

ORIGINAL ARTICLE

A cross-sectional study of chiropractic students' research readiness using the Academic Self-Concept Analysis Scale

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Objective: The shift toward evidence-based health care has reoriented tertiary clinical education in a way that necessitates and incorporates research. This study assesses the inclination and suitability of chiropractic students for research over a 5-year educational program.

Methods: Research attributes of chiropractic students were assessed in this cross-sectional study using a validated and modified academic self-concept analysis scale. Students in first and final year were assessed in 4 domains: creativity, motivation, self-regulation, and general intellectual ability. Univariable differences were assessed using Welch 2-sample *t* tests, and multivariable analysis was carried out with multiple linear regression models.

Results: The response rate was 71% ($n = 165$). First- and fifth-year students scored highly on all 4 domains (80% to 96%). Compared to first-year students, fifth-year students rated themselves significantly lower in 3 of the domains: general intellectual abilities ($t[126] = -2.01$; $p = 0.047$), motivation ($t[115] = -4.82$; $p < 0.001$), and creativity ($t[136] = -3.00$; $p = 0.003$).

Conclusion: Research suitability is high in chiropractic students. Both cohorts scored high in all domains despite the disparity between first and fifth years. First-year students outperformed fifth-year students in 3 domains, indicating a potential decline in the inclination to do research over time. However, unaccounted factors, such as the Dunning-Kruger effect, life changes, and "burnout," may have contributed to these differences. Future studies should include questions about stress, fatigue, clinical orientation, and educational environment to inform the interpretation of findings.

Key Indexing Terms: Chiropractic; Cross-Sectional Survey; Education; Motivation; Research; Students

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INTRODUCTION

Evidence-based medicine has best been described by David Sackett as requiring the demonstrated use of the most current best evidence in patient care. In its practice, it requires integrating clinical experience and expertise with patient values and systematic research. In order to practice successfully within the health care professions, a practitioner must apply self-directed learning toward tracking down the best research evidence for clinical care and appraise the quality of information for its validity and usefulness.^{1–3}

The implications for evidence-based best practice extend to private and government health funding. In recent years, developed countries have seen a move toward privatization of health care services away from what was previously managed by the government.⁴ Health care services, including privatized health care services, paid by insurance and/or government funding, expect quality

research to validate practice. Practitioners do not need to necessarily conduct their own original research but do need to be research literate and critical lifelong learners. It thus behooves academic institutions to answer to the need to produce research-literate graduates. It is also important that students are receptive to this new and important aspect of clinical teaching.

This study specifically investigates whether the students attracted to the chiropractic program at Macquarie University, Sydney, Australia, are oriented toward research and what 5 years in the program does to their orientation. In order to direct the development of future chiropractic cohorts toward evidence-based practice, quality education on research-intensive techniques and treatment modalities is required.^{5,6} The Department of Chiropractic at Macquarie University has over the past 10 years progressively incorporated research methods learning outcomes into the 5-year program in the form of critiquing papers and integrating the latest research into

every level of the curriculum plus a stand-alone research methods unit for health sciences and a research project in the final year. In 2016, we revised the program to include a full stream of research methodology through the entire program, building the learning outcomes to the goal of the final year research project. While providing the foundations for students to continue in the field of research, the program also aims to produce critical thinkers and evidence-based clinicians. But the question that will help us to understand the outcomes of this extensive new program is, are our students receptive to this type of education?

A study with a similar objective—to evaluate the self-concept chiropractic students have of themselves as science students—was done by Robert Shields.⁵ Shields astutely pointed out that students attracted to medicine are likely to be science oriented, but because chiropractic has historically been philosophically rather than scientifically underpinned, the same assumption cannot be made of students entering this profession. However, this research was done in 1993, and there is a need to investigate the attitudes of students in 2016 given the increasing pressure on the profession to leave its philosophical past and embrace an evidence-based future.

The aim of this study is to compare the academic self-concept of chiropractic students at entry level and in the final year of study in a cross-sectional study design using a self-evaluation questionnaire.

METHODS

Ethics approval was obtained from the Macquarie University Faculty of Science and Engineering Human Research Ethics Subcommittee in 2016 to conduct a questionnaire-based cross-sectional study on the first- and fifth-year chiropractic program student cohorts (ethics number 5201600237).

Students in the first year (145) and final year (80) of the 5-year chiropractic program at Macquarie University were invited to participate in this study. Permission to use in-class tutorial time was granted by conveners for the completion and collection of the questionnaire in week 12 of the first semester. Students were assured that participation was voluntary that the results would remain anonymous with only deidentified grouped data being used, and that the results of the questionnaire would not affect their grades.

The academic self-concept in adolescents (ASCA) questionnaire we used was first validated by Ordaz-Villegas et al,⁷ and we modified it by making it more applicable to tertiary students (available from the authors). In this modification, we changed “homework” to “work,” withdrew reference to “school” and substituted “university,” and removed some of the “school” information that would not be applicable to university, such as middle school grade-point average and a list of school-oriented abilities. The original questionnaire was validated by a panel of 10 professors in different schools of psychology, each with a PhD in education. Their study was conducted at the National Autonomous University of Mexico and

was administered to adolescents with the purpose of identifying high and low levels of academic self-concept within a secondary school.

Measurement of academic self-concept, or “personal perception of self,” and how this influences academic achievement has been shown in a meta-analysis of longitudinal studies to yield a high correlation between self-concept and academic outcomes.⁸ Thus, measuring personal self-perception around science and research is relevant in that the research suggests that this will influence academic outcomes. More useful when measuring self-perception is to have subjects judge their capabilities to complete tasks rather than how they personally feel about themselves.⁹ Therefore, we sought to find a questionnaire that asked task-oriented questions, as this has been shown to be more predictive of ability.¹⁰

The questionnaire comprises 28 items that are rated on a 5-point Likert scale, informing 4 task-oriented domains: self-regulation, general intellectual ability, motivation, and creativity. Self-regulation specifically measures “the positive attitude students have to the acquisition of knowledge and the learning process.” General intellectual ability emphasizes “the ability to process information; decompose it into parts; analyses different aspects of the same reality simultaneously; synthesize and incorporate experiences adapted to new situations.” Motivation measures “attraction towards a particular task or objective that encourages strategy search and analysis required to satisfy the attraction within an established program.” Finally, creativity measures “the process that generates sensibility to problems, deficiencies or gaps in knowledge leading to identify difficulties, and find solutions and make decisions strategically.” The questionnaire also collected demographic data.⁷ The full survey, as modified for this study, is available from the corresponding author.

The hard-copy questionnaires were distributed by hand, completed and collected from the first- and final-year chiropractic cohorts. Following protocol, the investigators did not touch the questionnaires until the last student of the cohort completed and sealed the envelope.

Descriptive statistics were produced for explanatory variables by each group (year of study). Mean and standard deviation were reported for continuous variables, while frequencies and proportions were provided for categorical variables. Baseline differences between groups were assessed using Welch 2-sample *t* test for continuous variables and Pearson’s chi-square test with Yates’s continuity correction for categorical variables. Outcome variables (i.e., factors of academic self-concept) were described with mean and standard deviation by group. For each outcome variable, differences between group were assessed both univariably using Welch 2-sample *t* tests and multivariably by fitting multiple linear regression models. Regression model fitting was achieved by (1) adding the explanatory variable and all potential confounders, (2) checking potential collinearity with variance inflation factors, (3) assessing effect modification by using backward elimination of nonsignificant interaction terms, and (4) removing nonconfounding explanatory variables. All mean differences from univariable analyses and

Table 1 - Demographic Characteristics of the Sample by Year of Study. Mean and Standard Deviation for Continuous Variables and Frequency and Proportion for Categorical Variables

Variable	First Year (n = 92)	Fifth Year (n = 68)	t/X ² (df)	p Value ^a
Age	20.4 ± 3.3	26.5 ± 4.4	t(116) = -9.51	<0.001
Number of siblings	1.7 ± 1.0	1.6 ± 1.1	t(130) = 0.67	0.505
Sex			χ ² (1) < 0.01	1.000
Female	33/91 (36%)	24/67 (36%)		—
Male	58/91 (64%)	43/67 (64%)		—
Birth order			χ ² (2) = 0.24	0.889
First child	34/73 (47%)	29/61 (48%)		—
Middle child	13/73 (18%)	9/61 (21%)		—
Last child	26/73 (36%)	23/61 (38%)		—
Currently employed			χ ² (1) = 1.26	0.262
No	19/90 (21%)	20/66 (30%)		—
Yes	71/90 (79%)	46/66 (70%)		—
House owner			χ ² (1) = 0.28	0.600
No	35/91 (44%)	29/66 (38%)		—
Yes	56/91 (56%)	37/66 (62%)		—
Extracurricular activity			χ ² (1) = 1.89	0.169
No	28/92 (31%)	13/66 (20%)		—
Yes	63/92 (69%)	53/66 (80%)		—
Mother with university degree			χ ² (1) = 3.75	0.053
No	42/71 (59%)	23/57 (40%)		—
Yes	29/71 (41%)	34/57 (60%)		—
Father with university degree			χ ² (1) = 6.13	0.013
No	42/71 (59%)	19/54 (35%)		—
Yes	29/71 (41%)	35/54 (65%)		—

^a Welch 2-sample t test for continuous variables and chi-square test for categorical variables.

regression coefficients from multivariable analyses were reported with 95% confidence intervals and corresponding p-values. The assumptions for all statistical tests were checked as appropriate. All statistical analyses were performed using the statistical computing software R version 3.3.1 (R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

One hundred and sixty students completed this study, representing 71% of possible respondents (92/145, or 63% first-year students, and 68/80, or 85% fifth-year students). Statistical evaluation of demographic data are shown in Table 1. The 2 cohorts were similar in all respects measured except for the education level of their father (41% first-year and 65% fifth-year students had a father with a university degree; χ²[1] = 6.13; *p* = 0.013) and, as can be expected, the age of the cohort (20.4 ± 3.3 years old for first-year students and 26.5 ± 4.4 years old for fifth-year students; *t*[116] = -9.51, *p* < 0.001).

The data revealed a high casual employment rate in both cohorts (79% for first-year students and 70% for fifth-year students; *p* = 0.262). The majority of both cohorts also participated in extracurricular activities (69% for first-year students and 80% for fifth-year students; *p* = 0.169).

First- and fifth-year students scored highly on all 4 domains, with mean values ranging from 12.0 to 14.4 out of 15, a score of 80% to 96%. The first- and fifth-year

cohorts were different in 3 of the 4 domains investigated. That is, first- and fifth-year cohorts were different in self-reported general intellectual abilities (*t*[126] = -2.01, *p* = 0.047), motivation (*t*[115] = -4.82, *p* < 0.001), and creativity (*t*[136] = -3.00, *p* = 0.003) but not self-regulation (*t*[132] = -1.03, *p* = 0.305) (see Table 2). Fifth-year students rated themselves significantly less able in these 3 domains compared to first year students. The results of the multiple linear regression analyses are shown in Table 3. The regression coefficients represent the mean difference between the 2 cohorts, controlling for all other variables included in the model. In general, the results of multivariable analyses are congruent with the univariable results reported in Table 2. Although employment status and engagement in extracurricular activities were found to be confounders for some of the domains, neither resulted in any major deviations from the unadjusted results (Table 3).

DISCUSSION

Many studies have been done on the attitudes that medical and allied health students have toward research.¹¹⁻¹⁹ Studies on chiropractic students' attitudes specifically have also been done. For example, Newell and Cunliffe¹⁹ conducted such a study on undergraduate students at McTimoney Chiropractic College and found that 64% of their 119 student respondents found research interesting, 54% thought it was difficult, and 75% considered chiropractic research to be necessary. An earlier, smaller study on

Table 2 - Mean and Standard Deviation and Comparison of Means Using Welch 2-Sample *t* Test for Each Factor Comprising Academic Self-Concept by Year of Study

Variable	First Year (<i>n</i> = 92)	Fifth Year (<i>n</i> = 68)	Mean Difference (95% CI)	<i>t</i> (<i>df</i>)	<i>p</i> Value
Self-regulation	12.5 ± 2.9	12.0 ± 3.3	−0.5 (−1.5, 0.5)	<i>t</i> (132) = −1.03	0.305
General intellectual abilities	12.9 ± 2.3	12.0 ± 2.9	−0.9 (−1.7, 0.0)	<i>t</i> (126) = −2.01	0.047
Motivation	14.4 ± 2.6	11.9 ± 3.6	−2.5 (−3.5, −1.5)	<i>t</i> (115) = −4.82	<0.001
Creativity	12.5 ± 2.8	11.1 ± 3.1	−1.4 (−2.3, −0.5)	<i>t</i> (136) = −3.00	0.003

70 randomly selected chiropractic students at Sherman College conducted in 1994 showed a similar belief that chiropractic research is necessary (71%), while only 51.6% were interested in research in general, and, interestingly at that much earlier time, only 19.4% thought research training should be a part of their training.²⁰

Our study was not so much interested in attitude as in the attributes that students have that would suit the increasing research orientation of our Macquarie University chiropractic program. The ASCA is a validated questionnaire that measures academic self-concept through the investigation of 4 defined variables: self-regulation, general intellectual abilities, motivation, and creativity. In the absence of definitively identified attributes for being a researcher in the literature, the following have been suggested: interest, motivation, inquisitiveness, commitment, sacrifice, excelling, knowledge, recognition, scholarly approach, and integration.²¹ Universities also identify attributes such as knowledge and intellectual ability, personal effectiveness, research governance and organization, engagement, influence, and impact.²² The variables as they are defined in ASCA and the questions asked in the ASCA questionnaire align well with these suggested attributes.

The results of our study show that both first- and fifth-year students do score highly on all 4 domains of self-regulation, general intellectual abilities, motivation, and creativity, with a score of 80% to 96%. This indicates that if we assume that these domains are important attributes of a research-ready student and that academic self-concept is a good way to measure these attributes, then the students in both their first year, recruited to the program, and the students in their final

year, leaving the program, are indeed suited to the evidence-based chiropractic care that is essential today.

These results concur with those of Shields,⁵ mentioned in the introduction, who found that the majority of 158 chiropractic students in the first and eighth trimesters at Los Angeles College of Chiropractic in 1993 (63.9%) had a positive academic self-concept. He concluded that chiropractic students show a readiness to “adopt the attitudes and values of science students . . . such as questioning and knowing the process of science itself.” A study done at the Palmer College of Chiropractic in Florida in 2008 on 303 students found that 99% of the students thought that chiropractic research was necessary for growth in the profession. Only 51% felt that they had the skills to conduct good research, a self-determined assessment that the authors felt was possibly inflated and perhaps could be explained by a “disconnect in their understanding of research skills and quality research”.¹⁷

Extracurricular activities and current employment were associated with higher ratings in all 4 domains across the student sample. This is a correlation, not a cause-and-effect relationship, and it would be conjecture to assume whether having these extra interests improves the outcome or whether the type of student who would have extra interests would also perhaps score better in the outcome domains.

What is interesting is that the fifth year students, when evaluating their personal academic self-concept of their general intellectual abilities, motivation, and creativity, rated themselves as less able in these domains compared to the self-rating that first-year students had of these abilities. An

Table 3 - Effect Sizes With 95% Confidence Intervals From Final Fitted Multivariable Linear Regression Models for Each Factor Comprising Academic Self-Concept

Variable	Model 1: Self-Regulation ^a	Model 2: General Intellectual Abilities ^b	Model 3: Motivation ^c	Model 4: Creativity ^d
Group (reference first year)	−0.6 (−1.5, 0.4)	−0.6 (−1.4, 0.2)	−2.2 (−3.1, −1.2)***	−1.0 (−1.9, −0.2)*
Age	—	—	—	—
Sex (reference male)	—	—	—	—
Number of siblings	—	—	—	—
Currently employed (reference no)	—	1.2 (0.2, 2.1)*	1.4 (0.4, 2.5)**	1.8 (0.8, 2.7)***
House owner (reference no)	—	—	—	—
Extracurricular activity (reference no)	1.6 (0.5, 2.6)**	—	—	—

^a *F*(2,154) = 4.57; *p* = 0.012; *R*² = 0.056.

^b *F*(2,153) = 4.71; *p* = 0.010; *R*² = 0.058.

^c *F*(2,153) = 15.37; *p* < 0.001; *R*² = 0.167.

^d *F*(2,153) = 10.18; *p* < 0.001; *R*² = 0.118.

* *p* < 0.05.

** *p* < 0.01.

*** *p* < 0.001.

example would be question 21 of the questionnaire (available from the authors), where fifth-year students reported less likelihood of contributing their best efforts in group activities compared to first-year students. An example of lowered self-reported creativity in fifth-year students can be demonstrated in question 25, where fifth-year students admit to less tendency to generate new ideas without previous knowledge of a topic compared to first-year students.

What would account for the differences between first- and fifth-year students? The results are self-reported, so it may be that the fifth-year students have a better grasp of their abilities or, said differently, that the first-year students suffer from the Dunning-Kruger effect. Kruger and Dunning²³ first proposed this phenomenon as the dual burden that people with limited knowledge bear: they jump to mistaken conclusions, and, without sufficient knowledge, they are unable to realize this. This was a similar finding in a study done at the University of Western States in Portland on 370 students in 2004²⁴ where they found that students who were more exposed to evidence-based practice in the curriculum did not feel more competent in retrieving or understanding research literature. They proposed the possibility of the evolution of an appreciation of the “complexities of modern research reporting and a better understanding of their own limitations.”

However, a few alternative perspectives in the observation of these trends must be considered. For example, motivation and creativity in fifth- and therefore final-year students may be significantly decreased due to study fatigue. Or with a shift in focus toward a lifetime career, academic work may lose priority for final-year students. Thus, it is not easy to say whether we are dealing with fifth-year burnout, a more clinical orientation in their thinking as they move closer to graduating, or cautious and more measured self-examination on the part of fifth-year students. It may also be the case that this is an indictment of the research-based teaching up to now (and prior to the changes instituted) in the curriculum. A study done in 2015 on the challenges faced by chiropractic higher-degree researchers using a modified Dundee Ready Education Environment Measure conducted as an international survey including high-degree research students at Macquarie University did find that the students did not think that undergraduate studies had been a good preparation for high-degree research courses.²⁵ It may even be the case that the younger generation is actually more science/research oriented to begin with. In the absence of longitudinal data, it is impossible to say for sure what the reason for these differences could be, and repeated research using the ASCA assessment tool is warranted.

It may have been beneficial therefore to also ask questions around the education environment, levels of energy, stress, and fatigue, as this could inform the outcomes. It is interesting that Shields⁵ did find similar but not significant differences between first- and eighth-trimester students in his study, with 69% of first- and only 58% of eighth-trimester students reporting a positive academic self-concept.

In addition, an analysis of the influence of some of the demographics that could impact these outcomes could not

be made, as some of the data were incomplete and excluded these demographics from further analysis. These included personal interests, socioeconomic status, and birth order.

Limitations

The questionnaire used a fairly indirect method to ascertain research readiness. Additional, more direct questions may actually have led to useful information using simple questions such as “I would consider conducting research in the future for chiropractic.” Further, the results of the questionnaire would have been easier to interpret if such variables as the education environment, fatigue, burnout, enthusiasm, optimism, and so on had been addressed. A modified Dundee Ready Education Environment Measure questionnaire may be a necessary adjunct to the questions asked of students.

Our study is cross-sectional, which limits us to drawing conclusions based on the respective cohorts at 1 point in time. In the future, a longitudinal study may be conducted as the current 2017 first-year cohort, which is now exposed to the full research stream component of the program, reaches final year. This result will be more accurate in determining the state of the students’ mindfulness toward research as well as determining whether the changes that have been implemented to create a continuous research stream in the program have beneficial effects with regard to improved attributes for becoming lifelong researchers during their professional lives.

CONCLUSION

This study found that the majority of chiropractic students display the attributes of self-regulation, general intellectual abilities, motivation, and creativity that would be well suited and oriented to a research and evidence-based chiropractic curriculum. For reasons that require further elucidation through research, the final-year students’ self-perception indicated a less oriented attitude toward these domains compared to the entry-level students.

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