

# Pain Knowledge, Attitudes, and Beliefs Among Final-Year Physiotherapy and Occupational Therapy Students in Jordan: A Cross-Sectional Study

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**Background:** Despite the global burden of chronic pain, gaps in pain education persist in healthcare programs. This study evaluated pain knowledge, attitudes, and beliefs among final-year physiotherapy (PT) and occupational therapy (OT) students in Jordan, compared these competencies between disciplines, examined the relationship between pain knowledge and beliefs, and explored significant predictors of pain knowledge.

**Methods:** A descriptive, cross-sectional study was conducted using an online survey of final-year PT and OT students from three public universities in Jordan. Pain knowledge was assessed using the Revised Neurophysiology of Pain Questionnaire (RNPQ), and attitudes and beliefs toward pain and disability were measured with the modified Health Care Providers' Pain and Impairment Relationship Scale (HC-PAIRS). Students also reported perceived sources of pain knowledge. Data analysis involved non-parametric tests for group comparisons, Spearman correlations to assess the RNPQ-HC-PAIRS association, and multiple linear regression to identify predictors of RNPQ scores.

**Results:** A total of 216 students completed the survey (PT: n=149; OT: n=67). PT students demonstrated higher RNPQ scores and lower HC-PAIRS scores than OT students (both  $p < 0.001$ ), indicating a better understanding of pain neurophysiology and more adaptive pain beliefs. Across the total sample, RNPQ and HC-PAIRS scores were inversely correlated ( $\rho = -0.334$ ,  $p < 0.001$ ). Regression analysis identified discipline (PT vs OT), endorsing university courses as a primary pain knowledge source, and HC-PAIRS scores as significant predictors of RNPQ scores (adjusted  $R^2 = 0.855$ ,  $p < 0.001$ ). A significant interaction showed that PT students derived greater pain knowledge gains from university courses than OT students.

**Conclusion:** Final-year PT and OT students in Jordan exhibited limited pain knowledge and persistent biomedical beliefs, with PT students outperforming OT students. University courses were the strongest predictor of pain knowledge, underscoring the need for integrating evidence-based pain curricula with a biopsychosocial focus in both disciplines.

**Plain Language Summary:** Chronic pain is a common problem worldwide. Future health care providers such as physiotherapists and occupational therapists need to have a sound understanding of modern pain concepts to provide care to people with pain. A key point is that pain is affected by our body, mind, and surroundings, not just tissue injury.

In our study, we surveyed 216 physiotherapy and occupational therapy students in their final year of training in Jordan. We also assessed their pain knowledge and attitudes and beliefs when caring for people with chronic pain.

We found that physiotherapy students had better knowledge and more positive beliefs about pain than occupational therapy students. We also found that students who viewed their university courses as a main source of pain knowledge tended to have higher scores on pain knowledge assessment. This connection was strongest for physiotherapy students.

Our findings show a clear opportunity to better prepare future health professionals for modern pain care by updating pain education curricula, especially occupational therapy programs. Improving pain education now will eventually lead to more effective and empathetic care in future.

**Keywords:** pain neuroscience education, biopsychosocial model, curricular assessment, health professional students

## Introduction

Pain is one of the most common reasons patients seek healthcare globally.<sup>1,2</sup> When pain persists or recurs beyond 3 months, it is classified as chronic.<sup>3</sup> Chronic pain represents a significant global burden, affecting between 20% and 50% of the world's population,<sup>4,5</sup> and is a leading cause of disability and reduced quality of life.<sup>6,7</sup> Low back pain remains one of the top contributors to years lived with disability (YLDs) worldwide,<sup>8,9</sup> with a significant proportion of cases progressing to chronicity through dynamic biopsychosocial mechanisms.<sup>10,11</sup>

This understanding has driven a global shift towards a biopsychosocial model of pain,<sup>12</sup> integrating patient-centered, multidisciplinary, and psychosocially informed care.<sup>13,14</sup> Nevertheless, biomedical beliefs and limited knowledge of modern pain science persist among health professionals<sup>15</sup> and students.<sup>16</sup> These biomedical beliefs may negatively influence clinical decisions, reduce adherence to evidence-based treatment guidelines, and reinforce maladaptive pain beliefs among patients, ultimately contributing to greater disability and poorer outcomes.<sup>17–19</sup>

In this setting, two interrelated competencies are essential: knowledge of pain neurophysiology and beliefs toward pain-related function and disability. Collectively, these factors influence clinical decisions and behaviors and may be modified through educational interventions, although their effect on clinical behaviors is unclear.<sup>19,20</sup> Despite growing consensus on the need for standardized, evidence-based pain education, most undergraduate curricula remain misaligned with the International Association for the Study of Pain (IASP) guidelines.<sup>21,22</sup> This gap impedes implementation of biopsychosocial care, and thus, demands targeted interventions.

Pain neuroscience education (PNE) has demonstrated efficacy in improving pain knowledge and modifying maladaptive beliefs among students, clinicians and patients.<sup>23–27</sup> Integrating PNE within IASP-aligned undergraduate curricula and biopsychosocial frameworks may enhance students' clinical competencies in contemporary pain management.<sup>28</sup>

While evidence is growing in high-income countries,<sup>20</sup> limited data exist on pain knowledge and beliefs among physiotherapy (PT) and occupational therapy (OT) students in the Arab region. In Saudi Arabia, for example, a study identified a significant pain knowledge gap in PT programs, indicating a need for curriculum reform.<sup>16</sup> Despite cultural and educational similarities with neighboring Arab countries, no comparable investigations into pain education have been conducted in Jordan. Furthermore, since 1999, three leading public Jordanian universities: The Hashemite University (HU), The University of Jordan (JU), and Jordan University of Science and Technology (JUST), have offered physiotherapy and occupational therapy programs, making this context particularly relevant.<sup>29</sup>

To our knowledge, no prior studies in Jordan have assessed pain knowledge and beliefs among final-year PT and OT students. Specifically, this study aimed to: (1) assess students' pain neurophysiology knowledge and attitudes toward pain-related disability using validated questionnaires; (2) examine the relationship between pain knowledge and beliefs; and (3) evaluate whether a priori candidate predictors (demographic factors, pain-related beliefs, and agreement with educational sources) were associated with pain knowledge. By establishing baseline data on pain knowledge and beliefs, this study provides a benchmark to guide curriculum development, support the integration of evidence-based pain neuroscience education, and encourage alignment with IASP guidelines.

## Materials and Methods

### Study Design and Setting

This descriptive, cross-sectional study was conducted using an online survey between February and June 2023 to evaluate the knowledge of pain neurophysiology among final year physiotherapy (PT) and occupational (OT) students enrolled at three major public universities in Jordan.

### Ethics

Ethical approval was granted by the Institutional Review Board of The Hashemite University (HU-IRB No. 29/9/2021/2022) prior to study commencement. This approval covered recruitment at the three participating universities; institutional acknowledgment and support were obtained at each site. The survey was conducted anonymously online, and electronic informed consent was obtained from all students before participation. Students were assured that their responses would remain confidential, would not affect their academic standing or grades, and that participation was entirely voluntary. All data were anonymized, and the study adhered to the principles of the Declaration of Helsinki.

### Participants

All final year Bachelor of Science (BSc) pre-registration PT and OT students from three major public Jordanian Universities were invited to participate. Inclusion required (1) active enrollment in the final year of a PT or OT program and (2) the ability to provide informed consent. Exclusion criteria were: enrollment in earlier academic years, current internship or graduation status, or being on academic leave at the time of data collection. An invitation letter, including study key information and a secure, anonymous Google Forms survey link, was distributed via social media platforms (WhatsApp and Facebook groups). After completing the electronic informed consent, students proceeded to complete the online questionnaires, which required an estimated 15 minutes to complete.

For multiple linear regression with 12 candidate predictors, sample size guidelines recommend a minimum of  $N \geq 116$  to test the overall model  $R^2$  and  $N \geq 146$  to adequately estimate individual predictors.<sup>30</sup> The final analyzed sample of  $N = 216$  exceeded these thresholds, supporting the stability and adequacy of the regression analyses.

### Questionnaires

The survey was administered in English, as this is the medium of instruction in PT and OT programs in Jordan. It comprised a brief demographic questionnaire (gender, age, university, and discipline) and three other questionnaires as follows:

#### The Revised Neurophysiology of Pain Questionnaire (RNPQ)

The Revised Neurophysiology of Pain Questionnaire (RNPQ) is a validated 12-item instrument used to assess pain neurophysiological knowledge.<sup>31</sup> The RNPQ consists of 12 closed-ended questions (true, false, undecided). Scoring for the RNPQ follows a binary system, where only correct responses receive 1 point, while incorrect or undecided responses scored as 0. The maximum possible score for the RNPQ is 12, with higher scores reflecting better understanding of pain neurophysiology.

The RNPQ was developed from the original Neurophysiology of Pain Questionnaire (NPQ) by Moseley.<sup>32</sup> The RNPQ demonstrates robust psychometric properties. It shows excellent test-retest reliability (ICC=0.97; 95% CI, 0.93–0.99) and good internal consistency (Cronbach's  $\alpha = 0.84$ ).<sup>31</sup> These features support the validity of the RNPQ for evaluating understanding of pain neurophysiology in health professional populations.

#### The 13-Item Modified Health Care Providers Pain and Impairment Relationship Scale (HC-PAIRS)

The modified Health Care Providers Pain and Impairment Relationship Scale (HC-PAIRS) was used to assess students' attitudes and beliefs towards individuals with chronic pain and their ability to function despite pain.<sup>33</sup> It has 13 items rated on a 7-point Likert scale (strongly disagree=1; strongly agree=7). Total scores range from 13 to 91, with lower scores indicating more positive attitudes towards patients with chronic pain. HC-PAIRS has shown strong psychometric properties, including excellent internal consistency (Cronbach's  $\alpha = 0.92$ ) and good test-retest reliability (ICC=0.84; 95% CI, 0.78–0.89).<sup>34</sup>

## Assessment of Pain Neurophysiology Knowledge Sources

To assess pain knowledge sources, a research team-developed tool was used, grounded in the pain education literature.<sup>16,35</sup> Students were asked to rate their level of agreement with five statements using a 5-point Likert scale (1=Strongly Disagree, 5=Strongly Agree). Each statement started with: “The majority of my pain neurophysiology knowledge came from...” followed by one of the five source categories: university courses, clinical training, internet (eg, podcasts, YouTube), self-study (eg books, journals), and other (workshops, peer discussion, conference talk). Further, students were asked to identify one source they considered their main source of pain knowledge by selecting just one. These items were developed specifically for this study and reviewed internally for content relevance. However, they have not undergone formal psychometric validation.

## Data Quality Control Procedures

Data were screened using prespecified quality-control procedures. Duplicates, identified by identical timestamps and response patterns, were removed. To identify low-quality responses, we implemented a multi-step protocol: questionnaires with >10% missing data were excluded; page-time tracking was used to flag responses with improbably short completion times (<5th percentile); and attention was assessed through both patterned responding (eg, invariant selections) and embedded attention-check items. Entries failing these quality criteria were excluded. Only complete, valid cases were retained for analysis.

## Statistical Analysis

Data were analyzed using Stata/SE (version 17, StataCorp LLC). For all analyses, two-sided tests with  $p < 0.05$  were considered statistically significant. Continuous variables were evaluated for normality using Shapiro–Wilk tests and graphical review.

Descriptive statistics were based on frequency distributions and percentages for categorical data (gender, discipline (PT vs OT), university affiliation (HU, JU, JUST), and main source of pain knowledge) and means and standard deviations (SD) or medians and interquartile ranges (IQR) for continuous/non-normally distributed (age, RNPQ, HC-PAIRS) or ordinal variables (Likert-type agreement variables).

Between-group comparisons included  $\chi^2$  and Fisher exact tests for categorical comparisons, and nonparametric tests (Mann–Whitney U, Kruskal–Wallis H) for non-normally distributed or ordinal outcomes. Effect sizes ( $r$ ) were reported where applicable.

To assess the relationships between RNPQ and HC-PAIRS, Spearman’s rank correlation coefficients ( $\rho$ ) were calculated for the total sample and stratified by discipline. The strength of the correlations was interpreted according to the guidelines defined by Mukaka.<sup>36</sup>

(negligible,  $0.00 \leq \rho < 0.30$ ; low,  $0.30 \leq \rho < 0.50$ ; moderate,  $0.50 \leq \rho < 0.70$ ; high,  $0.70 \leq \rho < 0.90$ ; very high,  $0.90 \leq \rho < 1.00$ ).

To determine predictors of RNPQ, multiple linear regression was used with RNPQ as the dependent variable. Based on theoretical relevance and prior literature,<sup>16,35</sup> the following predictors (independent variables) were included in the model: five 5-point Likert-type items reflecting perceived agreement with sources of knowledge (university courses, clinical training, internet, self-study, other), HC-PAIRS, demographic and institutional variables (age, gender, discipline, university affiliation). Categorical variables (gender, discipline, university) were dummy coded before modeling with the following reference groups: female (Gender), OT (Discipline), HU (University).

An initial model was fitted with all candidate predictors. A backward elimination approach was then applied to derive a parsimonious model while retaining theoretically meaningful variables. This was done by iteratively removing the independent variable with the largest  $p$ -value  $> 0.05$ . After identification of the final main effects model, an interaction term between discipline and agreement with university courses (discipline  $\times$  university courses) was added to test for potential effect modification. Model fit was assessed using the coefficient of determination ( $R^2$ )/adjusted  $R^2$ ,  $F$ -statistic and its corresponding  $p$ -value.

All regression models were estimated using Ordinary Least Squares (OLS) regression with HC3 heteroskedasticity-consistent (robust) standard errors (SEs). Coefficient tests used robust two-sided  $t$  statistics (coefficient/SE) with the model’s residual degrees of freedom. Regression assumptions (linearity, homoscedasticity, normality of residuals, and

multicollinearity) were assessed via visual inspection of residual plots, normal Q–Q plots, and Variance Inflation Factors (VIFs) scores.

## Results

There were 277 respondents from the 3 universities. Following data quality screening and removal of duplicate or incomplete entries, 216 complete questionnaires were retained and included in the analysis. This represents a 36% response rate from the eligible population (N=600), as reported by faculty collaborators affiliated with the participating universities. Characteristics of all participants are summarized in Table 1.

### Demographics

Final year PT students represented the majority of the sample (n=149, 68.98%). While the overall sample was dominated by females (n=132, 61.11%), there was no statistically significant difference in gender distribution between PT and OT students (p=0.283). Both student groups demonstrated no significant difference (p=0.456) in age, with median age of 22.0 years (IQR = 21.0–23.0) reported for the whole sample.

There was a relatively balanced university affiliation across the three institutions (HU, JU, JUST) for the overall sample (p=0.056). Although this result was not statistically significant, a higher proportion of OT students were from JUST (50.75%). However, PT students showed a more even distribution across the three universities (JUST: 33.56%, HU: 32.89%, JU: 33.56%).

As shown in Figure 1, PT and OT students identified similar distributions of main pain knowledge sources (p=0.898), with university courses (37.50%) being the most frequently reported source for the whole sample, followed by clinical training (23.61%) and the internet (15.14%). While both groups reported university courses as the predominant source of pain knowledge (PT: 39.60%, OT: 32.84%), they less frequently reported self-study and “other”.

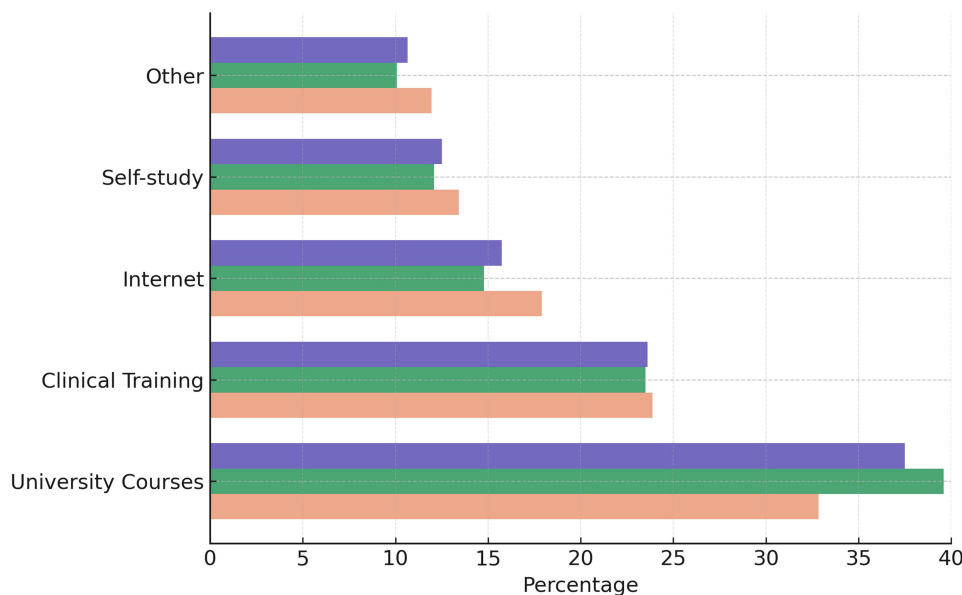
### Between-Group Differences

There were significantly higher RNPQ scores reported for PT students (Median = 8.0, IQR = 7.0–8.0) compared to OT students (Median = 6.0, IQR = 6.0–7.0), with a large effect size (r)=0.66, p<0.001. In addition, HC-PAIRS scores were significantly lower for PT students (Median = 45.0, IQR = 38.0–52.0) than OT students (median=57.0, IQR=49.0–60.0), with a moderate effect size (r=0.42, p<0.001). This indicates more positive attitudes towards pain among PT students (Table 2).

**Table 1** Descriptive Characteristics of the Sample by Discipline

Demographic	Sample N = 216	PT Students n = 149 (68.98%)	OT Students n = 67 (31.02%)	p
<b>Gender, n (%)</b>				
F	132 (61.11)	87 (58.39%)	45 (67.16%)	0.283
M	84 (38.89)	62 (41.61%)	22 (32.84%)	
<b>Age, years (Median, IQR)</b>	22 (21–23)	22 (21–23)	22 (21–23)	0.456
<b>University, n (%)</b>				
JUST	84 (38.88%)	50 (33.56%)	34 (50.75%)	0.056
HU	66 (30.56%)	49 (32.89%)	17 (25.37%)	
JU	66 (30.56%)	50 (33.56%)	16 (23.88%)	

**Abbreviations:** F, Female; M, Male; JUST, Jordan University of Science and Technology; HU, The Hashemite University; JU, The University of Jordan; IQR, Interquartile Range; PT, Physiotherapy; OT, Occupational Therapy.



**Figure 1** Main sources of pain neurophysiology knowledge (%) by discipline. Purple bars represent the whole sample, green bars represent physiotherapy (PT) students, and peach bars represent occupational therapy (OT) students.

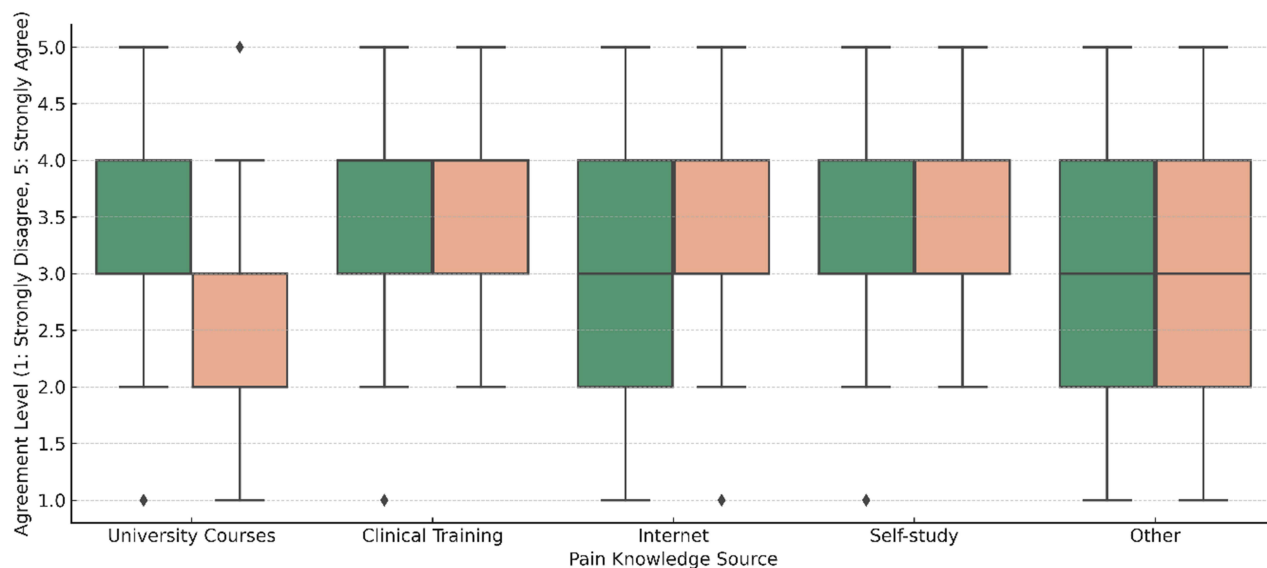
Levels of agreement with different sources of pain knowledge are illustrated in Table 2. There was only a significant between-group difference found for university courses, where PT students showed higher agreement scores (Median = 3.0, IQR = 3.0–4.0), than OT students (Median = 2.0, IQR = 2.0–3.0), with a moderate effect size ( $r=0.51$ ),  $p<0.001$ . No between-group differences in agreement level scores were reported with other sources of pain ( $p>0.05$ ). These between-group differences are further reinforced in boxplots (Figure 2), where the most evident gap is shown for university courses ( $p<0.001$ ) as opposed to all other sources across disciplines ( $p>0.05$ ). There were no statistical differences between universities in RNPQ ( $p=0.516$ ), HC-PAIRS ( $p=0.380$ ), or agreement with different sources of pain knowledge ( $p>0.05$ ) (Table 3).

**Table 2** Between-Group Comparison of RNPQ, HC-PAIRS, and Agreement with Pain Knowledge Sources

Variable	Sample	PT	OT	Mann-Whitney U	p	Effect Size (r)
<b>RNPQ</b>	7.0 (7.0–8.0)	8.0 (7.0–8.0)	6.0 (6.0–7.0)	8947.0	<b>&lt;0.001</b>	0.66
<b>HC-PAIRS</b>	48.0 (40–56)	45.0 (38.0–52.0)	57.0 (49.0–60.0)	2388.5	<b>&lt;0.001</b>	0.42
<b>Agreement with Sources</b>						
University Courses	3.0 (2.0–4.0)	3.0 (3.0–4.0)	2.0 (2.0–3.0)	8011.5	<b>&lt;0.001</b>	0.51
Clinical Training	4.0 (3.0–4.0)	4.0 (3.0–4.0)	4.0 (3.0–4.0)	4943.5	0.906	0.01
Internet	3.0 (2.0–4.0)	3.0 (2.0–4.0)	3.0 (3.0–4.0)	4306.0	0.093	0.11
Self-study	3.0 (3.0–4.0)	3.0 (3.0–4.0)	3.0 (3.0–4.0)	4423.5	0.158	0.10
Other	3.0 (2.0–4.0)	3.0 (2.0–4.0)	3.0 (2.0–3.0)	5201.0	0.608	0.03

**Notes:** Values are median (IQR) unless stated. Bold p-values indicate  $p < 0.05$ .

**Abbreviations:** RNPQ, Revised Neurophysiology of Pain Questionnaire; HC-PAIRS, Health Care Providers' Pain and Impairment Relationship Scale; IQR, Interquartile Range.



**Figure 2** Agreement with different sources of pain knowledge by discipline (Likert scale 1–5). Boxplots display median and interquartile range (IQR). Green represents physiotherapy (PT) students and peach represents occupational therapy (OT) students.

### The Correlation Between RNPQ and HC-PAIRS

The correlations between RNPQ and HC-PAIRS assessed by Spearman’s rank correlation are presented in Table 4. The overall sample showed a statistically significant weak correlation between RNPQ and HC-PAIRS ( $\rho = -0.334$ , 95% CI= $-0.448, -0.208$ ,  $p < 0.001$ ), indicating that better understanding of pain neurophysiology was associated with a more positive attitude towards pain. In contrast, there was no significant correlation in RNPQ and HC-PAIRS within PT ( $\rho = -0.067$ ,  $p = 0.416$ ) or within OT ( $\rho = -0.228$ ,  $p = 0.064$ ). The lack of statistically significant subgroup correlations may be due to limited statistical power, and these findings should therefore be interpreted with caution.

A LOWESS (Locally Weighted Scatterplot Smoothing) scatterplot was created to visually assess the relationship between RNPQ and HC-PAIRS scores for the total sample (Figure 3). Overall, the LOWESS line demonstrated a non-linear mainly negative association between RNPQ and HC-PAIRS scores, with a more noticeable drop in RNPQ scores as HC-PAIRS scores increased beyond the midpoint, supporting the negative correlation observed for the total sample.

**Table 3** University-Level Comparisons of RNPQ, HC-PAIRS, and Agreement with Pain Knowledge Sources

Variable	JUST	HU	JU	Kruskal–Wallis H	P
RNPQ	7.0 (6.0–8.0)	7.0 (7.0–8.0)	8.0 (7.0–8.0)	1.32	0.516
HC-PAIRS	49.0 (40.0–58.0)	46.5 (40.0–54.75)	49.0 (42.0–54.0)	1.94	0.380
<b>Agreement with Sources</b>					
University Courses	3.0 (2.0–4.0)	3.0 (2.0–4.0)	3.0 (3.0–4.0)	3.13	0.209
Clinical Training	4.0 (3.0–4.0)	4.0 (3.0–4.0)	4.0 (3.0–4.0)	0.35	0.840
Internet	3.0 (3.0–4.0)	3.0 (2.0–4.0)	3.0 (2.0–4.0)	0.59	0.734
Self-study	3.5 (3.0–4.0)	3.0 (3.0–4.0)	3.0 (3.0–4.0)	3.29	0.193
Other	3.0 (2.0–4.0)	3.0 (3.0–4.0)	3.0 (2.0–4.0)	0.75	0.688

**Note:** Values are median (IQR) unless stated.

**Abbreviations:** RNPQ, Revised Neurophysiology of Pain Questionnaire; HC-PAIRS, Health Care Providers’ Pain and Impairment Relationship Scale; JUST, Jordan University of Science and Technology; HU, The Hashemite University; JU, The University of Jordan; IQR, interquartile range.

**Table 4** Correlations Between the RNPQ and HC-PAIRS by Student Group

Group	Spearman $\rho$	95% CI	p
Sample	-0.334	-0.448, -0.208	<b>&lt;0.001</b>
PT Students	-0.067	-0.227, 0.095	0.416
OT Students	-0.228	-0.453, 0.018	0.064

**Note:** Bold values indicate  $p < 0.05$ .

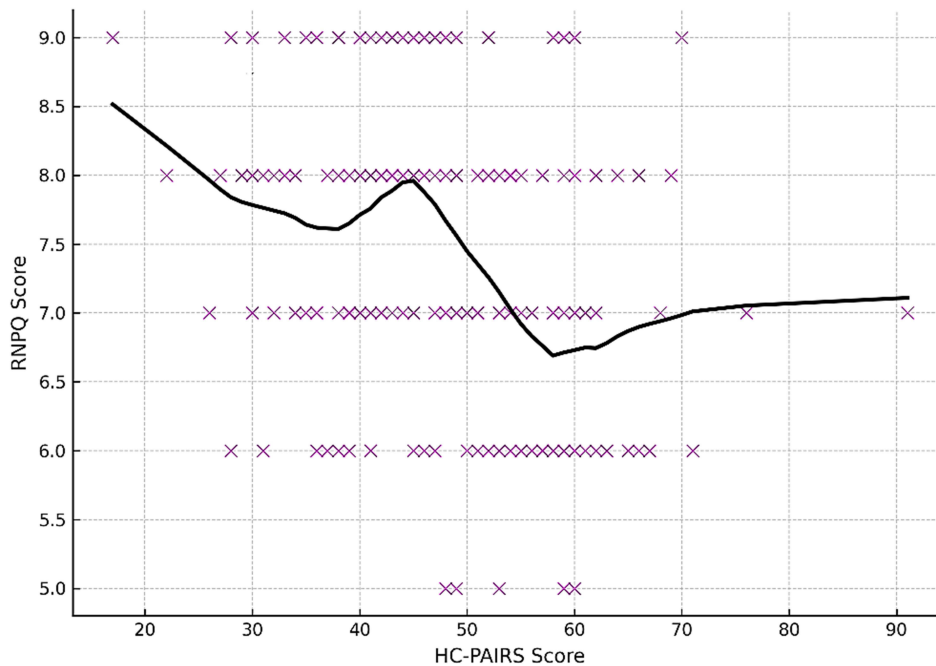
**Abbreviations:** RNPQ, Revised Neurophysiology of Pain Questionnaire; HC-PAIRS, Health Care Providers' Pain and Impairment Relationship Scale; CI, Confidence interval.

### Regression Modeling

Multiple linear regression (MLR) with backward elimination ( $\alpha = 0.05$ ) was used to build the most parsimonious model. The initial MLR model included all explanatory variables (predictors): age, gender, discipline, university, HC-PAIRS score, and five items reflecting agreement with different knowledge sources, to predict the RNPQ score (ie dependent variable).

The reduced model included three significant predictors ( $p < 0.05$ ): discipline (PT vs OT), agreement with university courses and HC-PAIRS (Table 5). The model demonstrated high predictive power, with 85.5% of the variance in the RNPQ score explained by the predictors (adjusted  $R^2 = 0.855$ ,  $F(3|176) = 363.73$ ,  $p < 0.001$ ). Analyses showed a positive association between agreement with university courses and RNPQ scores ( $B = 0.91$ ,  $p < 0.001$ ), while HC-PAIRS scores demonstrated a negative association ( $B = -0.027$ ,  $p < 0.001$ ). Further, PT students achieved significantly higher scores in RNPQ than OT students ( $B = 0.34$ ,  $p < 0.001$ ).

To assess whether the association between agreement with university courses and RNPQ scores differed by discipline, an interaction term (discipline x university courses) was included (Table 6). The interaction model demonstrated improved model fit (adjusted  $R^2 = 0.865$ ) compared to the reduced model (adjusted  $R^2 = 0.855$ ; Table 7). The analysis demonstrated a statistically significant interaction term ( $B = 0.320$ ,  $p = 0.026$ ), with PT students exhibiting a stronger



**Figure 3** LOWESS scatterplot illustrating the relationship between Health Care Providers' Pain and Impairment Relationship Scale (HC-PAIRS) scores and Revised Neurophysiology of Pain Questionnaire (RNPQ) scores in the total sample. Purple markers represent individual participants, and the solid line represents the locally weighted scatterplot smoothing (LOWESS) trend.

**Table 5** Reduced Regression Model Predicting RNPQ Score

Predictor	B	SE	t	95% CI	p
Intercept	5.780	0.160	36.120	5.470, 6.090	<0.001
Discipline PT (vs OT)	0.340	0.100	3.600	0.160, 0.530	<0.001
University Course*	0.910	0.040	21.990	0.830, 0.990	<0.001
HC-PAIRS	-0.027	0.003	-9.120	-0.033, -0.022	<0.001

**Notes:** Bold p-values indicate  $p < 0.05$ . \*University Courses refers to level of agreement with university teaching as a source of pain knowledge (Likert 1–5).

**Abbreviations:** RNPQ, Revised Neurophysiology of Pain Questionnaire; HC-PAIRS, Health Care Providers' Pain and Impairment Relationship Scale; PT, Physiotherapy; OT, Occupational Therapy; CI, Confidence interval.

**Table 6** Interaction Regression Model Predicting RNPQ Score

Predictor	B	SE	t	95% CI	p
Intercept	6.441	0.397	16.222	5.663, 7.219	<0.001
Discipline PT (vs OT)	-0.502	0.351	-1.430	-1.189, 0.186	0.153
University Courses*	0.677	0.134	5.068	0.415, 0.939	<0.001
PT × University Courses	0.320	0.144	2.223	0.038, 0.601	0.026
HC-PAIRS	-0.030	0.004	-8.361	-0.037, -0.023	<0.001

**Notes:** Bold p-values indicate  $p < 0.05$ . \*University Courses refers to level of agreement with university teaching as a source of pain knowledge (Likert 1–5).

**Abbreviations:** RNPQ, Revised Neurophysiology of Pain Questionnaire; HC-PAIRS, Health Care Providers' Pain and Impairment Relationship Scale; PT, Physiotherapy; OT, Occupational Therapy; CI, Confidence interval.

**Table 7** Model Fit Comparison for Reduced and Interaction Models Predicting RNPQ Score

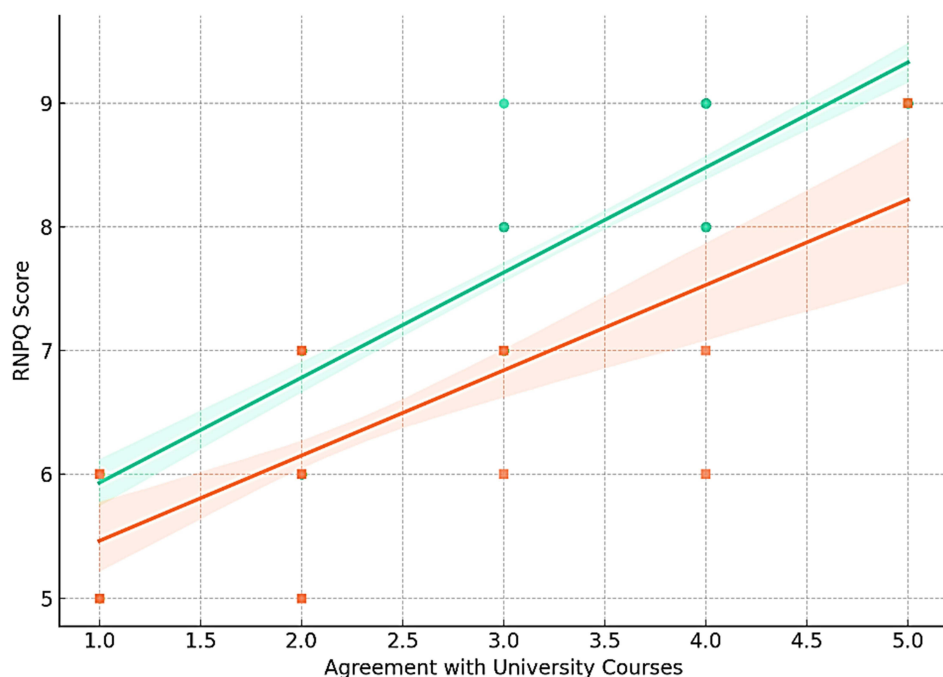
Model	R <sup>2</sup>	Adjusted R <sup>2</sup>	F	p (F)
Reduced	0.857	0.855	363.73	<0.001
Interaction	0.868	0.865	352.35	<0.001

**Note:** Bold p-values indicate  $p < 0.05$ .

**Abbreviations:** R<sup>2</sup>, Coefficient of determination; F, F-statistic.

positive association between agreement with university courses and RNPQ scores than OT students (Figure 4). Further, with the interaction included, the main effect of agreement with university courses and HC-PAIRS scores remained statistically significant ( $p < 0.001$ ). The main effect of discipline was no longer statistically significant ( $p = 0.135$ ), indicating that the discipline differences in RNPQ scores depend on agreement with university courses (ie moderation).

Sensitivity analysis was conducted to evaluate the robustness of the findings by testing a full covariate model (Table S1, Supplementary materials). The full model showed a comparable adjusted R<sup>2</sup> (0.864) to the interaction model and no meaningful change in the magnitude, direction, or significance of the key predictors. These results support the robustness and parsimony of the final interaction model (Table S2, Supplementary materials).



**Figure 4** Interaction plot showing the effect of agreement with university courses on Revised Neurophysiology of Pain Questionnaire (RNPQ) scores by discipline. Lines show model-predicted means with 95% confidence intervals from the interaction model (agreement rated 1–5). The green line represents physiotherapy (PT) students and the peach line represents occupational therapy (OT) students; shaded areas represent 95% confidence intervals.

Diagnostic tests verified model validity. Residuals exhibited no significant violations of normality or homoscedasticity. Variance inflation factors (VIFs) were  $< 2.5$ , ruling out multicollinearity. Full diagnostics are provided in [Figures S1, S2](#) and [Table S3](#) ([Supplementary materials](#)).

## Discussion

This study showed that final-year PT and OT students demonstrated limited to moderate levels of pain neurophysiology knowledge (as measured by RNPQ) and mixed attitudes and beliefs towards pain (as measured by HC-PAIRS). PT students exhibited a better understanding of pain neurophysiology and more positive attitudes towards pain compared to OT students. University courses and clinical training were the most frequently reported sources of pain knowledge. Further, levels of agreement with university courses as a primary source of pain knowledge positively associated with RNPQ scores, whereas higher HC-PAIRS scores (reflecting more maladaptive beliefs about pain and disability) negatively associated with lower RNPQ scores. The association between the agreement with university courses and RNPQ was stronger for PT students than OT students.

This study identified a significant difference in pain neurophysiology knowledge between final year PT students and their OT counterparts. This is evident by a higher RNPQ score of 8.0 (IQR: 7.0–8.0; 66.7%) for PT students than 6.0 (IQR: 6.0–7.0; 50%) for OT students. This represents a gap of 16.7 percentage points, resembling research findings from Mukoka et al,<sup>37</sup> who reported a mean RNPQ scores of 58.08% and 43.42%, for South African PT and OT students, respectively. Similarly, Mankelov et al<sup>35</sup> showed that international PT students surpassed OT students (75.8% vs 53.3%) on RNPQ. This disparity likely stems from structural discrepancies in curriculum design between the programs, particularly a greater emphasis on pain education in PT curricula. In support of this notion, Briggs et al<sup>21</sup> demonstrated that PT curricula dedicated more formal teaching hours and more structured pain content than OT or medical curricula. This likely explains the superior pain related knowledge observed among PT students in our study.

Internationally, Jordanian PT students demonstrated a higher median RNPQ score 8 (IQR: 7.0–8.0; 66.7%) than that reported for Saudi qualified PTs (55.8%),<sup>38</sup> South African PT students (58.1%),<sup>37</sup> Japanese PT students (54.2%),<sup>39</sup> and Portuguese PT students (62.5%).<sup>40</sup> However, the RNPQ score for Jordanian PT students is slightly lower than that

reported for Spanish PT students (68.9%)<sup>41</sup> and well below baseline RNPQ scores for US-Doctor of Physical Therapy (DPT) students (76.9%) prior to pain neuroscience education intervention.<sup>42</sup> These comparisons suggest that final-year status alone does not ensure advanced pain knowledge. In contrast, the RNPQ performance of Jordanian OT students (50%) remains below most comparable samples (43.42%)<sup>37</sup> and (53.3%),<sup>35</sup> consistent with reports of lower baseline pain knowledge among OT cohorts. Notably, pain knowledge among OT student cohorts remains remarkably understudied, which significantly limits comparative analysis and warrants further investigations.

In our study, PT students demonstrated a median HC-PAIRS score of 45.0 (IQR: 38.0–52.0; 49.5%), compared to a markedly higher HC-PAIRS score reported for OT students at 57.0 (IQR: 49.0–60.0; 62.6%), reflecting more biomedical- or disability-oriented beliefs for OT students. These findings align with international trends where OT students exhibit more biomedical oriented pain related beliefs than PT students. For example, in Australia, Briggs et al<sup>43</sup> reported HC-PAIRS scores of 44.2% among PT students compared to 54.6% for OT students. Similar trends were observed for South African: 59.0% (PT) vs 62.5% (OT)<sup>37</sup> and international (PT: 41.2% and OT: 58.0%) cohorts.<sup>35</sup> These discipline-specific orientations likely stem from differences in curricular emphasis, where pain-focused content is historically under-emphasized in OT compared to PT programs.<sup>21</sup>

When benchmarked internationally, HC-PAIRS scores for PT students demonstrate substantial variability with our cohort (49.5%). Our PT students' HC-PAIRS scores closely aligned with their final year Scottish (54.7%)<sup>44</sup> and Australian (49.5%)<sup>45</sup> PT counterparts. Conversely, our PT cohort's scores were markedly lower than those observed in Saudi Arabia (67.1%)<sup>46</sup> and Brazil (63.2%).<sup>47</sup> Further, the elevated HC-PAIRS scores observed in our OT cohort (62.6%) are particularly concerning, as they consistently mirror OT global trends of more persistent biomedical biases in OT education.<sup>35,37,43</sup> These observed cross-regional benchmarking disparities likely originate from cultural, institutional or curricular factors that frame students' understanding of pain and disability.

The study found a significant inverse relationship between pain neurophysiology knowledge (RNPQ) and pain-related beliefs (HC-PAIRS) across the total sample ( $\rho = -0.334$ ,  $p < 0.001$ ). Students who demonstrated greater understanding of pain neurophysiology tended to report more positive pain-related beliefs; however, this cross-sectional design does not allow assumptions regarding directionality. The lack of significant between-discipline subgroup correlations could be explained by underpowered subgroup sample sizes rather than a true absence of correlations. Our findings align with previous research of significant moderate negative correlations between RNPQ and HC-PAIRS among final year PT students ( $r = -0.30$ )<sup>37</sup> and across the entire PT cohort ( $r = -0.342$ ).<sup>19</sup> Springer et al<sup>19</sup> reported stronger associations after clinical placements ( $r = -0.42$ ), suggesting a progressive training effect. Furthermore, in our regression analyses, HC-PAIRS remained a significant predictor of RNPQ scores ( $B = -0.030$ ,  $p < 0.001$ ) after covariate adjustment, confirming a significant association between pain-related knowledge and attitudes.

Our findings suggest the need for further improvements in pain education within Jordanian PT and OT curricula. PT and OT students across all three universities (HU, JU, JUST) demonstrated limited pain knowledge with consistently persistent biomedical attitude trends. This suggests curricular rather than institutional limitations.

We found that university courses were one of the most frequently cited sources of pain knowledge (37.50%) and the strongest predictor of RNPQ scores ( $\beta = 0.677$ ,  $p < 0.001$ ). This association was significantly stronger among PT students than OT students, reflecting between-discipline differences in curricular pain education. These findings align with Alodaibi et al,<sup>16</sup> who demonstrated that university courses were the primary source of pain knowledge among Saudi PT students. Similarly, Mankelov et al<sup>35</sup> observed that the number of pain education teaching hours significantly predicted pain knowledge (RNPQ) and attitudes (HC-PAIRS) across international health professional students. These findings collectively highlight the primary influence that the curricular content exerts on students' pain education knowledge, emphasizing the imperative for inclusion of standardized evidence-based neuroscience pain education within PT and particularly OT programs in Jordan.

Our findings provide multi-institutional data on pain curricula within physical and occupational therapy programs in Jordan, illuminating discipline-specific patterns to guide future curriculum reform. However, these discipline differences are descriptive rather than causal, as this study design did not include a formal audit of curricular content or instructional methods that might explain them; therefore, their interpretation requires caution. The modest effect sizes align with established educational research, which indicates that meaningful changes in knowledge and beliefs can evolve

progressively through structured and sustained instructional and experiential learning. The observed association between university courses and pain knowledge scores suggests a potential educational driver and highlights practical opportunities to enhance pain curricula. Such enhancements could foster a more biopsychosocial approach in clinical practice and, ultimately, improve care for individuals with chronic pain.

Our study revealed a significant inverse relationship between pain knowledge (RNPQ) and maladaptive beliefs (HC-PAIRS). These findings highlight the relevance of addressing both knowledge and beliefs concurrently within educational approaches. This is consistent with meta-analytic evidence that biopsychosocially focused pain education improves both pain knowledge and attitudes among healthcare professionals and students.<sup>20</sup> Remarkably, a brief (70-min) pain neuroscience education (PNE) session significantly enhanced students' pain knowledge and attitudes.<sup>23</sup> Similarly, Mankelov et al<sup>27</sup> reported immediate - and sustained improvements after PNE, supporting the IASP - aligned scalable pain education approach. Overall, these findings emphasize the importance of embedding contemporary pain science education across both PT and OT training programs to better align graduate competencies with evidence-based practice.

## Limitations

Several limitations should be considered when interpreting these findings. First, the cross-sectional design precludes causal inference; therefore, relationships between educational exposure, pain knowledge, and beliefs should be interpreted as associative rather than directional. Second, voluntary online recruitment may have introduced self-selection bias, and the 36% response rate may limit representativeness. Although the survey was widely disseminated with reminders, the sample may not fully reflect all final-year PT and OT students in Jordan. Third, the instrument used to assess perceived sources of pain knowledge was developed internally for this study and has not undergone formal psychometric validation. Fourth, self-reported agreement with learning sources may be subject to recall or social desirability bias; however, such measures remain informative for understanding perceived educational influences.

Fifth, RNPQ and HC-PAIRS data were summarized using medians and IQRs due to non-normality, while score percentage conversions were used to facilitate comparison with previous literature. This approach may reduce distributional detail but enhances interpretability and benchmarking relevance. Sixth, although students were recruited from three major universities, we did not conduct a systematic audit of curricular content; however, the lack of between-university differences suggests shared structural limitations in pain education nationally.

Seventh, although an a priori power calculation was not performed, the sample exceeded recommended thresholds for regression with multiple predictors; nonetheless, subgroup comparisons—particularly those involving OT students—may have been underpowered to detect smaller effects. Future studies should consider stratified sampling or oversampling of smaller subgroups. Eighth, chronic pain history and analgesic use were not assessed; these personal factors may influence pain knowledge and beliefs. Finally, findings may not generalize to students in earlier years of training or to other health professions programs. Future research should address these limitations.

## Conclusion

This study provides the first multi-institutional data on pain-related knowledge and beliefs among final-year PT and OT students in Jordan. Although PT students demonstrated comparatively better understanding of pain and more favourable beliefs than their OT peers, both groups displayed significant gaps in pain neurophysiology knowledge and a tendency towards biomedical beliefs. University courses emerged as the dominant source of pain knowledge, particularly among PT students, and were positively associated with higher pain knowledge scores. The inverse relationship between pain knowledge and maladaptive beliefs confirms the interdependence of both domains, highlighting the importance of addressing both through curricular reform.

Collectively, these findings suggest a clear need for structured, biopsychosocially oriented pain education within undergraduate curricula. Implementing evidence-based pain neuroscience education (PNE) may enhance both pain knowledge and attitudes. Potential enhancements, aligned with the International Association for the Study of Pain (IASP) guidelines, could include increasing dedicated teaching hours on contemporary pain science, incorporating interprofessional and case-based learning, and fostering biopsychosocial reasoning during clinical training. Future

longitudinal and interventional studies are warranted to examine curricular effectiveness and guide large-scale reforms across PT and OT education in Jordan.

## Abbreviations

**Participant groups & institutions:** BSc, Bachelor of Science; DPT, Doctor of Physical Therapy; HU, Hashemite University; JU, University of Jordan; JUST, Jordan University of Science and Technology; OT, occupational therapy; PT, physiotherapy.

**Measures & instruments:** HC-PAIRS, Health Care Providers' Pain and Impairment Relationship Scale; IASP, International Association for the Study of Pain; NPQ, Neurophysiology of Pain Questionnaire; PNE, pain neuroscience education; RNPQ, Revised Neurophysiology of Pain Questionnaire.

**Study conduct & ethics:** IRB, Institutional Review Board.

**Statistical terms & reporting:** CI, confidence interval; df, degrees of freedom; HC3, heteroskedasticity-consistent covariance estimator, type 3; ICC, intraclass correlation coefficient; IQR, interquartile range; LOWESS, locally weighted scatterplot smoothing; OLS, ordinary least squares;  $R^2$ , coefficient of determination; SD, standard deviation; SE, standard error; VIF, variance inflation factor.

**Epidemiology terms:** GBD, Global Burden of Disease; YLDs, years lived with disability.

## Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

## Ethics Approval and Informed Consent

Ethical approval was obtained from the Institutional Review Board of The Hashemite University (HU-IRB No. 29/9/2021/2022) before study commencement. This approval covered recruitment at the three participating universities; institutional acknowledgment and support were obtained at each site. The survey was administered anonymously online (no identifiable data were collected). Participation was voluntary, responses were confidential and had no bearing on academic standing or grades, and electronic informed consent was obtained prior to participation. The study adhered to the principles of the Declaration of Helsinki.

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## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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## Disclosure

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