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Original Article

Teaching the Brain to Ease the Pain: A Neuroscience-Based Pain Education for Amateur Athletes

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What is already known on this topic?

- *Pain neuroscience education (PNE) has been shown to reduce pain intensity and improve pain-related outcomes in professional athletes with chronic musculoskeletal injuries.*
- *Chronic pain is common among amateur athletes but remains underexplored compared with professional populations.*
- *Amateur athletes are more prone to chronic pain due to inadequate training planning, technical deficiencies, and excessive loading.*

What this study adds on this topic?

- *Evidence regarding the effects of PNE in amateur athletic populations is still developing, and this study adds valuable data to the current understanding.*
- *It has significantly improved pain intensity, pain neurophysiology knowledge, and pain catastrophizing (helplessness, magnification, and total scores) in this population.*
- *The findings suggest that PNE may be an effective, integrative approach for managing chronic pain in amateur athletes, though larger randomized trials are needed to confirm long-term effects.*

ABSTRACT

Objective: This study aimed to examine the effects of pain neuroscience education (PNE) on pain intensity, pain knowledge, fear of movement, and pain catastrophizing in amateur athletes with chronic pain.

Methods: This single-group, pretest–posttest quasi-experimental study was conducted through face-to-face interviews between March and June 2025 with 66 amateur athletes studying at the Faculty of Sport Sciences, Muş Alparslan University. Demographic information (age, gender, educational status, history of chronic disease, history of falls, etc.) was collected using a structured information form. Pain intensity, pain neurophysiology knowledge, fear of movement, and pain cat-astrophizing were assessed using the Visual Analog Scale (VAS), the Revised Neurophysiology of Pain Questionnaire, the Tampa Scale of Kinesiophobia, and the Pain Catastrophizing Scale, respectively. Participants, divided into groups of 20, attended a PNE program defined by David Butler, held twice weekly for 6 weeks, with each session lasting approx-imately 45 minutes.

Results: The participants' mean age was 21.05 ± 2.97 years (18-36), mean body mass index was 21.34 ± 3.21 kg/m², and mean pain duration was 8.83 ± 11.52 months. Athletics, football, table tennis, and volleyball were the most common sports. Pain was most frequently reported in the head (18.5%), lower back (15.7%), knee (13.9%), and neck (9.3%). Significant differences were observed in activity-related VAS scores ($w = -2.603$; $P = .009$), pain neurophysiology knowledge ($w = -3.011$; $P = .003$), pain catastrophizing—helplessness ($w = -2.348$; $P = .019$), magnification ($w = -2.183$; $P = .029$), and total score ($w = -2.670$; $P = .008$).

Conclusion: Pain neuroscience education may be associated with reductions in pain intensity and pain catastrophizing, as well as improvements in pain-related knowledge, in amateur athletes with chronic pain. Further randomized trials are needed to confirm these results and determine the intervention's long-term effects.

Keywords: Amateur athletes, chronic pain, kinesiophobia, pain management, pain neuroscience education, sports injuries

Introduction

Participation in sports and exercise is an indispensable component for maintaining physical, mental, and social health throughout life.[1] However, the nature of these activities inherently involves certain risks for musculoskeletal injuries.[1] Sports injuries are often regarded as an unavoidable and self-limiting aspect of athletic participation. In reality, however, they may lead to substantial short- and long-term adverse consequences.[1] Among these, chronic musculoskeletal pain is one of the most prevalent

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conditions, representing a major health concern that negatively affects performance, motivation, and quality of life in both professional and amateur athletes.[2,3]

Globally, 11%-55% of professional athletes experience chronic pain originating from the musculoskeletal system.[4] Although robust epidemiological data in amateur athletes are scarce, the prevalence is assumed to be higher in this group. Unlike professional athletes, amateur athletes generally lack access to regular medical follow-up, multidisciplinary healthcare teams, and structured injury prevention or rehabilitation programs. Training supervision is often limited, and pain is frequently interpreted through a predominantly biomedical lens, leading to continued participation despite early warning signs. In this context, repetitive microtraumas, inappropriate loading, and delayed injury management may contribute not only to tissue sensitization but also to maladaptive pain-related beliefs and behaviors, placing amateur athletes at increased risk for the development of chronic pain.[3,5]

Traditionally, treatment approaches for musculoskeletal pain have been grounded in the biomedical model, which primarily associates pain with tissue damage.[6-8] However, recent research has demonstrated that pain is a biopsychosocial phenomenon shaped by neuroplastic changes within the central nervous system.[9,10] Building on this understanding, pain neuroscience education (PNE) was developed as an educational intervention aiming to help individuals understand pain not merely as a result of peripheral tissue injury but as a complex experience perceived, processed, and interpreted by the nervous system.[11] It explains the biological, psychological, and social dimensions of pain, thereby enhancing individuals' understanding of pain mechanisms and teaching the neurophysiological foundations of pain.[11,12] Within this framework, participants are introduced—on a scientific basis—to key concepts such as central and peripheral sensitization, brain plasticity, the influence of stress and emotional state on pain, the fear–avoidance cycle, and the importance of safe movement.[11,12]

From the perspective of athletes, this approach may foster significant awareness regarding chronic musculoskeletal pain associated with repetitive microtraumas, overtraining, and performance-related stress.[13,14] Replacing maladaptive pain beliefs (e.g., "My body is damaged; movement will make it worse") with more adaptive and functional interpretations may reduce fear of movement (kinesiophobia), encourage exercise participation, and enhance athletic performance.[9,11,12] Consequently, PNE has been increasingly adopted by clinicians as a holistic intervention approach—not only for alleviating pain intensity but also for improving body awareness, reducing performance anxiety, and mitigating the fear of reinjury during exercise.[12]

This study was designed to examine the effectiveness of PNE in amateur athletes. Although chronic pain among amateur athletes remains an underexplored topic, existing research has predominantly focused on professional populations. Previous studies have reported that PNE can reduce pain intensity and improve pain-related outcomes in professional athletes with chronic musculoskeletal injuries.[11,13,14] However, evidence concerning its effectiveness in amateur athletes remains limited. Given that amateur athletes are more prone to chronic pain, interventions such as PNE—which offer a more integrative perspective on musculoskeletal injury—may provide an effective approach to pain management. Therefore, this study hypothesizes that, compared to baseline, PNE will lead to improvements in pain intensity, pain neurophysiology knowledge, fear of movement, and pain catastrophizing among amateur athletes. Accordingly, the study seeks to answer the following research question: "What are the effects of PNE on pain-related outcomes and psychosocial factors in amateur athletes?"

Methods

Participants

This study was conducted between March and June 2025 with 66 amateur athletes who were students at the Faculty of Sport Sciences, Muş Alparslan University. The inclusion criteria were being between 18 and 35 years of age, having musculoskeletal pain complaints for at least 3 months, and engaging in at least 1 amateur sport for a minimum of 1 year. The exclusion criteria were having musculoskeletal pain lasting less than 3 months, a history of surgery within the last 6 months, having neurological, orthopedic, rheumatologic, metabolic, or cardiovascular diseases that could prevent participation in amateur sports, regular use of analgesics, corticosteroids, or muscle relaxants, and suspected pregnancy.

This study received ethical approval from the Muş Alparslan University Scientific Research and Publication Ethics Committee (Approval No: 2025-71; Date: March 6, 2025). Informed written consent was obtained from all participants in accordance with the principles of the Declaration of Helsinki.

Study Design

This was a single-group, pretest–posttest quasi-experimental study conducted through face-to-face interviews. Demographic information of the participants (age, gender, educational status, history of chronic disease, history of falls, etc.) was collected using a structured information form. Pain intensity during activity and at rest was assessed using the Visual Analog Scale (VAS). Knowledge of pain neurophysiology was evaluated with the Revised Neurophysiology of Pain Questionnaire (RNPQ). Kinesiophobia was assessed using the Tampa Scale of Kinesiophobia (TSK), and pain catastrophizing behaviors were measured with the Pain Catastrophizing Scale (PCS). All assessments were performed before and after the PNE. Assessments were based on self-reported questionnaires; therefore, assessor blinding was not applicable.

Participants received PNE twice a week for 45 minutes over a period of 6 weeks, delivered by a physiotherapist with 5 years of experience in PNE. Due to the absence of a control or comparison group, the interpretation of the observed changes as direct effects of the PNE intervention should be made with caution.

Outcome Measurements

The Visual Analog Scale

The VAS was used to assess musculoskeletal pain during activity and at rest. It is a widely used instrument for measuring pain intensity in daily clinical practice. It evaluates pain on a scale ranging from 0 to 10, where "0" indicates no pain, scores between 1-4 represent mild pain, 5-6 indicate moderate pain, and 7-10 correspond to severe pain levels. The reliability coefficient of the scale has been reported to range between 0.60 and 0.77.[15]

Revised Neurophysiology of Pain Questionnaire

The RNPQ is a self-report questionnaire designed to assess individuals' knowledge about pain mechanisms. Revised by Catley, O'Connell, and Moseley,[16] the questionnaire measures conceptual understanding of pain neurophysiology. It consists of 12 items with 3 response options: "true," "false," and "undecided." Correct answers are scored as 1 point, while incorrect or undecided responses receive 0 points. The total score ranges from 0 to 12, with higher scores indicating greater knowledge of pain physiology. The RNPQ is widely used in clinical and research settings, particularly for evaluating the effectiveness of PNE programs.[16] The Turkish validity and reliability study of the scale was conducted by Gül et al.[17]

Tampa Scale of Kinesiophobia
Kinesiophobia was assessed using the 11-item version of the Tampa Scale of Kinesiophobia (TSK-11). This 4-point Likert-type scale includes response options ranging from "strongly disagree" to "strongly agree." Each item is scored from 1 to 4, yielding a total score between 11 and 44, with higher scores indicating higher levels of kinesiophobia. Participants were instructed to mark the most appropriate response for each item, and total scores were calculated accordingly. The TSK-11 has demonstrated good reliability (Cronbach's $\alpha = 0.80$).[18] The Turkish validity and reliability study was performed by Yılmaz et al.[19] In the broader context of chronic pain, a change of 7.6 to 8.4 points on the TSK has been suggested to represent a clinically meaningful improvement.[18]

Pain Catastrophizing Scale
The PCS is a 13-item self-report measure developed to assess negative thoughts and emotions experienced during pain. It comprises 3 subscales: rumination, magnification, and helplessness. Each item is rated on a 5-point Likert scale ranging from 0 ("not at all") to 4 ("all the time"), producing a total score between 0 and 52. Higher scores indicate greater levels of pain catastrophizing.[20]
The subscale scores are calculated as follows:

Rumination: Items 8, 9, 10, and 11.

Magnification: Items 6, 7, and 13.

Helplessness: Items 1, 2, 3, 4, 5, and 12.

The total score is obtained by summing all item scores, with higher scores reflecting greater pain catastrophizing.[20] The Turkish validity and reliability study of the scale was conducted by Süren et al.[21]

Procedure
In this study, PNE was provided to amateur athletes with chronic pain in addition to their regular weekly sports training. The PNE program lasted for 6 weeks and consisted of 45-minute sessions conducted twice per week. Participants were divided into small groups of approximately 20 individuals to facilitate interaction and discussion. The educational sessions were delivered using structured PowerPoint presentations designed according to contemporary pain neuroscience education principles.

The content focused on explaining the neurophysiology of pain and the relationships between pain, injury, and brain processes. Enriched metaphors and illustrative examples were systematically used to help participants reconceptualize pain and understand that pain does not always indicate tissue damage. Topics included the role of the central nervous system in pain perception, neuroplasticity, pain modulation mechanisms, and the influence of psychological and cognitive factors on pain experience.

Each session incorporated interactive components, including group discussions and question-and-answer segments, to enhance engagement and comprehension. At the end of every session, brief quizzes were administered to assess participants' understanding of the material and reinforce key concepts.

To ensure intervention consistency (intervention fidelity), all sessions followed a standardized presentation structure and educational framework. The primary aim of the intervention was to move beyond the traditional biomedical model that associates pain solely with tissue damage and to emphasize that pain is a protective and dynamic output generated by the central nervous system.

The educational content covered key topics such as the fundamental differences between acute and chronic pain; the definitions of nociceptive, neuropathic, and nociplastic pain; the relationship between pain and tissue damage; central and peripheral sensitization; the pain–spasm–pain cycle; pain neuroanatomical pathways; and normal versus abnormal pain responses. In addition, the sessions addressed the effects of emotional changes, stress, trauma perception, pain attitudes, and behavioral patterns on central and peripheral nervous system sensitivity, highlighting the brain's essential role in pain perception.[22]

The PNE was designed to be simple, clear, and appropriate for the participants' knowledge level. It was enriched with various metaphors and visual materials to enhance understanding.[22] Participants were encouraged to integrate the learned concepts into their daily lives. Previous topics and concepts were revisited during subsequent sessions to reinforce learning and retention. The program was delivered by a physiotherapist with 5 years of professional experience in PNE.

Sample Size
Sample size calculation was performed using G*Power software based on the change in PCS scores, which was considered the primary outcome variable. PCS scores were 15.4 ± 5.8 at baseline, 14.4 ± 5.6 at the second assessment, and 14.5 ± 5.5 at the 3-month follow-up. The expected effect size was estimated as Cohen's $d = 0.7$.[23] indicating a moderate-to-large effect.

A paired *t*-test model was assumed for within-group comparisons over time. The analysis was conducted using a 2-tailed test, as both increases and decreases in PCS scores were considered clinically relevant.

The statistical power level was set at 95% ($1-\beta = 0.95$) to reduce the risk of Type II error and to ensure the detection of clinically meaningful changes in pain catastrophizing, which is considered an important psychological factor influencing pain-related disability.

Although the minimum required sample size was 24 (calculated with 95% statistical power and a 95% CI[24]) according to the power analysis, the final sample size (n = 66) was intentionally increased to account for potential dropouts, improve statistical precision, and enhance the generalizability and reliability of the findings.

Statistical Analysis
The SPSS 25 program was used for the statistical analysis of the data. The mean and standard deviation values of the demographic data were provided. The normal distribution of the data was tested using the Shapiro–Wilk test and skewness and kurtosis values. The Wilcoxon signed-rank test was used to compare the pre- and post-PNE values. Because the proportion of missing data was minimal, mean imputation was applied. $P < .05$ was considered statistically significant.

Results

The average age of participants in the study was 21.05 ± 2.98 years (18-36), and the average body mass index was calculated as 21.34 ± 3.21 (5.86-29.30). When examining the distribution of athletes by sport, athletics had the highest percentage at 22.7%, followed by table tennis, volleyball, and football, each with 16.7%. The proportion of athletes in badminton, basketball, and wrestling was equal at 6.1% each. In taekwondo and archery, the proportion was 3.0%. The participants' average daily sleep duration was determined to be 7.73 ± 1.89 hours (3-12). The average pain duration of the participants was 8.83 ± 11.52 months (3-48). In terms of exercise frequency, 62.0% of the participants exercised 2 days a week, 29.6% exercised 3-4 days a week, and 8.3% exercised 5 days or more a week. When assessing the location of pain, the most common reports were "other areas" (27.8%), headache (18.5%), lower back (15.7%), and knee (13.9%). The most common types of pain were pain that increased with movement (32.4%), constant and dull pain (18.5%), and sharp, sudden pain (14.8%). The timing of the pain was most commonly reported as occurring in both situations (38.9%), during activity (27.8%), and at rest (13.9%) (Table 1).

When pre- and post-PNE values were compared, no significant change was observed in Tampa Kinesiophobia Scale total scores (pre: 42.0 (IQR: 5.25); post: 40.0 (IQR: 6.75); w = −1.949; *P* = .051). The level of pain neurophysiology knowledge increased significantly after the training (pre: 5.0 (IQR: 2.00); post: 6.0 (IQR: 3.00); w = −3.011; *P* = .003).

Regarding the pain catastrophizing subscales, significant reductions were observed in helplessness (pre: 11.5 (IQR: 8.00); post: 7.5 (IQR: 6.00); w = −2.348; *P* = .019), magnification (pre: 6.5 (IQR: 3.25); post: 4.0 (IQR: 2.75); w = −2.183; *P* = .029), and the total catastrophizing score (pre: 25.0 (IQR: 15.25); post: 19.0 (IQR: 10.75); w = −2.670; *P* = .008). Although a decreasing trend was observed in the rumination subscale, this change did not reach statistical significance (pre: 8.0 (IQR: 7.00); post: 5.0 (IQR: 4.75); w = −1.861; *P* = .063).

For VAS scores, no significant difference was found in pain levels at rest (pre: 4.0 (IQR: 3.00); post: 5.0 (IQR: 3.75); w = −0.528; *P* = 0.597), whereas pain during activity showed a significant decrease following the training (pre: 5.0 (IQR: 5.00); post: 4.0 (IQR: 4.75); w = −2.603; *P* = .009) (Table 2).

Discussion

In the present study, which investigated the effectiveness of PNE in athletes with chronic pain, significant improvements were observed in participants' pain scores, pain-related knowledge levels, and pain catastrophizing levels after the training. However, no significant reduction was found in fear of movement.

Pain neuroscience education has been adapted and applied in various conditions such as chronic low back pain, neck pain, fibromyalgia, chronic fatigue syndrome, breast cancer, post-surgical and musculoskeletal rehabilitation contexts, as well as across different age groups. Studies have reported improvements in pain, kinesiophobia, pain catastrophizing, and disease-related symptoms.[14,24-28] To the best of current knowledge, studies conducted on amateur athletes with chronic pain are quite limited.

In a study that examined the effects of a PNE program on young athletes, a total of 52 participants were randomly divided into 2 groups in a 12-week intervention: the experimental group received both healthy sports training and PNE, while the control group received only healthy sports habits education. The results showed a significant reduction in stress levels, a higher rate of training without health problems (76.6% vs. 63.0%), and lower pain intensity in the group that received PNE compared with the control group.[29]

In a randomized controlled trial designed to investigate the effects of PNE on catastrophizing and injury rates among young athletes, both the intervention group (IG) (n = 36) and the control group (CG) (n = 42) participated in a 12-week healthy sports habits training program. However, the IG additionally received PNE sessions. The findings indicated a significant reduction in catastrophizing levels within the IG. Subgroup analysis revealed that the improvement was significant among male athletes but not among female athletes. Consequently, the study concluded that PNE may reduce pain-related catastrophizing tendencies in young athletes.[13]

The aforementioned studies conducted on amateur athletes demonstrated that PNE can have beneficial effects on pain catastrophizing, pain intensity, and stress levels. Consistent with these findings, the study also showed similar improvements while specifically targeting amateur athletes with chronic pain—a population that has been rarely investigated. Moreover, unlike the 2 prior studies on amateur athletes, the research also examined participants' neurophysiological knowledge of pain and fear of movement. Although no significant decrease was observed in fear of movement, a notable increase was found in pain knowledge levels. In addition, given the quasi-experimental design and absence of a control group, the findings should be interpreted cautiously, and no causal inferences can be drawn. The observed changes reflect associations following the pain neuroscience education program rather than definitive intervention effects.

Notably, fear of movement, as measured by the TSK-11, did not demonstrate a statistically significant change. This finding warrants careful consideration, as kinesiophobia is often regarded as a central target of PNE. Several factors may explain this result. First, the relatively short duration of the intervention may have been insufficient to influence entrenched movement-related beliefs. Second, amateur athletes typically maintain higher baseline activity levels compared with clinical populations, which may limit the magnitude of measurable change and contribute to potential ceiling or floor effects. Additionally, the intervention focused exclusively on educational components, without integrating graded exposure or movement-based behavioral strategies that may be necessary to translate cognitive shifts into changes in movement-related fear. Although statistical significance was not achieved, the extent to which the observed change approached thresholds for clinically meaningful improvement remains uncertain and should be interpreted in this exploratory context.

Participants reported chronic pain across multiple anatomical regions, indicating that the findings primarily reflect changes in general pain experience rather than region-specific effects. This heterogeneity

Table 1. Demographic and Clinical Characteristics of the Participants (n = 66)

Variable	n (%) or Mean ± SD (Range)
Age (years)	21.05 ± 2.98 (18-36)
Body Mass Index (kg/m²)	21.34 ± 3.21 (15.86-29.30)
Sleep duration (hours/day)	7.73 ± 1.89 (3-12)
Pain duration (months)	8.83 ± 11.52 (3-48)
Sports branch	Athletics: 15 (22.7%) • Table tennis: 11 (16.7%) • Volleyball: 11 (16.7%) • Football: 11 (16.7%) • Badminton: 4 (6.1%) • Basketball: 4 (6.1%) • Wrestling: 4 (6.1%) • Taekwondo: 2 (3.0%) • Archery: 2 (3.0%)
Exercise frequency	2 days/week: 41 (62.0%) • 3-4 days/week: 19 (29.6%) • ≥ 5 days/week: 6 (8.3%)
Pain location	Other regions: 18 (27.8%) • Head: 12 (18.5%) • Lower back: 10 (15.7%) • Knee: 9 (13.9%) • Others: 17 (24.1%)
Pain type	Movement-induced: 21 (32.4%) • Constant and dull: 12 (18.5%) • Sharp and sudden: 10 (14.8%) • Others: 23 (34.3%)
Pain timing	Both rest and activity: 26 (38.9%) • During activity: 18 (27.8%) • At rest: 9 (13.9%) • Others: 13 (19.4%)

Values are presented as mean ± standard deviation (SD) with range or as frequency (n) and percentage (%).

Table 2. Comparison of Participants' Pain Levels, Pain Knowledge Levels, Pain Catastrophising Levels, and Kinesiophobia Pre and Post Pain Neuroscience Education

Variable	Pre Training Median (IQR)	Post Training Median (IQR)	w	*P*<0.05
Tampa Kinesiophobia Scale	42.0 (5.25)	40.0 (6.75)	−1.949	.051
Revised Neurophysiology of Pain Questionnaire	5.0 (2.00)	6.0 (3.00)	−3.011	**.003**
Pain Catastrophizing Scale (helplessness)	11.5 (8.00)	7.5 (6.00)	−2.348	**.019**
Pain Catastrophizing Scale (magnification)	6.5 (3.25)	4.0 (2.75)	−2.183	**.029**
Pain Catastrophizing Scale (rumination)	8.0 (7.00)	5.0 (4.75)	−1.861	.063
Pain Catastrophizing Scale total	25.0 (15.25)	19.0 (10.75)	−2.670	**.008**
VAS in rest	4.0 (3.00)	5.0 (3.75)	−0.528	.597
VAS in activity	5.0 (5.00)	4.0 (4.75)	−2.603	**.009**

IQR, interquartile range; VAS, visual analog scale; w, Wilcoxon signed-rank test; bold, p<0.05.
P < .05.

may have diluted condition-specific responses and reduced sensitivity to detect changes in outcomes such as kinesiophobia, which can vary depending on pain location and functional demands. Explicitly acknowledging this variability is important when considering the applicability of the results to specific athletic or clinical subgroups.

In the study, the most frequently reported pain location among participants was the head, followed by the lower back and knee. To the best of current knowledge, no previous study has investigated the effects of PNE on chronic headache in amateur athletes. However, in a study examining the efficacy of PNE combined with physiotherapy in patients with migraine, participants (n = 82) were randomly assigned to either a PNE + physiotherapy group or a physiotherapy-only group. At the end of the intervention, both groups showed a significant reduction in pain intensity, while the PNE + physiotherapy group exhibited a greater reduction in the number of migraine attacks.[30] The high prevalence of headache reported among amateur athletes in the study is noteworthy. Future research should focus on investigating the prevalence of headache and the contributing factors among amateur athletes.

Finally, while prior research supports the potential value of PNE in chronic pain populations, the present findings also highlight the importance of integrating null results into interpretation. Together, these results underscore the need for future studies employing randomized controlled designs, region-specific pain samples, longer follow-up periods, and combined educational and movement-based interventions to more fully evaluate the role of PNE in amateur athletes.

Strengths and Limitations

The study is among the pioneering investigations examining pain neuroscience education in amateur athletes with chronic pain. Key strengths include the use of validated and culturally adapted assessment instruments, ensuring the reliability and contextual relevance of outcome measurements, as well as the implementation of a structured, multi-session pain neuroscience education program. These methodological features enhance the feasibility and acceptability of the intervention within athlete rehabilitation settings and provide a robust foundation for future controlled studies.

Of course, this study has several limitations. First, no control group was established and randomization was not applied, which limits causal interpretation of the findings. In addition, outcomes were based on self-report measures and may therefore be subject to reporting and expectancy biases. Participants also reported pain in different body regions, which may affect the specificity and generalizability of the results. Moreover, the absence of longer-term follow-up prevents conclusions regarding the sustainability of the observed changes. Given the lack of a control group, improvements in outcome measures may reflect regression to the mean, natural symptom variability, increased clinical attention, expectancy effects, or adaptations related to ongoing sports training. Future randomized controlled trials with region-specific pain populations and long-term follow-up are needed to strengthen the generalizability and interpretability of these findings.

Conclusion

Pain neuroscience education appears to be a feasible and acceptable approach for amateur athletes with chronic pain and shows promise in supporting improvements in pain-related outcomes, including pain intensity, pain catastrophizing, and pain knowledge. However, adequately powered randomized controlled trials with long-term follow-up are required to further explore its potential influence on kinesiophobia and to establish its effectiveness.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

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Declaration of Interests: The authors declare that they have no competing interest.

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