

Evaluation of chiropractic students' perspectives on back pain management following one of three clinical evidence-based educational training interventions: a cluster-randomized trial

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Objective: To assess the effectiveness of educational interventions' impact on chiropractic students' attitudes toward patient-centered care and low back pain (LBP) using knowledge about pain science and stratified LBP management with the MAINTAIN instrument.

Évaluation des perspectives des étudiants en chiropratique sur la gestion de la douleur dorsale à la suite de l'une des trois interventions de formation éducative fondée sur des données cliniques probantes : un essai randomisé en grappes.

Objectifs: Évaluer l'efficacité de l'impact des interventions éducatives sur les attitudes des étudiants en chiropratique envers les soins centrés sur le patient et la douleur lombaire (DL) en utilisant des connaissances sur la science de la douleur et la gestion stratifiée de la DL avec l'instrument MAINTAIN.

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Methods: From January-August 2022, students were cluster randomized into three groups (information-only, focused-lecture, workshop series) with the Health Care Providers' Pain and Impairment Relationship Scale (HC-PAIRS) and the Patient-Practitioner Orientation Scale (PPOS) measured at baseline, 4-months, and 8-months. Data were analyzed with descriptive statistics and repeated-measures ANOVA.

Results: Of 264 students, response rates declined by 8-months (16.7-31.3%). No significant within- or between-group differences were found across timepoints. A small but statistically significant shift toward doctor-centered attitudes in the instrument-only group ($p=0.024$) was not clinically meaningful.

Conclusions: Educational interventions did not significantly change student attitudes. Contributing factors may include focus on attitudinal change, limited research culture, implementation barriers, and student burnout.

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KEY WORDS: chiropractic, students, attitude, low back pain, maintenance care

Introduction

Low back pain (LBP) is a complex and multifaceted condition that varies significantly among patients.^{1,2} The attitudes and beliefs of healthcare providers toward LBP can profoundly influence clinical management strategies and patient outcomes. Evidence indicates that adherence to guideline-recommended care improves clinical outcomes and reduces costs.³ Despite this, variability in musculoskeletal education across healthcare training programs can lead to inconsistencies in knowledge acquisition and clinical decision-making.⁴⁻⁶ Understanding how educational interventions influence students' perceptions of LBP and patient-centered care is essential for improving future clinical practice.

Educational programs are critical in shaping the knowledge, skills, and attitudes necessary for quality health-

Méthodes: De janvier à août 2022, les étudiants ont été randomisés en grappes, en trois groupes (information seulement, conférence ciblée, série d'ateliers) avec l'Échelle de la relation entre la douleur et l'incapacité des fournisseurs de soins de santé (HC-PAIRS) et l'Échelle d'orientation patient-praticien (PPOS) mesurées à la ligne de base, à 4 mois et à 8 mois. Les données ont été analysées à l'aide de statistiques descriptives et d'une ANOVA à mesures répétées.

Résultats: Parmi 264 étudiants, les taux de réponse ont diminué de 8 mois (16,7-31,3 %). Aucune différence significative n'a été trouvée au sein des groupes ou entre les groupes à travers les points temporels. Un petit changement – statistiquement significatif tout de même – allant dans le sens des attitudes centrées sur le médecin dans le groupe uniquement instrumenté ($p=0,024$) n'était pas cliniquement significatif.

Conclusions: Les interventions éducatives n'ont pas significativement changé les attitudes des étudiants. Parmi les facteurs contributifs, on peut citer un accent mis sur le changement d'attitude, une culture de recherche limitée, des obstacles à la mise en œuvre et l'épuisement des étudiants.

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MOTS CLÉS : chiropratique, étudiants, attitude, douleur lombaire, soins d'entretien

care.⁷ However, limited research examines how chiropractic education impacts students' attitudes toward managing LBP or their confidence in applying evidence-based strategies. A deeper understanding of this process is needed to ensure that chiropractic students are equipped to deliver patient-centered, evidence-informed care.

Jack Mezirow's transformative learning theory (1978) provides a framework for understanding how students integrate new knowledge into clinical decision-making.⁸ This theory highlights the importance of reflective, experience-based learning in reshaping assumptions and guiding future behavior. Applied to chiropractic education, it supports evaluating whether training interventions—particularly those that emphasize patient stratification and tailored care—can effectively influence students' attitudes toward patient-centered care in LBP management.⁹

Psychology research shows that attitudes toward a behavior often predict future actions.^{10,11} In healthcare, cultivating attitudes of continuous learning, patient-centeredness, and clinical adaptability may be a key to improving patient outcomes.^{12,13} Patient-centered care, which integrates patient preferences, needs, and values into clinical decision-making, enhances the healthcare experience and reduces unnecessary costs.^{14,15} While it is difficult to measure directly,^{13,16} key components such as communication, empathy, and professionalism are known to improve satisfaction and adherence.^{17,18} To assess these critical attitudes, this study utilized two validated instruments:

- The Health Care Providers' Pain and Impairment Relationship Scale (HC-PAIRS), which evaluates beliefs about pain-related disability and the role of healthcare providers in patient recovery.¹⁹
- The Patient-Practitioner Orientation Scale (PPOS), which assesses student attitudes toward doctor-patient relationships and patient-centeredness.²⁰

Together, these instruments provide insights into the students' capacity for evidence-informed and patient-aligned clinical decision-making.

Doctors of Chiropractic (DCs) frequently manage LBP.²¹ Maintenance care is often recommended for long-term management following initial treatment success.²² Research from the Nordic Maintenance Care Program has demonstrated that stratified care approaches acknowledge that psychological and behavioral factors influence patients' responses to treatment care plans.^{23,24} The MAINTAIN instrument was developed as a stratification tool to assist clinicians in identifying patients' psychological profiles and tailoring LBP management strategies accordingly.²²

Instruction in the use of the MAINTAIN instrument is relevant to this study's outcome measures in two key ways:

1. Influence on HC-PAIRS: The MAINTAIN instrument operationalizes biopsychosocial principles by stratifying care based on psychological risk factors such as pain beliefs, fear-avoidance, and coping strategies.²² By engaging students with this tool, we hypothesize a reduction in maladaptive beliefs about pain and disability, thus positively influencing HC-PAIRS scores.

2. Influence on PPOS: Training in the MAINTAIN instrument promotes patient-centered care by guiding students to consider individual patient characteristics and preferences in clinical decision-making. This aligns with the principles of shared decision-making and personalized care—central constructs measured by the PPOS.

While the MAINTAIN instrument alone may not account for all expected changes in student attitudes, its use—within a broader educational framework that includes pain science education and evidence-based LBP management—is hypothesized to enhance student readiness to deliver guideline-concordant, patient-centered care.

This study aims to assess the effectiveness of three educational interventions: pain science, stratified LBP management, and the MAINTAIN instrument—on changing DC students' attitudes and beliefs about LBP and patient care. By integrating these tools and concepts and assessing their impact through validated measures, this research seeks to inform curricular strategies that foster clinical preparedness and improve future care for LBP.

Methods

Trial design

This cluster randomized trial was conducted at two chiropractic teaching clinics in the United States. Due to the nature of the research as an educational intervention, a trial registry was not utilized, and the protocol was not made available for publication. The investigators held meetings bi-weekly to assess the study's progress and provide updates. After implementation, no modifications were made to the protocol, and the study was funded entirely by internal resources. The study was approved by Parker University's Institutional Review Board (A-00219) and the protocol was registered *post-hoc* at Open Science Framework (osf.io/qvuxz) in February 2025.

Participants

Three hundred and thirty-six potential students were allocated among 26 supervising clinician/student pods. Each pod, supervised by up to two clinicians, guides students throughout their final year of a 40-month training program. All active supervising clinicians and students were eligible to participate. They were invited to participate during a team pod meeting scheduled with a team investi-

gator where they could access the e-consent and ask questions. If they signed the consent, the demographic and outcome questionnaires became available.

Educational Intervention

Supervising clinician/student pods were randomized to one of the following intervention groups:

1. **Written information** – an informal learning approach: All students in this less formalized training only received a copy of the MAINTAIN instrument and a manual detailing its development and best practices. This information was distributed during clinic orientation sessions. Throughout these sessions, the site team leaders and project managers were present to address inquiries, while informed consent and questionnaires were gathered from the students. This intervention was intentionally designed to mirror how many providers receive information – briefly and with minimal guidance on implementing the material.
2. **Focused lecture** – an informal learning approach: Students in this less formalized training group received the MAINTAIN instrument information but also participated in a lecture developed by the study investigators. This training model was designed to simulate how a provider might receive information at a conference.
3. **In-depth workshop series** – a transformative learning approach: Students allocated to this transformative learning group received both the written information and the lecture, along with monthly workshops that provided more in-depth insights on understanding and effectively implementing the MAINTAIN instrument. The topics and lectures for this group were informed by a mixed-methods qualitative analysis that explored chiropractic students' attitudes toward integrating evidence on chiropractic maintenance care.²⁵ Topics covered included:
 - Biopsychosocial Model
 - Patient-Centeredness
 - Importance of Knowledge Translation to Produce Evidence
 - Neurobiology of Pain
 - Deep Dive into the MAINTAIN Studies

Outcomes

Two outcome measures were employed to evaluate students' attitudes: the Health Care Providers' Pain and Impairment Relationship Scale (HC-PAIRS) and the Patient-Practitioner Orientation Scale (PPOS). These assessments were carried out at the baseline and the end of the term, which spanned roughly nine weeks. The HC-PAIRS is a 15-item tool designed to evaluate healthcare providers' attitudes and beliefs regarding functional expectations for patients with chronic LBP,²⁰ using a 7-point Likert response (1=completely disagree; 7=completely agree). While property measurements have been assessed, they have not been done specifically for the student population, albeit they have been used several times within this population.²⁶⁻³⁰ Higher HC-PAIRS scores indicate stronger beliefs that chronic LBP justifies disability and activity limitations, which are not aligned with current clinical practice guidelines.²⁹ Consequently, a reduction in the scores of healthcare providers and students indicates a transition towards more guideline-concordant beliefs regarding LBP management.

The PPOS was developed by Krupat *et al.*¹⁹ to measure respondents' attitudes toward the doctor-patient relationship. The PPOS scores range from 1 to 6, with a higher score indicating a more patient-centered approach and lower scores suggesting a more doctor-centered approach. The scale comprises 18 equally distributed items across two dimensions: "Sharing" and "Caring." "Sharing" assesses the respondent's belief in the importance of shared decision-making, where doctors and patients are equals in the healthcare relationship. "Caring" evaluates the extent to which the respondent believes a patient's ideas, concerns, expectations, life circumstances, and overall biopsychosocial model of health should influence care. A score of 5 or higher on the PPOS indicates a patient-centered approach, while a score of lower than 5 suggests a doctor-centered orientation.

Each item on the PPOS is a statement (e.g., "The doctor is the one who should decide what is talked about during a visit"), with responses ranging from "strongly agree" to "strongly disagree," assigned numeric values from 1 to 6. For 15 items, "strongly agree" is assigned a 1, with reversed scoring for the remaining three items. The PPOS has demonstrated satisfactory internal consistency among healthcare providers (Cronbach's $\alpha = 0.73$).²⁰ The study by Shaw *et al.*³¹ supports the instrument's validity,

revealing that practitioners with a greater emphasis on patient-centered approaches were more prone to focus on lifestyle issues, engage in rapport building, and place less emphasis on strictly biomedical matters during patient encounters.

Secondary measures

With the development of the MAINTAIN instrument, which emphasizes the psychological characteristics of patients in LBP management, this study examined the impact of transformative educational interventions using surrogate measures. Specifically, we assessed the number of patients each student successfully enrolled into a separate clinical research study utilizing the MAINTAIN instrument as the outcome measure.

Sample size justification

The sample size was based on cluster randomization with HC-PAIRS as the continuous outcome measure. A minimum detectable difference between groups of 0.5, with an SD of 0.6, was used, drawing from prior educational interventions that used HC-PAIRS as the outcome measure.³²⁻³⁶ Given the absence of a published intraclass correlation coefficient (ICC) that captures the variability within and between clusters for supervising clinicians in chiropractic teaching clinics, an estimation was derived from internal data obtained from a 2020 survey of HC-PAIRS scores. This analysis produced an ICC of 0.02. With an estimated ten students per pod, the study determined a need for five clusters. All pods were offered participation, and all interested participants were enrolled without restricting the smaller sample size to the minimum required.

Randomization

A project manager randomized the supervising clinician/student pods using Excel's randomization formula (Microsoft Corporation, 2018). To ensure allocation concealment, assignments were generated independently and provided to the site's clinical team lead in a sealed format, preventing prior knowledge of group assignments. The clinical team lead, who also served as an investigator, then announced the allocations to the supervising clinicians during a team meeting, with site investigators present to oversee the process and outline the next steps for each group. These measures were implemented to

minimize the risk of bias or influence on group behavior during the allocation process.

In Winter 2022, all clinic students were invited to participate, with enrollment contingent upon informed consent signed. Cluster randomization was employed due to the involvement of multiple students within each pod. Pods served as the unit of randomization, while individual students were the unit of analysis.

Blinding

Only the supervising clinicians of the randomized pods were explicitly informed that the pods were assigned to different groups. They were instructed to communicate only the necessary participation requirements to their students, explaining that this limitation was essential for maintaining study blinding and minimizing potential bias. Although the investigators recognized that students might discuss differences across pod activities, efforts were made to present these as routine clinician-led events rather than study-specific interventions, as described in all informed consent documents. No additional blinding measures were employed.

Data analysis

Descriptive statistics were used to summarize the characteristics of all students who consented to participate. The original analysis plan proposed evaluating outcome changes across multiple follow-up time points using non-parametric, repeated-measures analysis of variance (ANOVA), specifically the Kruskal-Wallis test—at the individual level, and comparing the change from baseline to follow-up between groups. However, due to the low response rate at the second follow-up, the analytical approach was revised to employ a non-parametric, one-way ANOVA to assess between-group differences at a single time point was used, still at the individual level. Although multiple imputation techniques and sensitivity analyses were considered to address the missing data, the extent and pattern of the missingness did not satisfy the assumptions required for data to be considered missing at random. Proceeding with imputation under these conditions risked further bias. Therefore, a between-subjects analytical approach was adopted, fully acknowledging its limitations. All statistical analyses were conducted using STATA 14.2 (StataCorp, College Station, TX, USA).

Results

Figure 1 illustrates student participation, starting with a potential pool of 336 students from the initial invitation to the meager response rate for the second-term follow-up.

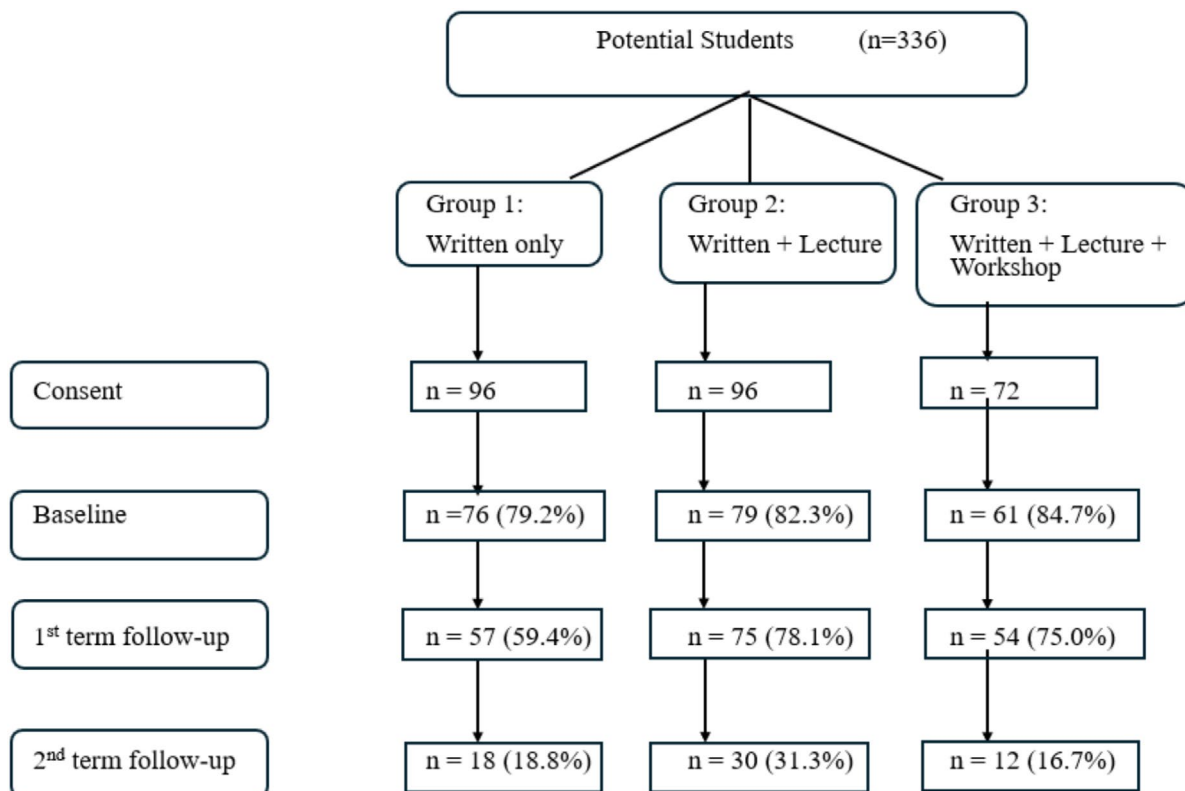


Figure 1.

Flow chart of student participation throughout the study.

Table 1 presents the demographics of the consenting students by group allocation. There was an uneven distribution, with the workshop group (Group 3) having fewer students. Despite this, most students were in their first term in the clinics and had grade point averages (GPA) above 3.2. The outcome measures, baseline HC-PAIRS and PPOS, were balanced across the groups at baseline. (See supplemental table 1 for the baseline findings by responders and non-responders.)

Table 2 displays the mean, SD, and 95% CI for the outcome measures by time point and group, revealing no statistically significant differences within groups across the time points for either of the primary outcomes. Between-group comparisons were not statistically significant at most time point ($p=0.078-0.090$, first follow-up;

$p=0.061-0.087$, second follow-up), except for the PPOS in Group 1 shifted to a more doctor-centered approach ($p=0.024$) by the second term follow-up; however, this change was only by a tenth of a point, suggesting it is unlikely to be clinically meaningful.

Discussion

Our study assessed the effectiveness of MAINTAIN instrument-informed educational interventions on DC students' attitudes toward LBP and patient-centered care. Despite previous studies demonstrating the effectiveness of educational interventions in shaping enhance health-care provider attitudes- particularly when rooted in transformative learning theory^{8,37,38} our findings revealed no significant improvement in students' attitudes toward

Table 1.
The demographics of consenting students by term and the surrogate outcome measure.

	Written Only Group 1 (n=96/118)	Lecture Group 2 (n=96/108)	Workshop Group 3 (n=72/90)	Total (n=264/316)
Response Rate, %	81.3%	88.9%	80.0%	83.5%
GPA, mean (SD)	3.28 (0.570)	3.33 (0.355)	3.22 (0.538)	3.28 (0.471)
Term, n (%)				
8	74 (77.1%)	80 (83.3%)	37 (51.4%)	191 (72.4%)
9	22 (22.9%)	15 (15.6%)	35 (48.6%)	72 (27.3%)
10	0 (0%)	1 (1.0%)	0 (0%)	1 (0.4%)
Sex, Female	48 (50.5%)	41 (42.7%)	29 (40.3%)	118 (44.7%)
Education, Bachelors or higher	88 (91.7%)	89 (90.8%)	73 (92.4%)	250 (91.6%)
HC-PAIRS, mean (SD)	56.9 (10.29)	57.7 (10.72)	58.6 (9.13)	57.5 (9.99)
PPOS, mean (SD)	3.9 (0.57)	3.9 (0.48)	3.9 (0.55)	3.9 (0.53)
Enrolled Patients (surrogate measure)	9	20	7	36

*- GPA- Grade Point Average, 4.0 scale; Term- 10 total terms in 3.4 years

Table 2.
Outcome measures by groups with complete outcome measures, mean (SD) (95% CI).

	Baseline	1 st Term Follow-up	2 nd Term Follow-up
Group 1: MAINTAIN Instrument Only			
HC-PAIRS	56.9 (10.29) (54.74, 59.15)	58.0 (8.56) (55.64, 60.36)	63.9 (12.76) (56.49, 71.23)
PPOS	3.9 (0.57) (3.78, 4.04)	3.8 (0.55) (3.66, 4.02)	3.8 (0.81) (3.19, 4.34)
Group 2: Instrument + Focused-Lecture			
HC-PAIRS	57.7 (10.72) (55.42, 59.91)	58.4 (11.75) (55.49, 61.22)	55.19 (13.65) (49.68, 60.71)
PPOS	3.9 (0.48) (3.79, 4.01)	3.9 (0.53) (3.79, 4.08)	3.7 (0.83) (3.35, 4.04)
Group 3: Instrument + Lecture + In-depth Workshop Series			
HC-PAIRS	58.6 (9.13) (56.38, 60.91)	57.9 (9.20) (55.27, 60.45)	69.6 (8.12) (62.83, 76.42)
PPOS	3.9 (0.55) (3.75, 4.04)	3.9 (0.59) (3.74, 4.09)	3.8 (0.46) (3.38, 4.24)

patient-centeredness or beliefs about back pain following educational training sessions. Various elements may have contributed to this result, including the study's focus attitudinal change rather than practical application, the prevailing research culture within the clinical settings, the novelty of the educational content, and the potential influence of student burnout.

A clearer alignment between the educational interventions and the chosen outcome measures was established by applying Mezirow's transformative learning theory as a guiding framework.⁸ This model emphasizes the role of reflection and critical analysis in reshaping attitudes and behaviors. Within this context, the MAINTAIN instrument was introduced not merely as a clinical tool, but as a pedagogical vehicle to help students better understand the biopsychosocial aspects of LBP. Theoretically, using MAINTAIN was expected to promote more nuanced, patient-centered decision-making by reinforcing individualization of care plans based on psychological risk factors—outcomes measured respectively by the PPOS and the HC-PAIRS. Specifically, exposure to MAINTAIN was intended to reduce maladaptive beliefs about chronic pain and disability (targeting HC-PAIRS scores) and to cultivate attitudes aligned with patient-centered care, such as shared decision-making and clinical empathy (captured by the PPOS). However, study findings did not support this hypothesis, possibly due to the brief duration and implementation context, which may not have allowed for sufficient integration of these concepts into students' attitudes.

Although this study aimed to measure attitudinal change, it may have been more effective to frame the research questions around the implementation of the MAINTAIN instrument.²² Implementation science highlights the importance of systematically identifying contextual, behavioral, and environmental factors that influence whether a new practice is successfully adopted.³⁹ Mediating variables such as student engagement, perceived relevance of the training, clinician mentorship, understanding of the MAINTAIN framework, and burnout may have obscured the impact of the intervention on attitudes. Future studies should consider these variables explicitly, as a well-formulated research question-grounded in implementation theory and guided by methodologically sound design-is critical to extracting actionable insights.⁴⁰

Contextual and participant-related factors are essen-

tial considerations in educational research. While evidence-based practice has become central to healthcare education, many programs still rely heavily on classroom instruction rather than embedding these principles within clinical environments.^{41,42} Supervising clinicians play an essential role in reinforcing these concepts in practice and supporting students' research engagement.⁴³ However, within the demanding environments of teaching clinics, the research component of this study may have been perceived as an additional burden. This perception likely contributed to the low participation and diminished follow-up response rates.

Moreover, while the MAINTAIN instrument offers innovative application of maintenance care evidence, other tools, such as the Keele STarT Back Screening Tool, may have been more familiar and readily accepted within chiropractic educational settings.⁴⁴ While studies using this tool have not directly measured provider attitudes, some suggested these tools offer time-efficient, structured insights into patient risk profiles, which can improve compliance with clinical practice guidelines.⁴⁵ Greater familiarity and broader evidence support may have increased student engagement and intervention uptake.

Student burnout represents another critical barrier. Recent findings from one participating institution highlight elevated levels of emotional exhaustion and cynicism beginning in the 8th academic term—precisely when this study took place.^{46,48} These emotional burdens may have compromised students' openness to reflection, engagement with content, and attitudinal shifts central to transformative learning.

Additionally, while most chiropractic institutions utilize patient-reported outcome measures, few incorporate tools that detect psychosocial influences, such as the MAINTAIN instrument.⁴⁹ As a result, this novel intervention may have been perceived as extra work rather than a meaningful addition to clinical training, further reducing the likelihood of positive attitudinal change and impacting follow-up engagement.

Also of note are the baseline scores for the outcome measures, both of which have been the focus of recent studies aiming to benchmark current results against contemporary standards.^{30,50} Specifically, for the HC-PAIRS scale—where lower scores reflect stronger alignment with best practices—previous research reported average scores of 56.54 for healthcare students and 51.67

for practicing chiropractors. In comparison, the baseline average in this study was 57.5, which, while higher, still falls within the 95% confidence intervals reported in this prior study.³⁰ For the PPOS, which assesses patient-centered attitudes (with higher scores indicating greater patient-centeredness), previous evaluations across various chiropractic training programs found an average score of 4.18, compared to 3.9 in the current study. Although both outcome measure scores fall within reported ranges, these findings suggest that participating students in this study demonstrated baseline attitudes that were slightly further from the desired direction than typically observed in similar cohorts.

While the study did not yield the anticipated changes in the outcome measures, it valuable insights to inform future educational research in chiropractic and other clinical disciplines. The low follow-up response rate—a major limitation—likely reflects the combined factors of contextual constraints, intervention novelty, and burnout. Simplifying the study design to two groups rather than three may have improved power and clarity, through the current approach sought to reflect real-world educational variability. Finally, while students were not informed of their assigned intervention group, peer discussions may have unintentionally introduced performance bias. Important reminder, this study was performed at two chiropractic teaching clinics, therefore results may not be generalizable to other chiropractic teaching clinics or students of other clinical professions.

Conclusion

This study found that educational interventions aimed at introducing a new instrument to assess patients' psychological characteristics did not impact the DC students' attitudes toward LBP and patient-centered care. Since these attitudes are believed to influence patient care, it remains essential to integrate such training into clinical education. Future research endeavors should prioritize the development of implementation strategies and ensure that studies are conducted within environments that promote a supportive research culture.

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Supplemental Table 1
Demographics by responders and non-responders to the 2nd follow-up.

	Total (n=264/316)	2 nd Follow-Up Responder (n=60)	2 nd Follow-Up Non-Responders (n=204)
GPA, mean (SD)	3.28 (0.471)	3.31 (0.382)	3.27 (0.449)
Sex, Female	118 (44.7%)	24 (46.2%)	92 (45.3%)
Education, Bachelors or higher	250 (91.6%)	45 (84.9%)	191 (93.8%)
HC-PAIRS, mean (SD)	57.5 (9.99)	57.2 (9.825)	57.7 (10.639)
PPOS, mean (SD)	3.9 (0.53)	3.9 (0.755)	3.9 (0.468)

*- GPA- Grade Point Average, 4.0 scale