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Research Article

Effect of acute low back pain on the risk of chronicity, functional disability and flexibility of the lumbar spine in CrossFit practitioners: Cross-sectional study

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HIGHLIGHTS

- Acute LBP increases chronicity risk in CrossFit practitioners.
- Low back pain did not affect lumbar spine flexibility or mobility.
- Chronicity of LBP is linked to higher pain intensity.
- CrossFit practitioners with LBP show no increased functional disability.

ABBREVIATIONS

CG	Control group
C7	Seventh cervical vertebra
GL	Low back pain group
LBP	Low back pain
L5	Fifth lumbar vertebra
QBPQ	Quebec Back Pain Disability Questionnaire
RMDQ	Roland-Morris Disability Index questionnaire
SBST	Start Back Screening Tool questionnaire
VAS	Visual Analog Scale

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BACKGROUND: Nonspecific low back pain can become chronic over time. However, monitoring the chronicity of low back pain symptoms can be a major challenge for health professionals.
AIM: To verify the effect of acute low back pain on the risk of chronicity and on clinical-functional changes in the lumbar spine in CrossFit practitioners.
METHOD: A total of Sixty CrossFit practitioners were divided into two groups: the low back pain group – GL (n = 30) and the control group – CG (n = 30). The pain was assessed using the VAS and lumbar spine flexibility was assessed using the Schober and Stibor tests. The risk of chronic low back pain was assessed using the Start Back Screening Tool (SBST) questionnaire. The functionality of the lumbar spine was assessed using the Roland-Morris Disability Index (RMDQ) questionnaire and the Quebec Back Pain Disability Questionnaire (QBPQ). An independent t-test was used to compare the measurements of the dependent variables between the groups, using $p < 0.05$.
RESULTS: CrossFit practitioners with low back pain (LBP) showed elevated scores on the Start Back Screening Tool (SBST), indicating a greater risk of chronicity compared to the pain-free control group. Functional disability assessments also revealed significant differences, with the LBP group scoring higher on the Rolland Morris and Quebec questionnaires, indicating greater disability. Both groups demonstrated similar thoracic and lumbar spine mobility and flexibility.
CONCLUSION: CrossFit practitioners with acute low back pain had a higher risk of chronicity and decreased functional disability when compared to the control group. Despite these differences, both groups demonstrated similar mobility and flexibility of the thoracic and lumbar spine.

KEYWORDS: Chronic pain | Lumbar spine | Start back screening tool | Spinal mobility

INTRODUCTION

Nonspecific low back pain (LBP), without an identifiable cause, is a prevalent musculoskeletal dysfunction affecting approximately 83.1% of CrossFit practitioners [1].

The etiology of LBP in this population is multifactorial, often linked to the high-intensity, repetitive nature of CrossFit exercises that involve complex functional movements performed under significant axial loading and short rest intervals [2,3]. Exercises such as deadlifts and squats, core components of CrossFit, impose substantial stress on the lumbar spine [4]. Minor deviations in form, particularly when compounded by fatigue, can result in increased intradiscal pressure, leading to lumbar disk herniation and chronic pain [1,5]. This biomechanical strain, coupled with the sport's emphasis on high repetitions and speed, creates an environment ripe for injury, especially in individuals lacking sufficient core stability or technical skill [6].

CrossFit athletes have higher values of muscular strength/endurance in the trunk, influencing the spine and lower limbs, this

could be one of the causes of the kinematic changes in the spine [7]. However, we still do not know whether flexibility could alter the kinematics of the spine [8]. The progression from acute to chronic LBP in CrossFit practitioners is often associated with kinematic changes in the sagittal plane of the spine [7,8]. Studies have shown that chronic LBP can lead to decreased movements and decreased functional capacity, further perpetuating the cycle of pain and disability [7,9,10].

Low back pain symptoms in CrossFit practitioners last for more than 6.4 months, impacting practitioners regarding the increase in conservative treatment time estimated at 9.6 months [1]. However, when unsuccessful, practitioners are directed to undergo surgical treatment, with the recommendation to return to CrossFit practice only one year after the surgical procedure [1,10]. Monitoring the progression of LBP symptoms presents a challenge for health professionals due to the complex interplay of physical, psychological, and social factors that influence pain perception and chronicity [11]. Factors such as fear-avoidance behaviors, stress, and lack of coping strategies can exacerbate pain, making effective management a multifaceted task requiring a patient-centered [12].

Given these complexities, this study aims to evaluate the effect of acute LBP on the risk of chronicity and on clinical-functional changes of the spine in CrossFit practitioners [7,11]. We hypothesize that acute LBP, if not adequately managed, significantly increases the risk of progression to chronic pain, which is associated with decreased lumbar spine mobility and increased functional disability. Understanding the effect of chronicity risk will inform assessment strategies focused on chronic pain.

METHODS

Participants

This cross-sectional study involved 60 CrossFit practitioners in the Scale category. The inclusion criteria were: CrossFit practitioners with and without low back pain, acute low back pain (pain perceived only in the last 14 days), CrossFit practitioners who reported having acute low back pain with constant symptoms (at least one episode of perceived pain per day) in the last 14 consecutive days, pain without radiation to the lower limbs, training frequency of twice a week [13], a minimum practice duration of one year [14], age between 18 and 59 years old, female and male sex, no neurological abnormalities, congenital diseases, or spinal disorders. The exclusion criterion was any functional limitation requiring movement assistance. The study procedure was reviewed and approved by the Research Departmental Committee of the University of Santo Amaro-UNISA (CAAE: 67814723.2.0000.0081 and registration number: 5.943.593). All participants signed an informed consent form.

Experimental Design and Procedures

The participants were divided into two groups according to low back pain symptom or not: low back pain group (LBP): CrossFit practitioners with non-specific low back pain symptoms (n=30); control group (CG): CrossFit practitioners who did not present any low back pain symptoms (n=30).

The initial questionnaire was administered to collect information about CrossFit practice (training duration and frequency, years of practice, days of perceived pain and musculoskeletal injuries).

Low back pain symptoms were assessed using the visual numerical pain scale (VAS), where intensity is evaluated on a 0-10 scale, where 0 indicates no pain, and 10 indicates unbearable pain [15]. The SBST questionnaire was used to stratify the prognosis of low back pain [16]. This tool classifies a patient's risk of chronicity for low back pain with a focus on modifiable biopsychosocial risk factors. The questionnaire contains nine items related to low back pain; items 1 to 4 are related to referred pain, dysfunction, and comorbidities (such as shoulder and neck pain), and items 5 to 9 are related to psychosocial changes (referring to discomfort, catastrophizing, fear, anxiety, and depression). A score in this subscale of ≤3 points indicate medium risk, and >3 points classify a patient in the high-risk group [17]. Thus, classification will be high risk when considered with a high level of psychosocial factors with or without the presence of physical characteristics, medium risk when considered with a low level of physical and psychosocial factors, and low risk when considered with minimal levels of physical and psychosocial factors [16].

The Schober's test (Figure 1a) was performed to evaluate the flexibility of the lumbar spine during anterior trunk flexion with validity and reliability [18]. For this test, each individual was barefoot; the lumbar spine area was free of clothing to allow the examining physiotherapist to delimit the anatomical points. With a ballpoint pen, the physiotherapist marked the lower margin of the posterior superior iliac spines, drawing a horizontal line on the midline between these two anatomical points. Next, the physiotherapist positioned the tip of a measuring tape firmly against the skin tissue of the marked area; a second vertical mark was added 15 cm above the initial mark. The participant was asked to flex the anterior part of the trunk until the onset of pain, and a new measurement was marked between the lower and upper boundaries; the participant then returned to the neutral position. During the test, participants were required to perform controlled trunk flexion in the sagittal plane, and were not allowed to tilt or rotate the spine. Participants were also not allowed to flex their knees or perform any compensation of the lower limbs. The difference between the initial distance (between the two skin demarcations in the neutral position) and the new measurement in the flexed trunk position indicated lumbar spine flexibility (mobility) in centimeters, with millimeter precision. Initially, it is 15 cm in the orthostatic position, and this measurement should increase by 6 cm during trunk flexion. After measurement, the marks were removed with hand sanitizer [18].

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The Stibor Index (Figure 1b) measures the flexibility between the thoracic and lumbar spine segments. With a ballpoint pen, the physiotherapist drew a line along the spinous process of the seventh cervical vertebra (C7) and the fifth lumbar vertebra (L5-S1), previously marked. During the test, participants were required to perform controlled trunk flexion in the sagittal plane, and were not allowed to tilt or rotate the spine. Participants were also not allowed to flex their knees or perform any compensation of the lower limbs. The distance between the anatomical points was measured and marked using a measuring tape. The participant was then asked to perform anterior trunk flexion, and the examiner measured the distance between the two points again. The Stibor Index is the difference between the two markings (in the orthostatic and inclined positions). For individuals with normal flexibility, this point should move to indicate an increase in distance of approximately 10 cm [18].

Two questionnaires were used to verify the functionality of the lumbar spine. The Roland-Morris Disability Index – (RMDQ) published in 1983, assesses the impact of low back pain on work and daily activities due to low back pain. It is more recommended for a population with low functional disability [19]. The instrument was validated for Brazilian Portuguese by Nusbaum et al. in 2001. Roland and Morris selected 24 out of 136 questions from the Sickness Impact Profile to produce the RMDQ, making it faster and easier to apply, with an average response time of five minutes. The score is calculated by summing the items from zero (no disability) to 24 (severe disability). Scores above 14 points indicate physical disability. The minimum clinically significant difference is 5 points.

Quebec Back Pain Disability Questionnaire – QBPQ. Developed by Kopec in 1995 to measure functional disability caused by low back pain, the completion time is 5 to 10 minutes. It was validated for Brazilian Portuguese by Rodrigues in 2007. It consists of 20 items that describe the difficulty of performing light-intensity physical activities. It comprises six domains: rest/sleep, sitting/standing, walking, movements, bending/stopping, and heavy objects. Each item has a scale with six scores (0 to 5), where 0 is no difficulty, and 5 is the maximum inability to perform the activity. Therefore, the final score ranges from 0 to 100 points, indicating a worse clinical condition as the score increases. The minimum value of 1 variation in the score for a clinical change to be observed is 15 to 20 [20].

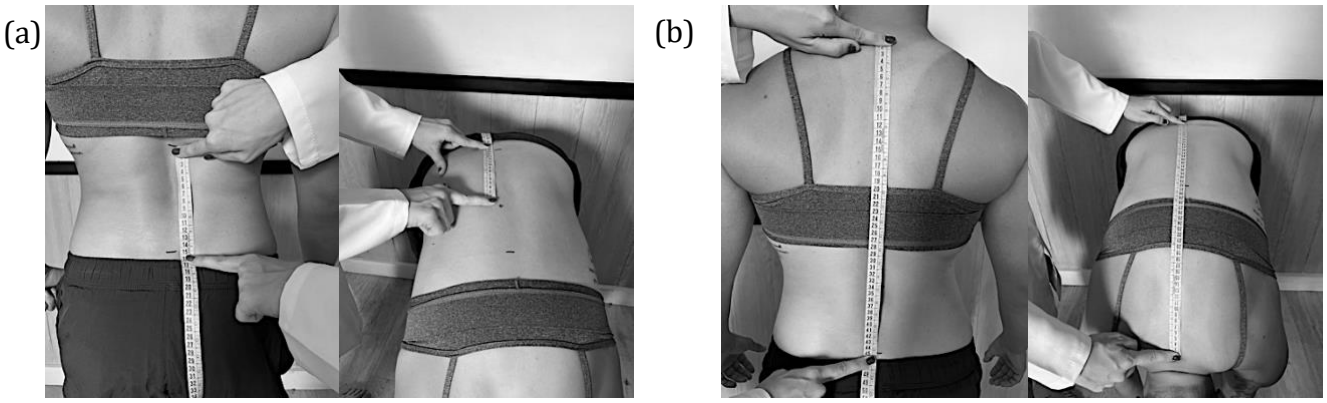

Figure 1. a) Demonstration of the schober test. b) Demonstration of the stibor test.

Statistical Analysis

All statistical analyses were performed using SPSS version 24 (IBM, Chicago, IL, USA). Descriptive measures will be presented as means and standard deviations. Data normality was verified using the Shapiro-Wilk test. To compare the measures of dependent variables between the groups with and without low back pain, the Student's t-test for independent measures was used. For all analyses, significant differences were considered when $p<0.05$.

RESULTS

The anthropometric variables, practice duration, pain and training frequency showed no statistically significant differences between the groups (Table 1).

Table 1. Mean, standard deviation, and p-value of anthropometric, pain and training variables between the groups of CrossFit practitioners.

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Variables	Low back pain group (n= 30)	Control group (n= 30)	p-value
Age (years)	34.1±44.7	34.2±62.9	0.486
Height (m)	1.7±0.1	1.7±0.2	0.494
Body mass (kg)	72.8±8.5	73.3±7.5	0.447
Body mass index (kg/m²)	24.9±2.6	25.1±2.6	0.422
Time practicing CrossFit (months)	48.9±3.1	46.3±3.5	0.092
Training frequency (h/week)	5.5±1.2	5.2±2.2	0.192
Pain (VAS)	5.7±4.7	0.2±0.1	<0.001*
Pain duration (days)	2,8±0.8	0.4±0.2	< 0.001*

* Independent t-test: considering statistical differences p<0.05.

The clinical-functional evaluation showed SBST scores higher values in the low back pain group. These findings suggest a greater risk of chronicity and more severe pain symptoms in the low back pain group. In contrast, there were no significant differences between the groups in the Schober and Stibor tests, reflecting similar mobility and flexibility of the thoracic and lumbar spine. These results emphasize the increased chronicity risk in the low back pain group, while spinal mobility and flexibility remained comparable (Table 2):

Table 2. Mean, standard deviation, and p-value of clinical-functional evaluation between the groups of CrossFit practitioners. SBST: Start Back Screening Tool questionnaire (risk of chronicity). Schober and Stibor index: mobility and flexibility of the thoracic and lumbar spine, respectively.

Clinical-functional evaluation	Low back pain group (n= 30)	Control group (n= 30)	p-value
SBST (score)	2.1±1.7	0.3±0.1	<0.001*
Schober test (cm)	6.0±6.0	6,3±4,4	0.268
Stibor test (cm)	9.3±9.3	9,7±5,4	0.285

* Independent t-test: considering statistical differences p<0.05.

The functional disability assessments showed significant differences between the low back pain group and the control group. The Rolland Morris scores were notably higher in the low back pain group, indicating greater disability, while the control group had much lower scores. Similarly, the Quebec scores were significantly elevated in the low back pain group compared to the control group, highlighting more pronounced functional impairment in those with low back pain (Table 3).

Table 3. Mean, standard deviation, and p-value of functional disability assessments of the lumbar spine between the groups of CrossFit practitioners.

Functional disability	Low back pain group (n= 30)	Control group (n= 30)	p-value
Rolland Morris (score)	3.6±1.9	0.7±0.3	<0.001*
Quebec (score)	12.2±2.7	1.5±0.8	<0.001*

* Independent t-test: considering statistical differences p<0.05.

DISCUSSION

The present study aimed to evaluate the effect of acute low back pain on the risk of chronicity, functional disability and flexibility of the lumbar spine in CrossFit practitioners. The findings revealed that CrossFit practitioners with low back pain (LBP) showed elevated scores on the Start Back Screening Tool (SBST), indicating a greater risk of chronicity compared to the pain-free control group. Despite these differences in chronicity risk, both groups demonstrated similar thoracic and lumbar spine mobility and flexibility, as measured by the Schober and Stibor tests. Functional disability assessments also revealed significant differences, with the LBP group scoring higher on the

Rolland Morris and Quebec questionnaires, indicating greater disability. This finding highlights the need for a clinical assessment model with a patient-centered focus.

Our findings are consistent with the existing literature, according to Hopkins et al. (2019) [1], the high prevalence of low back pain among CrossFit practitioners should be regarded as a contributing factor to interruptions in CrossFit practice [1]. Our study demonstrated that the group with low back pain experienced significantly greater chronicity risks, and increased functional disability compared to the pain-free control group, emphasizing the importance of targeted assessment strategies for chronic pain management.

Pain in athletes is a multifaceted issue influenced by neurophysiological, biomechanical, and psychosocial factors [21]. A study observed that pain can occur independently of injury or persist long after the initial injury has healed, emphasizing the complex nature of pain beyond mere physical damage [10]. In our study, while both groups displayed similar spinal mobility and flexibility, the significant differences in risks of chronicity in the low back pain group highlight the importance of considering assessment approaches in chronic pain that are more specific to the risk of chronicity of low back pain.

Medeiros et al. (2017) [22] supports the concept that non-specific low back pain, which was the focus of our study, often results from a combination of factors rather than a single identifiable cause [23]. The absence of significant differences in mobility tests between our low back pain and control groups suggests that functional impairment may only sometimes correlate directly with objective measures of flexibility or mobility. This finding highlights the importance of a quantitative approach through functional disability questionnaires for the evaluation of CrossFit practitioners.

Spinal mobility is one of the major functional requirements for physical performance during CrossFit [24]. According to the literature, some postural adaptations are performed by CrossFit practitioners, such as increased anterior trunk flexion during sports gestures involving squats [25]. As CrossFit practitioners in the sample of the present study showed acute symptoms of low back pain, and adaptations in spinal mobility may be more effective. This hypothesis is corroborated by studies showing that CrossFit practitioners present increased muscular performance of the lumbar spine muscles, especially resistance strength, causing an increase in anterior trunk flexion and, consequently, greater mobility of the lumbar spine [8,25].

One limitation of our study is its cross-sectional design, which restricts our ability to establish causality between low back pain and the factors evaluated, such as training frequency, duration, and biomechanical measures. Additionally, the sample size, though adequate, was limited to CrossFit practitioners in the Scale category, potentially reducing the generalizability of our findings to other levels of practitioners or to different high-intensity training modalities. Another limitation is the reliance on self-reported data for pain levels and training history, which introduces the possibility of recall bias and subjective variability in pain perception. Furthermore, while we used validated tools for assessing pain and disability, such as the Visual Analog Scale (VAS) and the Roland-Morris Disability Questionnaire, these instruments primarily capture the severity of symptoms rather than the underlying mechanisms of pain, which might include psychosocial factors not fully accounted for in our study. Lastly, the absence of longitudinal follow-up limits our ability to assess the long-term impact of CrossFit on low back pain progression and recovery, highlighting the need for future studies to adopt a prospective design to understand better the dynamics of pain and injury in this population.

The findings of this study have important clinical implications for the management of low back pain in CrossFit practitioners. Our results demonstrate that individuals with low back pain present an increased risk of chronicity, and greater functional disability, while exhibiting similar spinal mobility compared to those without pain. These findings suggest that health professionals should emphasize, during physical assessments, an approach that includes the evaluation of pain perception and the risk of chronicity, potentially through a biopsychosocial framework. This approach could facilitate the early identification of chronicity risk in CrossFit practitioners, allowing for a more targeted assessment focused on chronic pain. In this context, our findings contribute to the early identification of chronic low back pain, potentially preventing interruptions in CrossFit practice.

CONCLUSION

CrossFit practitioners with acute low back pain had a higher risk of chronicity and decreased functional disability when compared to the control group. Despite these differences, both groups demonstrated similar mobility and flexibility of the thoracic and lumbar spine.

REFERENCES

1. Hopkins BS, Cloney MB, Kesavabhotla K, et al. Impact of CrossFit-Related Spinal Injuries. *Clin J Sport Med*. Nov 2019;29(6):482-485. doi:10.1097/JSM.0000000000000553
2. Sprey JW, Ferreira T, de Lima MV, Duarte A, Jorge PB, Santili C. An Epidemiological Profile of CrossFit Athletes in Brazil. *Orthop J Sports Med*. Aug 2016;4(8):2325967116663706. doi:10.1177/2325967116663706
3. Moran S, Booker H, Staines J, Williams S. Rates and risk factors of injury in CrossFitTM: a prospective cohort study. *J Sports Med Phys Fitness*. Sep 2017;57(9):1147-1153. doi:10.23736/S0022-4707.16.06827-4

4. de Almeida RL, Carvalho VG, Ribeiro Neto F. In Response to: Impact of CrossFit-Related Spinal Injuries. *Clin J Sport Med*. Nov 2019;29(6):e87. doi:10.1097/JSM.0000000000000583
5. Ángel Rodríguez M, García-Calleja P, Terrados N, Crespo I, Del Valle M, Olmedillas H. Injury in CrossFit®: A Systematic Review of Epidemiology and Risk Factors. *Phys Sportsmed*. Feb 2022;50(1):3-10. doi:10.1080/00913847.2020.1864675
6. Ferreira IC, Almeida Souza M, Miarka B, et al. Interquartile differences in biomechanical parameters in CrossFit® athletes during deep squats with submaximal load until fatigue. *J Sports Med Phys Fitness*. Sep 2020;60(9):1216-1222. doi:10.23736/S0022-4707.20.10845-4
7. de Souza BL, de Souza PC, Ribeiro AP. Effect of low back pain on clinical-functional factors and its associated potential risk of chronicity in adolescent dancers of classical ballet: cross-sectional study. *BMC Sports Sci Med Rehabil*. May 02 2022;14(1):81. doi:10.1186/s13102-022-00474-6
8. Silva MVGD, Soares IC, Ventura SC, et al. Trunk muscles influence lower limb performance in crossfit athletes: A cross-sectional study. *Physiother Res Int*. Jan 2024;29(1):e2040. doi:10.1002/pri.2040
9. Patrick N, Emanski E, Knaub MA. Acute and chronic low back pain. *Med Clin North Am*. Jul 2014;98(4):777-89, xii. doi:10.1016/j.mcna.2014.03.005
10. Cohen SP, Vase L, Hooten WM. Chronic pain: an update on burden, best practices, and new advances. *Lancet*. May 29 2021;397(10289):2082-2097. doi:10.1016/S0140-6736(21)00393-7
11. Edwards RR, Dworkin RH, Sullivan MD, Turk DC, Wasan AD. The Role of Psychosocial Processes in the Development and Maintenance of Chronic Pain. *J Pain*. Sep 2016;17(9 Suppl):T70-92. doi:10.1016/j.jpain.2016.01.001
12. Hochheim M, Ramm P, Amelung V. The effectiveness of low-dosed outpatient biopsychosocial interventions compared to active physical interventions on pain and disability in adults with nonspecific chronic low back pain: A systematic review with meta-analysis. *Pain Pract*. Apr 2023;23(4):409-436. doi:10.1111/papr.13198
13. Szeles PRQ, da Costa TS, da Cunha RA, et al. CrossFit and the Epidemiology of Musculoskeletal Injuries: A Prospective 12-Week Cohort Study. *Orthop J Sports Med*. Mar 2020;8(3):2325967120908884. doi:10.1177/2325967120908884
14. Feito Y, Burrows EK, Tabb LP. A 4-Year Analysis of the Incidence of Injuries Among CrossFit-Trained Participants. *Orthop J Sports Med*. Oct 2018;6(10):2325967118803100. doi:10.1177/2325967118803100
15. Shafshak TS, Elnemr R. The Visual Analogue Scale Versus Numerical Rating Scale in Measuring Pain Severity and Predicting Disability in Low Back Pain. *J Clin Rheumatol*. Oct 01 2021;27(7):282-285. doi:10.1097/RHU.0000000000001320
16. Pilz B, Vasconcelos RA, Marcondes FB, Lodovichi SS, Mello W, Grossi DB. The Brazilian version of STarT Back Screening Tool - translation, cross-cultural adaptation and reliability. *Braz J Phys Ther*. 2014 Sep-Oct 2014;18(5):453-61. doi:10.1590/bjpt-rbf.2014.0028
17. Hill JC, Fritz JM. Psychosocial influences on low back pain, disability, and response to treatment. *Phys Ther*. May 2011;91(5):712-21. doi:10.2522/ptj.20100280
18. Rezvani A, Ergin O, Karacan I, Oncu M. Validity and reliability of the metric measurements in the assessment of lumbar spine motion in patients with ankylosing spondylitis. *Spine (Phila Pa 1976)*. Sep 01 2012;37(19):E1189-96. doi:10.1097/BRS.0b013e31825ef954
19. Roland M, Fairbank J. The Roland-Morris Disability Questionnaire and the Oswestry Disability Questionnaire. *Spine (Phila Pa 1976)*. Dec 15 2000;25(24):3115-24. doi:10.1097/00007632-200012150-00006
20. Fritz JM, Irrgang JJ. A comparison of a modified Oswestry Low Back Pain Disability Questionnaire and the Quebec Back Pain Disability Scale. *Phys Ther*. Feb 2001;81(2):776-88. doi:10.1093/ptj/81.2.776
21. Hainline B, Turner JA, Caneiro JP, Stewart M, Lorimer Moseley G. Pain in elite athletes-neurophysiological, biomechanical and psychosocial considerations: a narrative review. *Br J Sports Med*. Sep 2017;51(17):1259-1264. doi:10.1136/bjsports-2017-097890
22. Medeiros FC, Costa LOP, Added MAN, Salomão EC, Costa LDCM. Longitudinal Monitoring of Patients With Chronic Low Back Pain During Physical Therapy Treatment Using the STarT Back Screening Tool. *J Orthop Sports Phys Ther*. May 2017;47(5):314-323. doi:10.2519/jospt.2017.7199
23. Medeiros FC, Costa LOP, Oliveira IS, Costa LDCM. A Responsiveness Analysis of the Subgroups for Targeted Treatment (STarT) Back Screening Tool in Patients With Nonspecific Low Back Pain. *J Orthop Sports Phys Ther*. 10 2019;49(10):725-735. doi:10.2519/jospt.2019.8776
24. Hak PT, Hodzovic E, Hickey B. The nature and prevalence of injury during CrossFit training. *J Strength Cond Res*. Nov 22 2013;doi:10.1519/JSC.0000000000000318
25. Willwacher S, Koopmann T, Dill S, Kurz M, Brüggemann GP. Dorsal muscle fatigue increases thoracic spine curvature in all-out recreational ergometer rowing. *Eur J Sport Sci*. Feb 2021;21(2):176-182. doi:10.1080/17461391.2020.1737242

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