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ORIGINAL ARTICLE

Prevalence of adverse effects among students taking technique classes: *A retrospective study*

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Objective: The main objective of this study was to determine characteristics of injuries experienced by students while learning chiropractic procedures in the classroom.
Methods: Injury was defined as any physical adverse effect such as pain, stiffness, headache, and muscle spasm. Survey questions included age, sex, role, anatomical areas of injury, adjustive technique utilized, types of injury, treatment (if any), and recovery time. The survey was administered among the students in the 5th, 6th, and 8th trimesters of our doctor of chiropractic program. Only students who had completed one or more chiropractic procedures courses at the institution were asked to participate in the study.
Results: Female recipients had a higher prevalence of adverse effects as the recipient of the adjustment than did male recipients. The most common site for injury overall was the lower back. The relationship between recipient role and sacroiliac joint injury and the relationship between adjustor role and wrist/hand injury were statistically significant. Students were more likely to be injured in the beginning of their technique education.
Conclusion: This study suggests that students in technique courses learning adjustive procedures experience minor adverse physical effects related to the physical skills being learned. Strategies for prevention need to be considered.

Key Indexing Terms: Chiropractic; Students; Injuries; Performance, Psychomotor

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INTRODUCTION

Injuries have been reported among practicing chiropractors, chiropractic patients, and chiropractic students who are learning manipulation skills, also known as adjustive procedures.[1–12] In chiropractic technique classes, where students learn these skills, chiropractic students usually assume the roles of adjustor and recipient of adjustments. As a result, some students may experience injuries to various parts of their bodies similar to those injuries experienced by chiropractic doctors and their patients. All institutions offering chiropractic education teach high-velocity, low-amplitude adjustive procedures; therefore, students are likely to experience adverse effects even while learning under controlled, supervised educational settings.[9,11]

It is important to identify the types and characteristics of chiropractic students' injuries in order to develop strategies for prevention, not only during learning but also during practice. The few studies published on chiropractic students' injuries have determined prevalence, anatomical location, and symptoms associated with injuries, and they have looked for relationships between student age and sex.[9–12] Macanuel et al[9] surveyed chiropractic students regarding injuries during their academic training and found that 43% of respondents reported 1 or more injuries and that nearly 60% of the reported injuries occurred during students' 2nd years. The results of this study also showed that the lumbar spine and pelvis were the most likely sites of injury and that local pain and stiffness were the most common symptoms. These researchers found no significant relationship between the occurrence of injury and the student's sex or age. A similar study conducted by Bisiacchi and Huber[10] found that 32% of respondents reported 1 or more injuries. Female students were more likely to have low back injuries, whereas male students were more likely to have neck injuries. They also found that, overall, more injuries were reported in a preclinical educational setting than in a clinical setting. Female students reported more injuries than did males during their clinical education. However, these authors did not report whether or not group differences were statistically significant. Furthermore, Kuehnel et al[11] published a collaborative survey of the prevalence of injuries experienced by chiropractic students from 5 colleges around the world. Results indicated that

Table 1 - Preclinical Chiropractic Procedures Curriculum

Trimester	Course	Topic
1	CP1	Axial skeleton joint and muscle assessment; mobilization
2	CP2	Extremity joint and muscle assessment; mobilization
3	CP3	Muscle energy procedures, mobilizations, and other soft tissue techniques
4	CP4	Osseous adjusting for the pelvis and lumbar spine
5	CP5	Osseous adjusting for the cervical and thoracic spine
	SCP	System/name techniques (survey course)
6	CP6	Extremity adjusting and review of all procedures
7	CP7	Special populations and assisted adjusting

CP indicates chiropractic procedures; SCP, specialized chiropractic procedures.

7% to 53% of participants reported injuries, and no differences were found between injured and noninjured respondents with regard to sex and age. Finally, Ndetan et al[12] found a prevalence of injury in nearly one-third of respondents in an epidemiological survey of students at one chiropractic college. This study also reported that neck and shoulder injuries were more prevalent while students were receiving adjustments in the role of a patient, whereas hand and wrist injuries were more prevalent while students were delivering adjustments in the role of the doctor. Also, female students were more likely to be injured in general and especially while in the role of the adjustor than were male students. These authors reported no significant difference in the prevalence of injuries with regard to students' age.

The preclinical chiropractic technique curriculum at Southern California University of Health Sciences (SCU) is composed of 8 chiropractic procedures (CP) courses offered over the first 7 trimesters of instruction (Table 1). Trimester 5 includes an additional CP course—specialized chiropractic procedures (SCP)—which exposes the student to a variety of chiropractic system/name techniques. In trimester 4 and above, the student enrolls in a prescribed number of selective/elective courses, which may include chiropractic technique topics.

Osseous adjusting techniques, including high-velocity, low-amplitude procedures, are first introduced in terms 4 and 5. The curriculum for this part of the chiropractic program is shown in Table 1. It is worth noting that trimester 6 includes extremity adjusting plus a review of all previously taught adjustive procedures. In trimester 7, at the beginning of the 3rd year, the course teaches the use of various mechanical and nonmechanical devices to assist with chiropractic adjustments.

Training professionals to perform manual therapies involves the learning of psychomotor skills and necessarily carries the risk of injury. It is important to identify these risks to develop strategies for prevention. The purpose of this study was multifold. First, we aimed to determine the incidence of classroom-related injuries among chiropractic students in technique courses. Second, we intended to characterize these injuries in terms of their anatomical location and the symptoms associated with injury. Third, we looked at the relationship between students' injuries and their age and sex, and, finally, we explored the relationship between students' injuries and their assigned learning role as an adjustor or as a recipient of an adjustment.

METHODS

This research study was approved by the Southern California University of Health Sciences institutional review board to administer an in-classroom survey to chiropractic students in the 5th, 6th, and 8th trimesters of the doctor of chiropractic program. Only students who had completed 1 or more chiropractic procedures courses at SCU were asked to participate in the study.

The survey included questions on age, sex, role (adjustor or recipient), course in which the injury occurred, anatomical area of injury, adjustive technique utilized, symptoms, treatment (if any), and recovery time. We defined injury as any physical adverse effect such as pain, stiffness, headache, and muscle spasm. This definition was derived from a previous study that listed the symptoms reported by respondents.[9] Validation of the survey was performed prior to its administration through a peer review process conducted by technique and research faculty.

The survey was distributed during technique department courses. The surveys were anonymous, and participation was voluntary. Completion of the survey indicated the responder's consent to participate in the study. Double verification of data was performed by 2 independent research assistants to avoid any errors while entering the survey results.

The data were analyzed using a variety of statistical techniques. All data were analyzed using SPSS for Windows, version 21 (IBM Corp, Armonk, NY). Missing data were evaluated for patterns of randomness prior to the adoption of a simple listwise deletion procedure. Primarily, most of our quantitative data were analyzed and explored descriptively using percentages or other measures of central tendency and dispersion. After the data were appropriately described, we began to explore data comparatively using a variety of inferential tests. The determination of the appropriateness of our decision to employ a certain inferential analytic tool was made by examining the nature of the outcome variable (ie, variable type and spread) and by considering possible violations to testing assumptions (ie, between- and within-group variation). The totality of hypothesis testing tools used in this investigation included χ^2, a vital nonparametric measure of

Table 2 - Distribution of Injury by Participant Age

	20–25 yr	26–30 yr	31–35 yr	36–40 yr	41+ yr
Total participants (%)	32	45	14	6	2
Injured (%)	75	65	78	75	67

independence. Conclusions were then drawn after running the appropriate statistical tests.

RESULTS

Out of 151 students, 126 responded to the survey, indicating an 83% response rate. Sixty-four percent of the respondents were male and 36% were female. The mean age was 28.4 (±4.8) years. Eighty-nine of the survey respondents (71%) reported having experienced at least 1 injury during a technique course.

Among male respondents, 62% reported injuries, and among female respondents, 87% reported injuries. Thus, it appears that females were more likely to be injured than were males. This relationship between sex and injury was statistically significant: χ^2 (2, $N = 126$) = 8.68, $p < .05$.

Among our survey respondents, the highest prevalence of injuries (78%) was observed among the age group between 31 and 35 years; however, there was no statistically significant difference in the percent of injured respondents among the five age ranges (Table 2).

The anatomical location of student injuries is shown in Figure 1. The cervical spine was the area with the highest prevalence of injuries, followed by the lumbar spine, sacroiliac (SI) joints, and thoracic spine. Females were more likely to experience lumbar spine ($p < .05$), SI joint ($p < .01$), shoulder ($p < .05$), elbow ($p < .01$), and wrist/hand ($p < .05$) injuries than were males. There were no statistically significance differences between sex for cervical spine, thoracic spine, hip, knee, and ankle/foot injuries.

The majority of injuries were reported to have occurred when the student was acting in the recipient role (75%), and this outcome was statistically significant: t (88 = 45.07, $p < .01$). The most common symptom of injury reported by students in the recipient role was muscle soreness localized to the site of adjustment. Other symptoms included stiffness, headache, dizziness, and nausea. The most common symptom of injury reported by students in the adjustor role was wrist, shoulder, and knee pain.

The relationship between recipient role and SI joint injury was statistically significant, χ^2 (2, $N = 126$) = 6.65, $p < .05$, and the relationship between adjustor role and wrist/hand injury was statistically significant, χ^2 (2, $N = 126$) = 29.59, $p < .05$. There was no statistically significant relationship identified between any other anatomical area of injury and role of participants.

Female students were more likely to be injured in the recipient role, and male students were more likely to be injured in the adjustor role, and these relationships between sex and role were statistically significant, χ^2 (2, $N = 126$) = 7.06, $p < .05$. A participant's age was not significantly related to the role of the participant at the time of injury, t (88) = 4.34, $p = .83$.

Participants were asked to indicate in which chiropractic procedures course they had experienced injuries (Figure 2) and were permitted to report an injurious experience in more than one course. More injuries were reported in CP5 (cervical and thoracic spine adjusting) than any other course. The associations between courses CP4, CP5, and CP6 and injuries were all statistically significant: CP4: χ^2 (2, $N = 126$) = 38.03, $p < .01$; CP5: χ^2 (2, $N = 126$) = 55.81, $p < .01$; CP6: χ^2 (2, $N = 126$) = 18.58, $p < .01$.

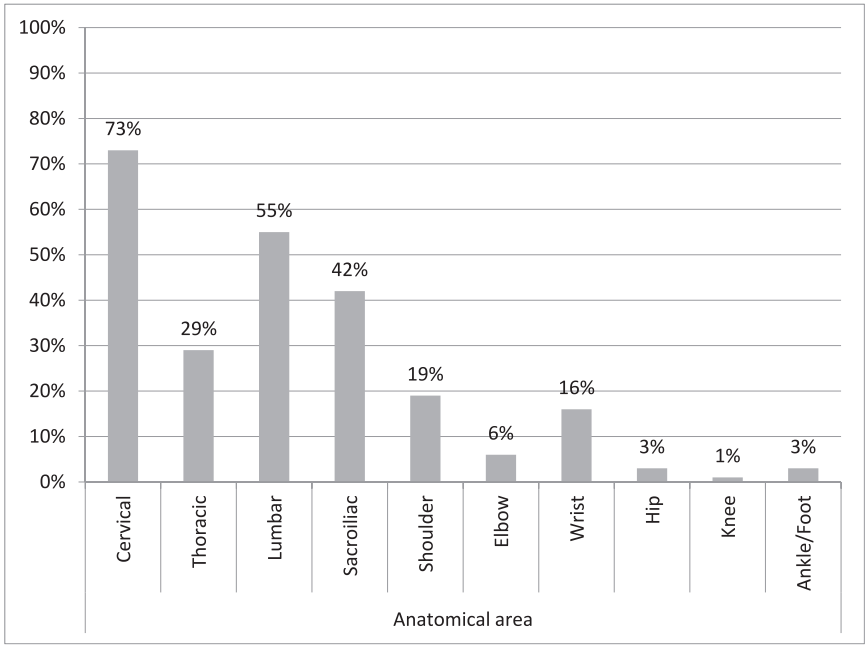

Figure 1 - Percent of student injuries by anatomical area.

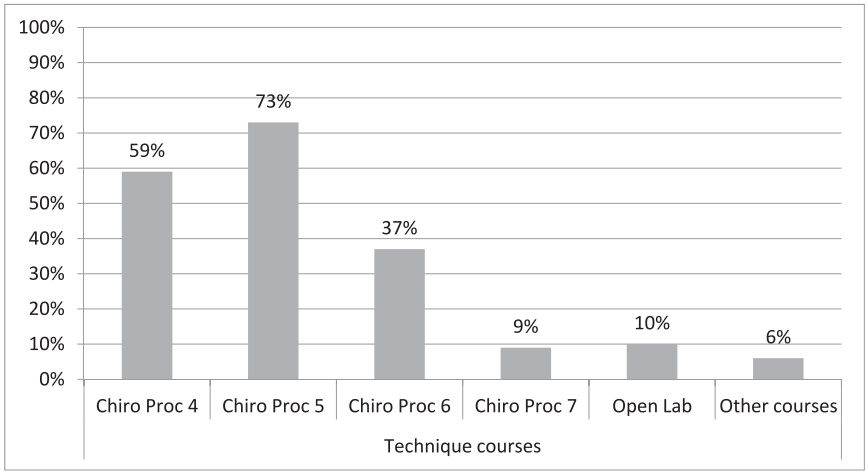

Figure 2 - Percent of student injuries by course.

Table 3 lists the prevalence of injuries by course and anatomical area. Students taking CP4 (pelvis and lumbar spine adjusting) reported more injuries to the cervical spine, lumbar spine, and pelvis than other anatomical areas. Students taking CP5 (cervical and thoracic spine adjusting) reported more injuries to the cervical and thoracic spine than did students taking other courses. Students in CP6 (extremity adjusting and review of all procedures) reported more injuries to the cervical and lumbar spine and about the same prevalence of extremity injuries as reported by students in CP4 and CP5. In all three courses, statistically significant injuries were reported for all areas of the spine (cervical $\chi^2 = 28.20$, $p < .05$; thoracic $\chi^2 = 11.17$, $p < .05$; and lumbar $\chi^2 = 41.43$, $p < .05$) and pelvis ($\chi^2 = 76.17$, $p < .05$). In CP5 and CP6, statistically significant injuries were reported for shoulder and wrist/hand ($\chi^2 = 15.08$, $p < .05$). No other statistically significant correlations were noted between a course and an anatomical area of injury. Of the respondents reporting injury, 35% received treatment and 28% had residual effects, most commonly reported as pain.

DISCUSSION

There is some literature demonstrating the prevalence of musculoskeletal injuries in manual therapy health care professionals. A study of 161 massage therapists by Jang et al[13] found that 71% of therapists had at least one work-related musculoskeletal disorder (WMSD). The most common areas of injuries were the fingers (50%) and thumbs (50%), followed by other areas of the upper limbs. This study also found that more experienced practitioners were more likely to report finger and thumb injuries than were less experienced practitioners. In a study of physiotherapists, Bork et al[14] found that the highest prevalence of musculoskeletal disorders was in the low back, upper back, hand and wrist, and neck. This study also found that female practitioners reported more injuries than did male practitioners and that older practitioners reported fewer injuries than did younger practitioners. A study by Cromie at al.[15] found that the lifetime prevalence of WMSD among physiotherapists was 91%. They also reported that younger therapists experienced a higher prevalence of these disorders than did older therapists and that male

Table 3 - Prevalence of Injuries by Anatomical Area and Course

	Percentage of Total Injuries					
Injury Type	**CP4 (%)**	**CP5 (%)**	**CP6 (%)**	**CP7 (%)**	**Open Lab (%)**	**Other (%)**
Cervical spine	47	65	32	7	9	3
Thoracic spine	18	24	19	7	5	1
Lumbar spine	43	46	24	7	5	3
Sacroiliac joint	34	32	18	6	3	2
Shoulder	11	12	12	3	1	2
Elbow	3	3	2	1	1	0
Wrist/hand	9	12	7	0	1	0
Hip	2	1	0	0	1	0
Knee	1	1	0	0	0	0
Ankle/foot	2	3	2	1	1	0

CP indicates chiropractic procedures.

practitioners were more likely to have neck, wrist, hand, and thumb injuries than were female practitioners. This study also found that the highest prevalence of musculoskeletal disorders among this group was in low back, neck, upper back, and thumbs.

In studies exploring injuries experienced among practicing chiropractors, Mior and Diakow's[1] survey of 320 Canadian chiropractors found that the overall prevalence of back pain was 87% among the participants. Rupert and Ebete[2] stated that 57% of practitioners reported WSMD injuries, while Holm and Rose[4] found that 42% of respondents reported injuries. In another study by Homack,[3] it was determined that the wrist, lower back, and hand were the most commonly injured anatomical areas. In addition, Holm and Rose[4] found that novice practitioners were more likely to be injured compared to those with more practice experience.

Retrospective and prospective studies have shown that injuries to patients commonly occur during chiropractic care. A study by Senstad et al[5] reported that more adverse reactions to chiropractic treatment occurred during the first treatment session or when more than one region of the spine was treated. This study also showed that more adverse reactions were reported when the thoracic spine alone was treated, and women and younger adults were more likely to experience at least one adverse reaction compared to men and older adults. Using the same data, Senstad et al[6] reported that 55% of patients at some time during the course of care experience at least one adverse reaction. Among 85% of the cases, these reactions were reported to be mild to moderate in intensity, and 74% of the symptoms resolved with 24 hours of their onset. The most common symptom reported was local discomfort. In another study among 625 patients of 66 chiropractors, Lebouef-Yde et al[7] reported that 44% of patients reported experiencing an adverse reaction to the therapy, and two-thirds of these patients described their symptoms most commonly as local discomfort of light to moderate intensity at the site of treatment. In three-fourths of these patients, their symptoms resolved within 48 hours of onset. In a study of patients being treated with spinal manipulation for neck pain, Hurwitz et al[8] stated that 30% of their 280 respondents reported at least one adverse reaction from chiropractic therapy in the first 2 weeks of care. In 80% of these cases, symptoms resolved within 24 hours of their onset. In all of these studies, there were no reports of serious injuries or adverse effects, and most of these symptoms were resolved within 24 to 48 hours of onset.

Injuries have also been observed among chiropractic student populations during their education in the training of psychomotor skills. Studies by Macanuel et al,[9] Bisiacchi and Huber,[10] Kuehnel et al,[11] and Ndetan et al[12] describe the injuries or adverse effects experienced by the chiropractic students. Our study has determined the prevalence and nature of injuries occurring among chiropractic students in association with their learning and practice of adjustive technique. In this context, the students served both in the role of adjustor, like a practicing chiropractor, and in the role of recipients of the adjustment, like a chiropractic patient.

We found that 71% of our students experienced injuries and that there was no correlation between the age of the student and the likelihood of having an injury. The prevalence of injuries reported in other studies was 53% or less.[9–12] The higher prevalence in our study may be a consequence of the differences in technique curriculum among schools, students' understanding of the definition of injury when surveyed, or the timing of the survey administration in relation to the time of the injury. The majority of our students were surveyed within 6 months of their course experience and may have been more likely to have remembered an injury if it occurred within that time frame. Our results on students' age were similar to those published previously on student injuries. [9,11,12] As in our study, Macanuel et al[9] Kuehnet et al,[11]and Ndetan et al[12] previously reported no correlation between a student's age and injury. This outcome refutes any notion that younger students may be less conscientious and more careless while learning compared to older students who have more life experience. Our study results also indicate that females were more likely to be injured and this result is consistent with the findings of Ndetan et al[12] among students and Senstad et al[5] among patients. Our study of students practicing on each other to learn manual therapy skills demonstrated that 28% of the injured participants had residual effects.

Previous studies by Macanuel et al[9] and Bisiacchi and Huber[10] identified the low back and pelvis as the most common site of injury for chiropractic students. As we stated in the results section, the most commonly injured area in our study was the cervical spine. However, if the results for lumbar spine and SI joints from our study are combined to represent the low back, then the percentage of injury is the highest (97%) for this area in our study. With this modification, the cervical spine was the second most likely location to be injured among our students. Bisiacchi and Huber[10] found that the wrist was the second most commonly injured area, followed by the cervical spine. In our technique curriculum, the lumbar spine and pelvis are the anatomical areas that students are first taught to adjust; therefore, the highest prevalence for injuries to these areas may be explained as a consequence of students being novices at this time in their education. The high prevalence of cervical spine injuries may be a result of poor positioning. In this study, females were more likely to sustain lower back and upper limb injuries than males, and this sex difference was also noted by Bisiacchi and Huber[10] in their study.

This study's results also show that students who were in the role of the recipient of an adjustment were more likely to be injured (75%) than students who were in the role of adjustor. (This analysis was based on the survey respondents who reported injuries only in the recipient role.) With the exception of the study by Ndetan et al,[12] who also reported a higher percentage of injuries among students in the recipient role, previous studies had not investigated this distinction between roles. The current study also shows that females were more likely to experience SI joint injuries in the recipient role and males more likely to experience wrist/hand injuries in the adjustor role. These outcomes

appear to reflect the challenges of learning high-velocity, low-amplitude adjustive procedures, in which initially novices may apply excessive force at lower velocity and greater amplitude than necessary. Bisiacchi and Huber[10] also reported that female students had more lumbar spine injuries and male students had more neck injuries. Holm and Rose[4] found that the wrist, hand, shoulder, and low back were the most likely sites of injuries among practicing chiropractors, with no difference with regard to sex of the injured.

In the current study, the anatomical location of students' injuries generally correlated with the anatomical areas of emphasis of the chiropractic procedures course students were taking at the time of injury. Previous studies have not investigated these correlations. Students in CP4 learn adjustive procedures for the lumbar spine and pelvis and experienced more injuries to the low back (combining lumbar spine and sacroiliac joint). However, students in the CP4 course, in which cervical spine adjusting does not occur, also reported a high incidence of cervical spine adverse effects. This outcome may be due to students learning proper doctor and patient positioning for delivering side posture adjustments, which involve special attention to managing body mass, and/or students practicing cervical spine palpation, a skill first learned in CP1. Students in CP5 learn adjustive procedures for the cervical and thoracic spine and experienced more injuries to the cervical and thoracic spine. In addition, as students progressed through the technique curriculum they reported fewer injuries, suggesting that their skills improved with practice.

Limitations

This study was retrospective, thus there may be recollection bias. The survey gave the students the choice to state if the injuries occurred while receiving or administering adjustments or both. For those who chose both, we could not determine whether the injuries were from receiving adjustments vs administering adjustments. Therefore, we had to exclude these data from analysis. The 3 student cohorts we surveyed differed with regard to their individual cohort course experience. One cohort took only CP4, a second cohort took only CP4 and CP5, and the third cohort took all of the technique courses (CP4 through CP7). Thus, all 3 cohorts took CP4 and 2 cohorts took CP5; however, none of these cohorts took the same course at the same time, and they may have experienced differences in the ways the courses were taught, including different instructors. These possible differences might have influenced students' experiences and their survey responses. Our survey did not ask the respondent to differentiate between newly occurring adverse effects vs an exacerbation of a previously existing condition; thus, we have no data regarding this distinction.

CONCLUSION

This study suggests that students in technique courses who are learning adjustive procedures experience a similar nature of injury as that of doctors and patients in chiropractic practices. This study should help technique faculty adopt new pedagogical strategies to minimize the occurrence of injury. Based on the significant findings in this study, the pedagogical strategies will need to consider the anatomical regions being addressed in each course, the sex of the student, and the roles of student as adjustor and recipient of adjustment. Larger studies including other chiropractic colleges and better delineation of the student's role if injured will provide more generalizable data.

CONFLICT OF INTERESTS

There were no external sources of funding for this study, and no conflicts of interests were identified within this investigation.

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