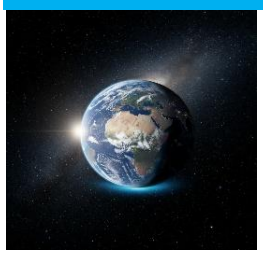
Quality in Sport. 2026;51:68947. eISSN 2450-3118.

https://doi.org/10.12775/QS.2026.51.68947



Quality in Sport. eISSN 2450-3118

Journal Home Page
https://apcz.umk.pl/QS/index

PIETRASZ, Michal. Exercise-related pain without clear structural injury – clinical implications for general practice. Quality in Sport. 2026;51:68947. eISSN 2450-3118. https://doi.org/10.12775/QS.2026.51.68947

The journal has been awarded 20 points in the parametric evaluation by the Ministry of Higher Education and Science of Poland. This is according to the Annex to the announcement of the Minister of Higher Education and Science dated 05.01.2024, No. 32553. The journal has a Unique Identifier: 201398. Scientific disciplines assigned: Economics and Finance (Field of Social Sciences); Management and Quality Sciences (Field of Social Sciences).
Punkty Ministerialne z 2019 - aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 l.p. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398. Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych).
The authors declare that there is no conflict of interest regarding the publication of this paper.
Received: 13.02.2026. Revised: 15.02.2026. Accepted: 16.02.2026. Published: 28.02.2026.

Exercise-related pain without clear structural injury – clinical implications for general practice

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Abstract

Background

Exercise-related pain is a common reason for consultation among physically active individuals in general practice. In a substantial proportion of cases, pain occurs in the absence of clear structural abnormalities on clinical examination or imaging. Evidence from systematic reviews indicates that morphological findings often poorly correlate with pain severity, creating diagnostic and therapeutic challenges in primary care.

Aim

The aim of this narrative review was to summarize current evidence on exercise-related pain without clear structural injury and to discuss its clinical implications for general practitioners, with particular emphasis on evidence-based diagnostic reasoning and management strategies.

Results

Available evidence suggests that exercise-related pain without structural injury may result from load-related mechanisms, impaired neuromuscular control, myofascial pain syndromes, and altered pain modulation, including peripheral and central sensitization. Overreliance on imaging may lead to overdiagnosis of incidental findings and unnecessary interventions. Effective clinical management requires careful clinical assessment, identification of red flag symptoms, patient education, load modification, and a gradual return to physical activity rather than routine diagnostic escalation.

Conclusion

Exercise-related pain without clear structural injury represents a significant clinical issue in general practice. An evidence-based approach that prioritizes functional assessment, limits unnecessary imaging, and emphasizes patient education and load management may improve clinical outcomes and reduce overt medicalization.

Keywords: exercise-related pain; non-specific musculoskeletal pain; primary care; diagnostic imaging; load management; patient education

1. Introduction

Regular physical activity is widely recognized as one of the key components of chronic disease prevention and the maintenance of health in the adult population. Evidence from numerous systematic reviews and current public health guidelines indicates that regular exercise is associated with a significant reduction in the risk of cardiovascular disease, type 2 diabetes, selected malignancies, and premature mortality, as well as with improvements in mental health and overall quality of life [1,2]. For these reasons, physical activity is strongly recommended as a fundamental non-pharmacological health intervention in the general population.

Over recent decades, a marked increase has been observed in the number of individuals engaging in physical activity in the form of recreational spor3ts, resistance training, running, fitness classes, and other organized or semi-organized forms of exercise. This trend spans a broad age range and includes individuals without prior athletic preparation, who often train without regular supervision by qualified coaches or medical professionals [3,4]. In contrast to elite athletes, recreationally active individuals rarely benefit from structured training programs or systematic load monitoring, which may predispose them to the development of exercise-related pain.

In parallel with the growing popularity of physical activity, primary care physicians increasingly encounter patients presenting with pain occurring during or after exercise. Musculoskeletal pain is currently among the most common reasons for medical consultations in the adult population and represents a substantial clinical burden in both general practice and sports medicine settings [5,6]. Such complaints frequently lead to reduced physical activity, patient anxiety, and concern about the presence of potentially serious underlying pathology.

A particular diagnostic challenge arises in cases of exercise-related pain in which no clear structural abnormalities are identified on physical examination or imaging studies. Meta-analyses of imaging findings have demonstrated that degenerative changes of the spine and other components of the musculoskeletal system are frequently present in asymptomatic individuals, thereby undermining a simple causal relationship between morphological findings

and pain intensity [7,8]. This phenomenon has important clinical implications, as it may result in overinterpretation of imaging results and inappropriate therapeutic decisions.

In recent years, increasing attention has been directed toward the recognition that exercise-related pain does not necessarily reflect tissue damage. Scientific evidence suggests that pain symptoms may arise from functional overload, impaired adaptation to training demands, alterations in neuromuscular control, and changes in pain modulation mechanisms, even in the absence of identifiable structural pathology [9,10]. This contemporary understanding of pain is particularly relevant in the context of general practice.

From an evidence-based medicine perspective, it is therefore essential to distinguish between pain that warrants urgent investigation for serious structural pathology and symptoms of a functional nature that can be safely managed within primary care. Accurate interpretation of clinical features, identification of so-called “red flag” symptoms, and rational use of additional diagnostic tests constitute the foundation of effective and safe clinical management [11,12].

The aim of this review is to present the current state of knowledge regarding exercise-related pain occurring in the absence of clear structural abnormalities and to discuss its clinical implications for general practitioners, based on the available scientific evidence.

2. Materials and Methods

This article is a narrative review of the literature, prepared in accordance with the principles of evidence-based medicine. The choice of this review format was driven by the heterogeneity of available data on exercise-related pain without clear structural abnormalities, as well as by the need to provide a concise and clinically oriented synthesis relevant to general practice settings [13,14].

The literature search was conducted using the PubMed, Scopus, and Google Scholar databases. Publications addressing exercise-related pain, non-specific musculoskeletal pain, overuse syndromes, pain without identifiable structural pathology, and clinical management in primary care were considered. The search included articles published up to March 2025 and was performed using combinations of English-language keywords such as exercise-related pain,

non-specific musculoskeletal pain, overuse injuries, load-related pain, primary care, sports medicine, and diagnostic imaging.

The analysis primarily included systematic reviews, meta-analyses, randomized controlled trials, and current clinical guidelines concerning adult individuals engaging in recreational physical activity. In addition, selected publications of particular clinical and educational relevance for general practitioners were included. Studies focusing exclusively on elite athletes, pediatric populations, or acute traumatic injuries requiring surgical intervention were excluded, unless they directly addressed the differential diagnosis of pain without clear structural abnormalities [14,15].

Given the narrative nature of this review, no formal assessment of risk of bias or quantitative data synthesis was performed. The purpose of the literature analysis was to summarize the current state of knowledge and to identify practical clinical implications relevant to everyday practice in primary care.

3. Clinical characteristics of exercise-related pain without clear structural injury

Exercise-related pain occurring in the absence of clear structural abnormalities represents a common clinical problem among individuals engaging in recreational physical activity. Such complaints are characterized by considerable heterogeneity in clinical presentation and by a lack of a consistent correlation between symptom severity and findings on imaging studies [5–7]. In general practice, this often results in diagnostic uncertainty and increases the risk of excessive diagnostic investigations and medicalization of symptoms.

This section outlines the clinical characteristics of exercise-related pain without identifiable structural pathology, with particular emphasis on the relationship between mechanical load and symptom development, the role of neurophysiological mechanisms, and the importance of functional assessment in primary care settings.

3.1. Clinical characteristics of pain symptoms

Exercise-related pain without clear structural abnormalities typically presents with a mechanical, load-dependent pattern. Symptoms most often develop gradually, intensify with the duration or intensity of physical activity, or appear after exercise, frequently with a delayed

onset. In contrast to acute traumatic pain, these complaints rarely have a sudden onset or a clear association with a single traumatic event [16,17].

Pain localization may be variable and difficult to define precisely, and symptom intensity often differs depending on the type of physical activity performed, training intensity, and adequacy of recovery. The absence of systemic symptoms and progressive neurological deficits generally supports a benign, functional nature of the condition, although ongoing clinical vigilance remains essential [21,22].

3.2. Relationship between mechanical load and pain development

One of the key elements in the pathogenesis of exercise-related pain is the relationship between training load and the adaptive capacity of the musculoskeletal system. The concept of load-related pain assumes that symptoms may occur even in the absence of identifiable structural damage when the magnitude or rate of applied load exceeds the current adaptive capacity of tissues [9,27].

Evidence indicates that sudden increases in training volume or intensity, insufficient recovery time, and a lack of gradual load progression are among the most frequently identified risk factors for the development of overuse-related pain in recreationally active individuals [27,30].

3.3. Neurophysiological mechanisms and pain modulation

Contemporary models of pain emphasize that pain symptoms are not solely a direct consequence of tissue damage, but rather the result of a complex process integrating peripheral and central nociceptive input alongside psychosocial factors. In the context of exercise-related pain without clear structural abnormalities, mechanisms of altered pain modulation and increased nervous system sensitivity play a particularly important role [10,28].

Factors such as fear of movement, negative beliefs about pain, and previous pain experiences may influence symptom severity and contribute to the persistence of pain despite the absence of identifiable structural pathology [28,29].

3.4. Importance of functional assessment

From a clinical perspective, the assessment of exercise-related pain should focus primarily on the patient's functional status and the relationship between symptoms, physical load, and recovery. Improvement following activity modification, lack of symptom progression, and absence of red flag features support a functional nature of the condition [21,22].

This approach allows for the limitation of unjustified imaging investigations and provides a foundation for rational clinical management in primary care, in accordance with the principles of evidence-based medicine.

4. Diagnostic challenges in general practice

Exercise-related pain without clear structural abnormalities represents a significant diagnostic challenge in general practice. The non-specific nature of symptoms, their variable intensity, and the frequent lack of correlation with imaging findings increase the risk of both overlooking relevant pathology and excessive diagnostic investigation with subsequent medicalization of symptoms [11,12]. In accordance with the principles of evidence-based medicine, appropriate clinical assessment and careful selection of patients requiring further diagnostic workup are of central importance.

4.1. Importance of medical history and physical examination

A detailed medical history and thorough physical examination remain the cornerstone of the diagnostic process. Information regarding the type of physical activity performed, the magnitude and dynamics of training load, the timing of symptom onset, and the relationship between pain, movement, and rest is essential for the initial assessment of pain characteristics [16,17]. A gradual onset of symptoms, their association with specific movement patterns, and improvement following activity modification are suggestive of a functional or load-related origin of pain.

4.2. Role of red flag symptoms

An essential component of differential diagnosis is the identification of so-called red flag symptoms, which may indicate the presence of serious pathology requiring urgent diagnostic evaluation. Commonly cited red flags include unintentional weight loss, fever, night pain, progressive neurological deficits, sphincter disturbances, a history of malignancy, or high-

energy trauma [21,22]. It should be emphasized, however, that individual red flag symptoms have limited specificity and should always be interpreted within the context of the overall clinical presentation.

4.3. Diagnostic imaging and the risk of overdiagnosis

One of the greatest challenges in everyday primary care practice is the rational use of diagnostic imaging. Numerous studies have demonstrated that abnormalities detected by imaging modalities such as magnetic resonance imaging or computed tomography are frequently present in asymptomatic individuals and often show poor correlation with pain severity [7,8]. Routine imaging in patients without red flag features does not improve clinical outcomes and may lead to overdiagnosis and unnecessary interventions [11,12].

In line with recommendations from international initiatives such as Choosing Wisely, imaging studies should be reserved for patients presenting with features suggestive of serious pathology or for those who fail to improve despite appropriate conservative management [12].

4.4. Risk of medicalization of symptoms

Excessive diagnostic testing and the absence of a coherent diagnostic narrative may contribute to the medicalization of pain symptoms. Patients in whom no clear structural cause of pain is identified often experience frustration, anxiety, and a tendency to seek further diagnoses, which may lead to symptom persistence and avoidance of physical activity [23,24]. This phenomenon has important clinical as well as economic implications.

4.5. Importance of a holistic approach in primary care

From the perspective of general practice, a holistic approach that integrates both biomechanical and psychosocial factors is particularly important. Continuity of care and familiarity with the patient's broader health context facilitate accurate interpretation of symptoms, effective patient education, and limitation of unnecessary diagnostic investigations [22,24]. Such an approach forms the basis of safe and rational management of patients presenting with exercise-related pain without clear structural abnormalities.

Table 1. Exercise-related pain without clear structural injury – clinical implications for primary care physicians

Clinical assessment element	Features suggestive of functional / load-related pain	Features requiring further diagnostic evaluation
Onset of symptoms	Gradual, progressive	Sudden, acute
Relation to physical activity	Worsens with activity, improves with rest or load modification	No clear relation to movement
Pain characteristics	Mechanical, variable, load-dependent	Constant, progressive, nocturnal
Pain localization	Diffuse, poorly localized, variable	Well localized
Systemic symptoms	Absent	Fever, weight loss, night sweats
Neurological examination	Normal	Sensory or motor deficits, sphincter disturbances
Response to load modification	Partial or complete improvement	No improvement or symptom progression
Role of imaging	Often poor correlation with symptoms	Useful when red flags are present

5. Clinical management and practical implications

Management of patients presenting with exercise-related pain without clear structural abnormalities should be guided by the principles of evidence-based medicine and focus on improving function, reducing pain, and enabling a safe return to physical activity. Avoidance of excessive diagnostic testing and medicalization of symptoms is essential, while maintaining appropriate clinical vigilance for signs of serious pathology [11,12].

5.1. Patient education and reassurance

Patient education represents a fundamental component of clinical management. Evidence indicates that understanding pain mechanisms and awareness of the lack of clear evidence for structural tissue damage can reduce patient anxiety, improve therapeutic engagement, and contribute to better clinical outcomes [10,28]. Reassurance based on accurate and transparent information should emphasize that pain does not necessarily indicate tissue injury and that appropriately modified physical activity is generally safe and beneficial.

5.2. Load modification and activity management

One of the key components in the management of overuse-related pain is modification of training load (load management). Rather than complete cessation of physical activity, a temporary reduction in training intensity, volume, or frequency is recommended, while maintaining activity within a range tolerated by the patient [9,27]. This approach allows preservation of musculoskeletal adaptation and helps prevent deconditioning.

5.3. Gradual return to physical activity

A gradual return to physical activity (graded return to activity) should be planned on an individual basis and guided by the patient's response to load. Avoidance of rigid, time-based protocols and monitoring of symptom severity during load progression reduce the risk of symptom recurrence [27,30]. This strategy is consistent with current recommendations in sports medicine.

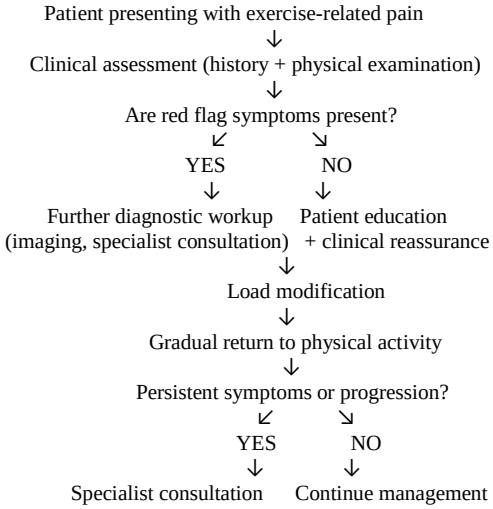
5.4. Role of non-pharmacological interventions

Non-pharmacological interventions, including exercise programs aimed at improving neuromuscular control, stability, and load tolerance, have demonstrated effectiveness in reducing pain and improving function in patients with non-specific musculoskeletal conditions [14,17]. When referral to physiotherapy is indicated, the use of active therapeutic strategies is recommended over approaches relying exclusively on passive techniques.

5.5. Pharmacological treatment and indications for specialist referral

Pharmacological treatment should be limited to a short-term, supportive role. There is no evidence supporting the long-term effectiveness of pharmacological therapy in pain without clear structural abnormalities, and excessive use may lead to adverse effects and masking of symptoms [34,35]. Referral to a specialist is indicated in cases of insufficient improvement despite appropriate conservative management, symptom progression, or the emergence of red flag features.

Figure 1. Proposed management pathway for patients with exercise-related pain without clear structural injury



6. Limitations of the available evidence

This article is a narrative review, which entails inherent methodological limitations, including the absence of a formal risk-of-bias assessment and the lack of quantitative data synthesis. As a result, the applied approach does not allow for a precise determination of the strength of evidence or direct comparison of outcomes across individual studies.

The available literature addressing exercise-related pain without clear structural abnormalities is characterized by substantial heterogeneity with respect to the definitions of pain syndromes, population characteristics, and diagnostic methods used. This limits the generalizability of the presented conclusions to the broader population of patients managed in primary care settings.

Furthermore, a considerable proportion of the analyzed studies focus on selected types of physical activity or involve relatively small study populations, which may reduce their practical applicability. Further research, particularly prospective studies conducted in primary care environments, is needed to better define optimal diagnostic and management strategies for patients presenting with exercise-related pain without identifiable structural pathology.

7. Conclusions

Exercise-related pain without clear structural abnormalities is a common clinical problem in general practice; however, its clinical presentation is often non-specific and heterogeneous. The lack of a clear correlation between symptom severity and imaging findings may complicate the diagnostic process and contribute to uncertainty on the part of both patients and clinicians.

Available evidence suggests that, in a substantial proportion of patients, effective management can be based on careful clinical assessment, deliberate identification of red flag features, and cautious, selective use of additional diagnostic investigations. In everyday practice, avoidance of routine imaging in patients without signs of serious pathology, combined with clear communication regarding the significance of diagnostic findings, appears particularly important.

From the perspective of general practice, adopting an approach focused on patient function rather than the exclusive pursuit of structural abnormalities may be especially beneficial. Patient education, modification of activity-related loads, and a gradual, individually tailored return to physical activity may represent a safe and rational management strategy for selected patients.

It should also be emphasized that these conclusions are derived from the analysis of heterogeneous data and should therefore be interpreted with caution. Further research, particularly prospective studies conducted in primary care settings, is required to better define optimal diagnostic and therapeutic strategies for patients presenting with exercise-related pain in the absence of clear structural pathology.

8. Disclosure

Conflict of Interest Statement: The authors declare no conflict of interest related to the publication of this article.

9. Author Contributions

Conceptualization: Michał Pietrasz
Methodology: Michał Pietrasz
Software: Not applicable

Formal analysis: Michał Pietrasz
Investigation: Michał Pietrasz
Resources: Michał Pietrasz
Writing- rough preparation: Michał Pietrasz
Writing- review and editing: Michał Pietrasz

All authors have read and agreed to the published version of the manuscript.

Funding Statement

No external funding was received for this study.

Institutional Review Board Statement

Not applicable. This article is a narrative review and does not involve human or animal subjects.

Informed Consent Statement

Not applicable. This study does not involve human participants.

Data Availability Statement

No new data were created or analyzed in this study.

Data sharing is not applicable to this article.

Conflict of Interest Statement

The authors declare no conflict of interest.

References

1. Warburton DER, Bredin SSD. Health benefits of physical activity: a systematic review of current systematic reviews. Curr Opin Cardiol. 2017;32(5):541–556. https://doi.org/10.1097/HCO.0000000000000437

2. Piercy KL, Troiano RP, Ballard RM, et al. The Physical Activity Guidelines for Americans. JAMA. 2018;320(19):2020–2028. https://doi.org/10.1001/jama.2018.14854

3. Hartvigsen J, Hancock MJ, Kongsted A, et al. What low back pain is and why we need to pay attention. Lancet. 2018;391(10137):2356–2367. https://doi.org/10.1016/S0140-6736(18)30480-X

4. Hoy D, Bain C, Williams G, et al. A systematic review of the global prevalence of low back pain. Ann Rheum Dis. 2012;71(6):968–974. https://doi.org/10.1136/annrheumdis-2011-201333

5. Brinjikji W, Luetmer PH, Comstock B, et al. Systematic literature review of imaging features of spinal degeneration in asymptomatic populations. AJNR Am J Neuroradiol. 2015;36(4):811–816. https://doi.org/10.3174/ajnr.A4173

6. Steffens D, Maher CG, Pereira LSM, et al. Prevention of low back pain. JAMA Intern Med. 2016;176(2):199–208. https://doi.org/10.1001/jamainternmed.2015.7431

7. Gabbett TJ. The training–injury prevention paradox. Br J Sports Med. 2016;50(5):273–280. https://doi.org/10.1136/bjsports-2015-095788

8. Moseley GL, Butler DS. Fifteen years of explaining pain. J Pain. 2015;16(9):807–813. https://doi.org/10.1016/j.jpain.2015.05.005

9. Drew MK, Finch CF. The relationship between training load and injury. Sports Med. 2016;46(6):861–883. https://doi.org/10.1007/s40279-015-0459-8

10. Jarvik JG, Gold LS, Tan K, et al. Rapid magnetic resonance imaging vs radiographs for patients with low back pain. JAMA. 2003;289(21):2810–2818. https://doi.org/10.1001/jama.289.21.2810

11. Morgan DJ, Dhruva SS, Wright SM, Korenstein D. Update on medical overuse. JAMA Intern Med. 2015;175(1):120–124. https://doi.org/10.1001/jamainternmed.2014.5441

12. Berwick DM, Hackbarth AD. Eliminating waste in US health care. JAMA. 2012;307(14):1513–1516. https://doi.org/10.1001/jama.2012.362

13. Balagué F, Mannion AF, Pellisé F, Cedraschi C. Non-specific low back pain. Lancet. 2012;379(9814):482–491. https://doi.org/10.1016/S0140-6736(11)60610-7

14. Choosing Wisely Campaign. Five things physicians should question. JAMA. 2012;307(20):2115–2116. https://doi.org/10.1001/jama.2012.475

15. Finestone AS, Raveh A. Overuse injuries in sport. BMJ. 2014;349:g4902. https://doi.org/10.1136/bmj.g4902

16. Henschke N, Maher CG, Refshauge KM, et al. Prognosis in patients with recent onset low back pain. BMJ. 2008;337:a171. https://doi.org/10.1136/bmj.a171

17. Hamilton DF, Lane JV, Gaston P, et al. What determines patient satisfaction? BMJ Open. 2014;4:e005123. https://doi.org/10.1136/bmjopen-2014-005123

18. Raja AS, Ip IK, Sodickson A, et al. Radiology utilization in the emergency department. Radiology. 2014;273(2):445–453. https://doi.org/10.1148/radiol.14132331

19. Travell JG, Simons DG. Myofascial Pain and Dysfunction. Baltimore: Williams & Wilkins; 1999.

20. McGill SM. Low Back Disorders: Evidence-Based Prevention and Rehabilitation. Champaign: Human Kinetics; 2007.

21. Bogduk N. Clinical Anatomy of the Lumbar Spine. 5th ed. London: Elsevier; 2012.

22. Brukner P, Khan K. Clinical Sports Medicine. 4th ed. Sydney: McGraw-Hill; 2012.

23. Fields BK, Skalski MR, Patel DB, et al. Athletic injuries of the abdominal wall. Radiographics. 2017;37(6):1780–1796. https://doi.org/10.1148/rg.2017170059

24. Srinivasan R, Greenbaum DS. Chronic abdominal wall pain. Am J Gastroenterol. 2002;97(4):824–830. https://doi.org/10.1111/j.1572-0241.2002.05605.x

25. Weir A, Brukner P, Delahunt E, et al. Doha agreement on terminology and definitions in groin pain. Br J Sports Med. 2015;49(12):768–774. https://doi.org/10.1136/bjsports-2015-094869

26. Serner A, van Eijck CH, Beumer BR, et al. Study of groin pain diagnoses. Br J Sports Med. 2015;49(12):810–817. https://doi.org/10.1136/bjsports-2014-094575

27. Tak IJR, Langhout RF, Barendrecht M, et al. Risk factors for groin injury. Br J Sports Med. 2017;51(16):1211–1218. https://doi.org/10.1136/bjsports-2016-096608

28. Orchard J, Read JW, Neophyton J, Garlick D. Groin pain associated with hip pathology. Br J Sports Med. 2000;34(5):379–382. https://doi.org/10.1136/bjsm.34.5.379

29. Fairbank JCT, Pynsent PB. The Oswestry Disability Index. Spine. 2000;25(22):2940–2953. https://doi.org/10.1097/00007632-200011150-00017

30. Hoy D, March L, Brooks P, et al. The global burden of low back pain. Ann Rheum Dis. 2014;73(6):968–974. https://doi.org/10.1136/annrheumdis-2013-204428

31. Caudill P, Nyland J, Smith C, et al. Sports hernia. Sports Health. 2008;1(1):33–42. https://doi.org/10.1177/1941738108324118

32. Meyers WC, Foley DP, Garrett WE, et al. Management of severe lower abdominal pain. Am J Sports Med. 2000;28(1):2–8. https://doi.org/10.1177/03635465000280011301

33. Robinson P, Barron DA, Parsons W, et al. Adductor-related groin pain. Clin Radiol. 2004;59(6):523–530. https://doi.org/10.1016/j.crad.2004.01.006

34. Hölmich P, Larsen K, Krogsgaard K, Gluud C. Exercise program for long-standing groin pain. Lancet. 1999;353(9151):439–443. https://doi.org/10.1016/S0140-6736(98)03340-6

35. Bahr R, Holme I. Risk factors for sports injuries. Br J Sports Med. 2003;37(5):384–392. https://doi.org/10.1136/bjsm.37.5.384

36. Reiner M, Niermann C, Jekauc D, Woll A. Long-term health benefits of physical activity. BMC Public Health. 2013;13:813. https://doi.org/10.1186/1471-2458-13-813

37. Pines JM, Hilton JA, Weber EJ, et al. International perspectives on emergency department crowding. Acad Emerg Med. 2011;18(12):1358–1370. https://doi.org/10.1111/j.1553-2712.2011.01235.x

38. Pitts SR, Niska RW, Xu J, Burt CW. National Hospital Ambulatory Medical Care Survey. Natl Health Stat Rep. 2008;7:1–38.

39. Vlaeyen JWS, Linton SJ. Fear-avoidance and chronic musculoskeletal pain. Pain. 2000;85(3):317–332. https://doi.org/10.1016/S0304-3959(99)00242-0

40. Woolf CJ. Central sensitization. Pain. 2011;152(3 Suppl):S2–S15. https://doi.org/10.1016/j.pain.2010.11.002

41. Crombez G, Vlaeyen JWS, Heuts PHTG, Lysens R. Pain-related fear is more disabling than pain itself. Pain. 1999;80(1–2):329–339. https://doi.org/10.1016/S0304-3959(98)00229-2

42. Cassel CK, Guest JA. Choosing wisely. JAMA. 2012;307(17):1801–1802. https://doi.org/10.1001/jama.2012.476

43. Louw A, Diener I, Butler DS, Puentedura EJ. The effect of neuroscience education on pain. Arch Phys Med Rehabil. 2011;92(12):2041–2056. https://doi.org/10.1016/j.apmr.2011.07.198

44. Silbernagel KG, Crossley KM. A proposed return-to-sport framework. Br J Sports Med. 2015;49(9):589–595. https://doi.org/10.1136/bjsports-2014-094844

45. Turk DC, Wilson HD, Cahana A. Treatment of chronic non-cancer pain. Lancet. 2011;377(9784):2226–2235. https://doi.org/10.1016/S0140-6736(11)60402-9