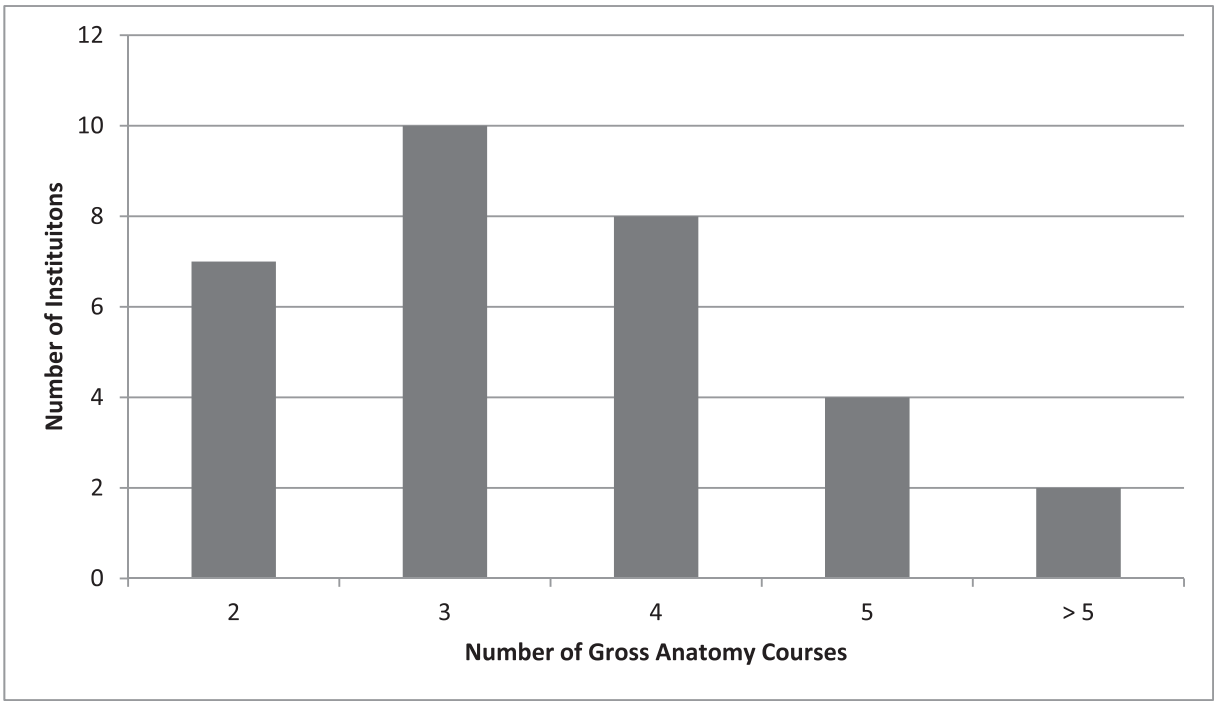

Figure 2. Number of gross anatomy courses in chiropractic colleges.

tors. Of the respondents' institutions in the United States, 80% offered review classes for licensure examinations. Respondents' institutions outside of the United States did not offer review classes.

The following data about courses was collected for 31 chiropractic colleges from public sources. Fifty-two percent of the institutions were in the United States, and 58% percent were affiliated with the Association of Chiropractic Colleges. All chiropractic programs had multiple gross anatomy courses, but the number of those courses within the curriculum ranged from two to more than five (Fig. 2). Sixty-three percent had all of the gross anatomy courses in the first year of the curriculum. A separate cell and tissue anatomy course was offered by 93% of the institutions in the United States and 53% of the institutions outside the United States. A separate neuroanatomy course was offered by all of the institutions in the United States and 73% of the institutions outside the United States. A separate embryology course was offered by 75% of the institutions in the United States and 20% of the institutions outside of the United States.

Each institution had a unique system for assigning credits and hours to gross anatomy courses: 84% assigned combined credits for the lecture portion and the laboratory portion, 19% assigned the same number of hours for both of these portions, and 50% assigned more hours for the lecture than the 84% combined credits and 16% assigned separate credits for lecture and laboratory portion. 19% same hours, 50% more lecture hours and 31% assigned more hours for laboratory that the lecture.

DISCUSSION

Internationally, all chiropractic institutions recognize the need to provide students with a strong preclinical anatomy foundation by offering two or more gross anatomy courses. A majority of chiropractic institutions have separate neuroscience courses, cell and tissue anatomy courses, and embryology courses within their curriculums.

A current need identified by allopathic and osteopathic schools is an anatomy curriculum designed with stand-alone gross anatomy courses with a laboratory and a lecture, yet these institutions integrate neuroscience, histology, and embryology into the gross anatomy courses.[3,4] This research showed that while medical institutions are following the trend of gross anatomy course design that has been identified in medical curricula, chiropractic institutions continue to dedicate separate curricular hours to cellular anatomy, neuroanatomy, and developmental anatomy. This research suggested that graduates of chiropractic institutions are well educated in many aspects of anatomy, yet more research needs to be conducted in order to compare anatomical course hours in chiropractic institutions to anatomical course hours in medical institutions.

Gross anatomy faculty at chiropractic institutions are highly trained with a variety of advanced science-oriented degrees, such as anatomy and anthropology. In addition, all chiropractic institutions have at least one faculty member with a clinical degree. This mixture in gross anatomy

faculty provides expertise in the anatomical and clinical sciences.

Faculty members at chiropractic institutions provide clinical integration of anatomy and clinical sciences by utilizing problem-based learning, radiology, and surface anatomy in gross anatomy lecture and laboratory. Radiologic and surface anatomy enhance the clinical basis of anatomy by making clinical correlations between anatomical structures in the cadaver or plastic model and anatomical structures in the patient.[11,12] Problem-based learning, clinical vignettes, and case studies initiate development of the clinical reasoning skills by creating student-centered learning and enhancing reflection on clinical aspects of anatomy, and providing collaboration between basic science and clinical courses.[13,14]

Gross anatomy faculty at chiropractic institutions are involved in publishing research. This activity enhances their anatomical content knowledge and their development as faculty members because the areas of publication are normal variants and anatomical anomalies, as well as current trends in anatomical education. These areas of publication indicate that gross anatomy faculty at chiropractic institutions are dedicated to and engaged in the fields of anatomy and anatomy education.

The gross anatomy lecture and laboratory classes are combined and registered as a single set of grades and credit hours in the majority of chiropractic institutions. However, all institutions separate assessments in the lecture portion and the laboratory portion. Learning is assessed in the lecture portion by a written examination and in the laboratory portion by identification of anatomic structures. The individual assessments for lecture and laboratory portions are necessary because lecture and laboratory courses utilize different modes of learning–didactic learning with some active learning and clinical reasoning in lecture versus kinesthetic, exploratory hands-on learning in laboratory.

Collected public source data identified that chiropractic institutions value gross anatomy education by offering a minimum of two gross anatomy courses in some institutions to more than five in others. The placement of gross anatomy within the first and second years follows the 2 x 2 model recommended by the Flexner Report of 1910,[15] and it is the same curricular design reflected in most medical schools.[16] Even though chiropractic education does not include clinical education in a teaching hospital, gross anatomy within the first 2 years serves as an important basis for clinical education in the third and fourth years of chiropractic education.

The majority of institutions required the same or more hours in gross anatomy lecture compared with laboratory. Only half of the institutions required attendance in gross anatomy lecture, yet a majority of the institutions required attendance in laboratory. Gross anatomy lectures at chiropractic institutions is primarily an instructor-centered delivery method focused on the didactic aspect of anatomy, while the laboratory is more learner-centered. The laboratory attendance requirement suggested that anatomy faculty valued the hands-on discovery aspect of the gross anatomy laboratory. The opportunity to use the laboratory outside of scheduled class time is an important feature of the gross anatomy laboratory offered by all chiropractic institutions. This offers students hands-on experience in the laboratory and allows them the time to repeat activities during open laboratory times and to interact with fellow students in a more relaxed environment.

Gross anatomy laboratories in the majority of chiropractic institutions utilized human cadavers for dissection and pre-dissected human cadaveric specimens. Most chiropractic institutions utilized laboratory class time for a gross anatomy faculty member to identify anatomic structures on a pre-dissected specimen. Dissections in gross anatomy laboratories provided students with opportunities for acquiring important clinical and professional skills.[17] However, utilizing a pre-dissected cadaveric specimen allowed students to visualize anatomic structures and their relationship to other structures on a cadaver without using class time to perform dissections. Chiropractic institutions utilized both teacher-centered anatomic demonstrations and learner-centered dissection in the gross anatomy laboratory. Gross anatomy laboratories at chiropractic institutions were primarily learner-centered utilizing multiple teaching methodologies, which maximizes the time allotted for laboratory and highlights the clinical significance of anatomy. Designing anatomy courses with multiple methods is effective in emphasizing clinical anatomy and transforming how students think, reason, and learn.[14]

The return rate of the survey was determined to be acceptable although less than 50% of the surveys were returned, so this limited the results. For the majority of the survey responses, the degree of variance from the population was low. This low degree of variance and the small population of chiropractic colleges worldwide were used to determine that the 44% response rate was acceptable and statistically accurate.[18] The size of the survey and the number of questions may have deterred faculty members from completing the survey.

This study was also limited by the forced responses in the survey. In certain portions of the survey, the ranges given were too large. Some questions and terms were interpreted differently, and this led to confusion for some respondents especially since this survey was distributed internationally. For example, the term "prosection" was used in the survey to define a human pre-dissected model as well as a presentation by an instructor identifying anatomical structures on a pre-dissected specimen. This term is used in the current literature to define a pre-dissected specimen, not as a presentation. This term was confusing for a respondent.

CONCLUSION

This study's results provided a description of current gross anatomy course design, composition, and delivery among chiropractic institutions. It appeared that chiropractic institutions internationally had similar gross anatomy faculty, anatomy program design, teaching methods, and assessment methods. This description of gross anatomy in chiropractic colleges internationally will serve as a baseline for identifying trends in the future. From this research, the chiropractic community is provided with an account of how gross anatomy is taught to their future health professionals. Also, it might encourage chiropractic institutions to discuss their individual pedagogy and instructional design with other institutions in an effort toward collaboration. Further research will allow potential comparisons of gross anatomy education in medical education and gross anatomy education in chiropractic education.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

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