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ORIGINAL ARTICLE

Association of pain neurophysiology knowledge and application amongst UK chiropractic students: A cross-sectional study

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ABSTRACT

Objective: To investigate if chiropractic placement students in the United Kingdom are aware of current pain evidence and how they relate this to the management of chronic pain patients. Moreover, to gain an understanding of how this can lead to improved pain education planning and engagement in the future.

Methods: The revised Neurophysiology of Pain Questionnaire and the researchers' own questionnaire were administered online to chiropractic placement students. The aggregated total number of correct responses and the individual mean scores were calculated. Statistical analysis included tests of normality and difference using the Kolmogorov-Smirnov, Mann-Whitney U, Kruskal-Wallis, and χ^2 tests.

Results: There was an overall response rate of 21.6% ($n = 50$). The mean score achieved on the revised neurophysiology of pain questionnaire was 37.8%. A significant difference between individual mean scores on the revised Neurophysiology of Pain Questionnaire was observed between male and female participants. No differences in mean score were observed between age, number of chronic pain patients seen, and previous qualifications. For the study-specific questionnaire, statistically significant differences were found in mean score for previous qualifications, number of patients seen, and sex.

Conclusion: Chiropractic placement students in the United Kingdom appear to have a lower level of pain knowledge than other health care professionals and education institutions may wish to consider how to best address this within their curricula.

Key Indexing Terms: Chronic Pain; Pain Management; Neurophysiology; Education; Chiropractic

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INTRODUCTION

The experience of pain is subjective and multifactorial.¹ Research has identified that tissue damage and nociception are not directly linked, and that pain management should encompass biopsychosocial processes, which are key to providing better outcomes in pain management and address the intricate nature of pain.^{1–3} Reconceptualization of pain has shown to be beneficial for chronic low back pain patients with an increased participation in biopsychosocial rehabilitation.⁴ Moreover, using specific pain neurophysiology education from Butler and Moseley has demonstrated significantly reduced perception of pain.^{5,6} Pain education can be used as an effective tool for managing chronic pain patients (CPP) as pain intensity and expectations about recovery are primary considerations for people in pain.⁷ This knowledge and effective

communication from clinician to patient is therefore essential. A recent survey suggests that patients who receive pain education report lower pain intensity and higher expectations of recovery compared with not receiving education.⁷ Similarly, it would appear that widespread misconceptions exist regarding investigation and management of low back pain amongst medical students and the public as reported in 1 study where almost 60% of the general public believed that “bed rest is the mainstay of therapy.”⁸

Pain concepts are established during health care professionals' formal education. In the United Kingdom, physiotherapy students averaged 38 hours of pain education, which covers approximately 1.9% of their total education. Pain curricula in medical education lasts an average of 13 hours,⁹ with some studies recording pain education as lasting anything from 1 to 10 hours of a medical curriculum.^{10,11}

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No research has been undertaken to explore the hours spent on pain education in undergraduate chiropractic degree courses. As physiotherapists and chiropractors manage similar conditions of the musculoskeletal system,^{12,13} it can be hypothesized that similar levels of pain education are present in chiropractic education. It would therefore be useful to gain information about the application of this knowledge in a clinical setting to establish a framework for future pain education. The International Association for the Study of Pain designated 2022 as the Global Year for Translating Pain Knowledge to Practice.¹⁴ They highlight the importance of health professionals accumulating pain knowledge to ensure they can develop appropriate management of pain and a better experience for patients.

Previous studies have assessed the knowledge of students who study physiotherapy, osteopathy, nutrition and medicine using the Neurophysiology of Pain Questionnaire (NPQ) from Moseley.³ This questionnaire asks whether health care professionals have appropriate knowledge of pain to inform their practice and patients. These studies identified that the current knowledge amongst these students is either too low or insufficient to effectively manage patients and that an additional pain module to the syllabus improved their pain knowledge.^{15–22} Despite the fact that most patients see their primary care physician because they are in pain, health care students lack significant knowledge regarding pain at graduation, which is a hindrance that can limit pain management efficiency.^{23,24} Chiropractors treat various conditions concerned with pain, integrating passive and active care through an evidence-based model.²⁵ There is currently no research exploring chiropractic students' pain neurophysiology knowledge and their application of chronic pain mechanisms in practice. Identification of this might assist future research and education to improve knowledge for both chiropractic interns and the university itself.

To explore this gap in the understanding of chiropractic pain education, the purpose of this study was to investigate if a sample of chiropractic placement students in the United Kingdom are aware of current pain evidence and how they relate this to the management of chronic pain patients.

METHODS

Educational Context

This cross-sectional study assessing the students' knowledge of pain neurophysiology and application was conducted at 2 universities in the United Kingdom. Both universities offer a 4-year undergraduate chiropractic degree and 1 also offers 2-year post-graduate chiropractic degree options. Pain education at these universities is embedded within the curricula as opposed to a stand-alone module.

Participants

The study sample was comprised of all final year undergraduate (MChiro), and first and second year pre-registration post-graduate students from the 2 institutions.

A total of 231 students were invited to participate during the 2021–2022 academic year. The survey was administered online for 12 weeks between November 2021 and January 2022. Participants were recruited via email, sent to eligible participants by staff at each institution. Three reminder emails were sent 2, 4, and 6 weeks after the initial launch of the survey with the aim of increasing participation and for students who may not have seen a CPP when the initial email was sent out, allowing them to take part. Each email contained the study information sheet and a link to the online survey, which was developed on JISC Online Surveys (JISC, Bristol, UK). Informed consent was obtained prior to completion of the survey by a welcome page, which summarized key information about the study and asked participants if they agreed to take part. Demographic data such as age, sex, and previous qualifications were collected as well as the number of chronic patients seen. No other data related to education were included. The questionnaires were designed to take 10 minutes to complete. Data were collected anonymously with no credit or criticism given for choosing to engage or not with the study.

The inclusion criteria were chiropractic clinic placement year students enrolled during the 2021–2022 academic year who had treated at least 1 CPP (defined as a patient experiencing pain for more than 3 months). Participants were excluded if they had not treated a CPP (evident through an introductory question in the survey).

Variables

The main variables were the results of the revised Neurophysiology of Pain Questionnaire (rNPQ) and the researchers' questionnaire titled Application and Communication of Pain in Practice.

Questionnaires

There is currently no gold standard for measuring pain knowledge, but tools do exist to measure different aspects of pain knowledge and were used for this study. Pain knowledge was measured using the revised Neurophysiology of Pain (rNPQ) questionnaire. Catley et al²⁶ revised the validity of the original Neurophysiology of Pain (NPQ) questionnaire from Moseley³ using a Rasch analysis. Questions from the NPQ and rNPQ assess the knowledge of nociception, pain, and the understanding of the biopsychosocial model of pain. The authors reduced the questions and stated it to be a useful and reliable tool to assess people of all ability levels and can be used to identify and measure knowledge gaps. The rNPQ has demonstrated strong internal consistency and test-retest reliability.²⁶ Numerous studies have used the NPQ and rNPQ to assess pain knowledge on students.^{15–22} The responses were reproduced in the standard format of *true*, *false*, or *undecided*. Table 1 provides a full description of the questions asked.

The second part of the survey comprised 8 statements designed by the researcher regarding the application and communication of pain in practice. These contained statements regarding patient education, understanding, and explanation of pain. Additionally, it included

Table 1 - Revised Neurophysiology of Pain Questionnaire²⁶: Part 1

Question	T	F	U
1 It is possible to have pain and not know about it			✓
2 When part of your body is injured, special pain receptors convey the pain message to your brain			✓
3 Pain only occurs when you are injured or at risk of being injured			✓
4 When you are injured, special receptors convey the danger message to your spinal cord	✓		
5 Special nerves in your spinal cord convey “danger” messages to your brain	✓		
6 Nerves adapt by increasing their resting level of excitement	✓		
7 Chronic pain means that an injury hasn’t healed properly			✓
8 Worse injuries always result in worse pain			✓
9 Descending neurons are always inhibitory			✓
10 Pain occurs whenever you are injured			✓
11 When you injure yourself, the environment that you are in will not affect the amount of pain that you experience, as long as the injury is exactly the same			✓
12 The brain decides when you will experience pain	✓		

✓, correct answer; T, true; F, false; U, undecided

questions concerning the participants’ confidence applying pain knowledge within the management of CPP. The answers contained a selection of choices such as *strongly agree*, *agree*, *neither agree nor disagree*, *disagree*, or *strongly disagree* (Table 2). This questionnaire has not been tested in any population, hence there is no prior knowledge of its reliability and validity, which is different to a standardized questionnaire. However, the questionnaire was piloted by a small sample comprising 6 chiropractic students with different cultural backgrounds and academic knowledge. From the feedback the survey statements were clear and easy to understand, and only item required minor grammatical and syntax changes. The piloting process was undertaken to mitigate any errors or inconsistencies, improve the validity of the study, and make the questionnaire more relevant for the study population.

Data Analysis

Data were collected on the JISC Online Survey platform and exported to Microsoft Office Excel 2014 (Microsoft Corp, Redmond, WA, USA). Data were prepared for analysis and transferred to Statistical Package for the Social Sciences for Windows (SPSS,

version 27.0, IBM, Inc, Chicago, IL, USA) for statistical analysis.

Demographic data and the number of CPP seen were described as frequencies and percentages, whereas means, SDs, and statistical significance were used to describe correct answers within categories. The assumptions of normality within the rNPQ response data were not met with the Kolmogorov-Smirnov test and as a result, comparisons for both questionnaires were made using the non-parametric tests Mann-Whitney U, Kruskal-Wallis, and χ^2 with the significance level set at .05.

Ethical Considerations

Ethical approval was obtained from the AECCUC Ethics Committee in October prior to the first email being sent to participants.

RESULTS

The combined response rate from the 2 institutions was 21.6% ($n = 50$). There were slightly more women ($n = 28$, 56%) than men ($n = 22$, 44%). Most participants were in the age range of 21–24 ($n = 72\%$). Table 3 displays participant demographic data.

Table 2 - Explanation and Application of Chronic Pain in Practice Questionnaire: Part 2

Question	
13	Chiropractic clinic year students should be able to explain the neurophysiology of chronic pain accurately
14	If a patient is struggling with the understanding of how chronic pain and nociception works, it is important to provide them with accurate information and tools to do so
15	There are multiple potential benefits of patient education regarding pain mechanisms on chronic pain patients
16	Patient education and understanding is an important part of a management plan when it comes to chronic pain
17	Having a lack of knowledge regarding pain mechanisms can potentially alter the management plan and ultimately the recovery of a patient presenting with chronic pain
18	There is a lack of teaching regarding the neurophysiology of pain in the early years prior to treating patients in the university student clinic
19	I believe explaining pain mechanisms to chronic pain patients is of high importance
20	I feel confident enough to apply my knowledge regarding pain mechanisms within my management of chronic pain patients and effectively communicate this

Table 3 - Participant Demographic Data

	Frequency (%)
Sex	
Women	28 (56)
Men	22 (44)
Age	
21–24	36 (72)
25–28	8 (16)
29–33	4 (8)
Older than 33	2 (4)
Previously completed qualification/degree	
Yes, relating to health care	7 (14)
Yes, not relating to health care	9 (18)
No	34 (68)
Number of chronic pain patients seen in practice	
1–3	13 (26)
4–6	21 (42)
More than 6	16 (32)

The Revised Neurophysiology of Pain Questionnaire

A total of 50 participants answered 12 questions each with 600 questions answered in total. The aggregated total number of correct responses in the rNPQ was 426 out of 600 or 71%. Mean score of the rNPQ was 4.54 out of 12 or 37.8%. For men the mean score was 5.18 (SD 1.29) out of 12 (43.2%) and women 3.89 (SD 1.44) out of 12 (32.4%). These mean scores were analyzed using the Mann-Whitney U test with men scoring significantly higher than women ($p = .003$). There were no significant differences in rNPQ mean scores by age, number of CPP seen in practice, or previous qualification. However, there were trends toward greater age, previous qualifications, and number of chronic patients seen associated with increased pain knowledge (Table 4).

Item-by-Item Analysis

To determine the percentage of correct responses across the questionnaire, a more detailed analysis was undertaken. The item that achieved the lowest percentage (12%) was item 2: “When part of your body is injured, special pain receptors convey the pain message to your brain.” The item that achieved the highest percentage (98%) was item 8: “Worse injuries always result in worse pain.” The percentage of correct responses across the items can be found in Figure 1.

Study-Specific Additional Questions (Part 2 Questionnaire)

A comparison amongst the students’ demographic data using the Kruskal-Wallis test showed statistical significance for item 14 ($p = .04$), 17 ($p = .01$), and 19 ($p = .04$). However, the cells had an expected count less than 5 in χ^2 calculations. Item 20 reached statistical significance for sex ($p = .04$). No statistical significance was observed for age for any of the items. Table 5 presents the results of χ^2 tests for all items and variables.

Table 4 - Individual Mean Scores on the rNPQ

Group	Mean \pm SD	Significance (p)
Sex		.003*
Men	5.18 \pm 1.29	
Women	3.89 \pm 1.44	
Age ^a		.198
21–24	4.44 \pm 1.59	
25–28	4.75 \pm 1.28	
29–33	5.00 \pm 0.81	
>33	2.50 \pm 0.70	
Number of chronic pain patients seen in practice ^a		.132
1–3	4.15 \pm 1.06	
4–6	4.95 \pm 1.32	
>6	4.06 \pm 1.91	
Previous qualifications ^a		.126
Yes, relating to health care	5.14 \pm 1.06	
Yes, but not relating to health care	4.88 \pm 1.36	
No previous qualifications	4.20 \pm 1.59	

rNPQ, revised Neurophysiology of Pain Questionnaire.

* $p < .05$ (Mann-Whitney U test).

^a Kruskal-Wallis test.

A non-parametric analysis was completed for questions 13–20. This was done to explore the association between the degree of pain knowledge (total rNPQ) and application in practice. The Kruskal-Wallis test showed no statistically significant difference between agreeing or disagreeing within pain knowledge and application in practice.

DISCUSSION

This study set out to determine the level of pain knowledge amongst a sample of UK chiropractic students and their opinions and confidence in applying this knowledge in practice. This was achieved through a cross-sectional survey using the rNPQ. The rNPQ was chosen due to its wide use with similar studies and its ability to assess both the biological aspects of pain and cognitive applications of possessing such knowledge for both clinicians and patients.²⁶ Moreover, this study also contained a second survey that was designed by the researcher to obtain a deeper understanding regarding the application and communication of pain in practice.

Overall, the level of knowledge of pain neurophysiology amongst these students was less in comparison with similar studies. Amongst final year health science and therapies students, Adillón et al²² reported a NPQ mean of 58.13% and Mukoka et al¹⁸ a mean NPQ of 50% compared with 37.83% in the rNPQ used in the current study. In both Adillón et al²² and Mukoka et al,¹⁸ physiotherapy students reported a higher NPQ compared with other health sciences such as medicine, nutrition, and exercise science. Briggs et al²⁷ found that chiropractors and physiotherapists spent more time and emphasis on spinal pain in their curricula compared with pharmacy, medicine, and occupational therapy, which might explain a greater pain

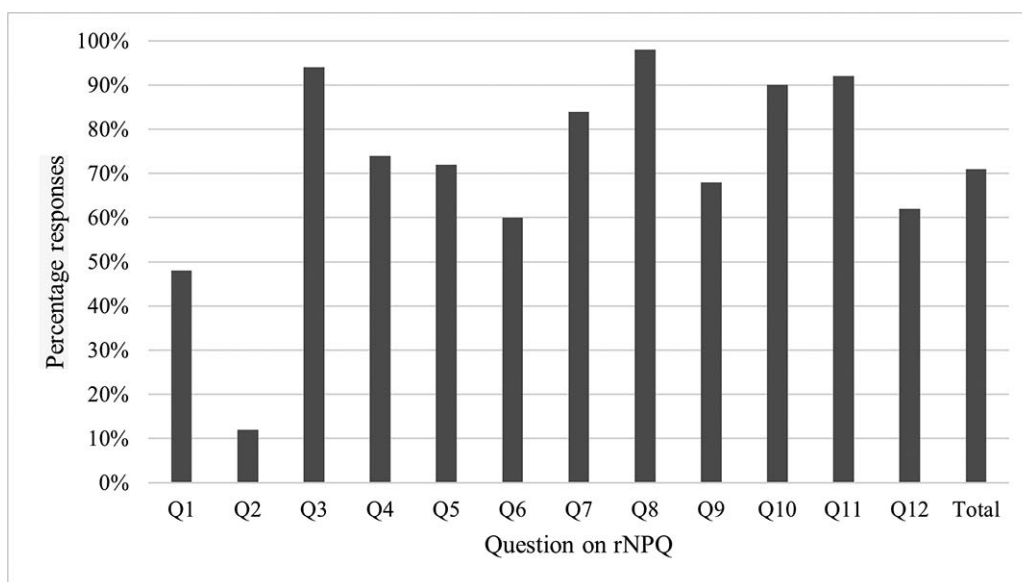


Figure 1 - Percentage of correct responses revised Neurophysiology of Pain Questionnaire.

knowledge, but this was not evident in the results of this study. Trends were noted between age, previous qualifications, and number of CPP and pain knowledge in this study, although these were not statistically significant.

Other studies have shown an increase in pain knowledge following a short-term program specifically targeted toward pain neuroscience. Fitzgerald et al²⁸ reported an increase of mean score from 53% to 74% for osteopathy students after a 12-week pain module. Cox et al¹⁶ demonstrated an increase from 41% to 84% following a 3-hour neuroscience education lecture for physiotherapy students. As this present study did not include an additional pain module, a direct comparison is difficult. However, it can be suggested that short-term additional pain modules might improve pain neurophysiology knowledge in chiropractic students.

This study showed that the men had slightly higher knowledge of pain than the women. This was supported in studies by Adillón et al²² and Mukoka et al¹⁸ who showed that men were found to have significantly higher knowledge of neurophysiology of pain than women. The proportion of men in the present study was 44%, whereas

the proportion in their studies were 31% and 21%, respectively. It is unclear why the men may have better knowledge of pain neuroscience. Possible explanations could be that men perceive biopsychological aspects of pain better, they understand the content more, and/or do better in theoretical concepts compared with women. Future studies could benefit from exploring this relationship between sex and pain knowledge, and include data related to their education levels.

When looking at subsections within the questionnaire, the least amount of knowledge was centered around the presence of unique pain receptors, and the highest amount of knowledge was associated with the relationship between injury and pain. Adillón et al²² discovered similar results, where less than 10% answered the former question correctly. It can be hypothesized that the students' understanding regarding the definition of *pain receptors* differ. The body contains sensory receptors that transfer and encode noxious stimuli. Pain and nociception are different phenomena, and pain cannot be deduced solely from activity in sensory neurons.²⁹ This misunderstanding of the question could highlight the gap in education and nociception being synonymous.

The second part of the survey analyzed the participants' communication and application of pain science and knowledge. The opinion-based statements of this survey showed statistical significance for 4 of the questions. Noticeable differences were found between men and women regarding confidence in applying pain knowledge. Women were more likely to be neutral while men were more likely to disagree with this statement. This is an interesting observation because men were shown to have a higher pain knowledge than women, so it might be expected that men would be more confident. However, the results presented in the present study suggest that men are less confident to apply this in practice. Future research should investigate reasons for sex differences in confidence and knowledge application.

Table 5 - Results of χ^2 Tests Between Categorical Variables (Part 2 Questionnaire)

Question	Men/Women	Age	No. of pts	Prev. Q
Q13	0.51	0.24	0.57	0.17
Q14	0.25	0.14	0.33	0.04*
Q15	0.86	0.59	0.56	0.61
Q16	0.25	0.94	0.49	0.78
Q17	0.72	0.72	0.88	0.01*
Q18	0.39	0.71	0.17	0.68
Q19	0.44	0.59	0.04*	0.41
Q20	0.04*	0.64	0.20	0.74

No. of pts, number of patients; Prev. Q, previous qualifications.

Questions 13–19 had an expected count less than 5, * $p < .05$ (χ^2 test).

Interestingly, clear differences were seen between students who had seen more CPP and the importance of explaining pain in practice. This may suggest that the fewer CPP seen the more difficult it is for students to discuss the subject. This could help explain the differences in confidence in applying pain knowledge and its importance in managing patients. Future research could benefit from investigating this relationship and whether this would be beneficial in preparing students for practice. There was also a noticeable agreement between participants who completed a previous health degree with the statement that a lack of pain knowledge results in poor recovery of a CPP. On the contrary, participants with no previous qualifications were more likely to disagree. This emphasizes the importance of health and pain education and shows that previous qualification might have an effect on pain application.

As the results indicated the absence of association between the degree of pain knowledge and application in practice, other factors might be at play. Students who obtain a certain level of pain knowledge, but choose not to apply it, may be influenced by either a biomechanical model or a metaphysical philosophy. Both are powerful perspectives within the chiropractic profession. These knowledge and application challenges would be beneficial to investigate in the future to gain a better understanding of those who choose not to apply their pain knowledge. It could be that chiropractic curricula require review regarding the quantity of the psychosocial element through pain science. A recent study suggests that terminology describing psychosocial factors in the US chiropractic curricula is poorly represented.³⁰ Alternatively, students with a lack of interest or awareness of pain knowledge might be useful to target in the future and be made aware that pain evidence and chiropractic philosophy are not necessarily the same concepts.

This study included a relatively small number of participants from 2 universities, as well as a low response rate (21.6%). Therefore, the results can be suggestive, but not representative due to the small population. Because of the low response rate, an increased possibility of response bias is present. This might mean the subjects that answered the survey were the ones with a particular interest or an existing knowledge of pain. It could also be possible that the participants with a higher response rate were always likely to generate a positive outcome due to cognitive bias. For this reason, this study may not accurately represent the knowledge of all chiropractic students. Future studies with larger samples from all chiropractic universities in the United Kingdom should be conducted to evaluate knowledge of pain. The students outside of this current sample (non-responders) should be considered as a priority for engagement in pain knowledge in the future. Engaging in pain education simply offers a further understanding to better inform patients in practice.

The subjective opinion section from this survey is a different concept to the knowledge-based section. This section was intended for the individual student to reflect on the knowledge being transferred into practice, and the importance of it. This section was only piloted and had not been assessed for its validity and specificity. However,

piloting the survey aided in mitigating this disadvantage and made it useful to the study population. Finally, being a cross-sectional study, the interpretation of the results is limited in terms of association between the variables. Nevertheless, the results have been useful for establishing preliminary evidence for future studies.

CONCLUSION

The findings of this survey show that the majority of the respondents in this study are disposed to include pain science within their practice. However, they have a base level of understanding that compares less favorably with similar research. Those who were willing to take part in this study and who are assumed to have a particular interest in pain education may not necessarily be the primary group that requires the greatest attention. It is therefore important to engage with those students who have little or no awareness of pain science who may need a greater understanding and application in their clinical practice. It is therefore recommended that future research and education should prioritize the engagement of pain mechanisms.

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Author Contributions

Concept development: KN. Design: KN. Supervision: PD. Data collection/processing: KN. Analysis/interpretation: KN. Literature search: KN. Writing: KN. Critical review: PD.

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