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*Editorial*

# Physical Exercise in Sports Sciences and Rehabilitation: Physiology, Clinical Applications and Real Practice

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## 1. Introduction

Physical exercise has long been recognized as a cornerstone of health promotion, disease prevention, and rehabilitation. Over the years, a substantial body of research has accumulated highlighting the beneficial effects of physical exercise on a wide range of health outcomes, such as cardiovascular disease, diabetes, obesity, cancer, mental health, cognitive function, and overall well-being [1,2]. In sports sciences and rehabilitation, physical exercise is not only used as a preventive and therapeutic tool, but also as a performance enhancer, allowing athletes to achieve their full potential and optimize their competitive outcomes [3,4].

In this Special Issue of Applied Sciences, we bring together a collection of original research articles, reviews, and clinical case reports that cover various aspects of physical exercise in sports sciences and rehabilitation. The aim of this Special Issue is to provide a comprehensive overview of the latest advances in the field, spanning from the basic physiological mechanisms underlying the effects of exercise on human health and performance, to the clinical applications of exercise in the management of various diseases and disabilities, and the real-world practice of exercise prescription and implementation in diverse settings.

## 2. Technology Advancement in Sports Sciences and Rehabilitation

The Special Issue "Physical Exercise in Sports Sciences and Rehabilitation: Physiology, Clinical Applications and Real Practice" explores the recent advancements and applications of physical exercise and rehabilitation in sports science. The issue contains a variety of research papers that investigate the use of physical exercise in improving muscular activity, in the prevention and management of chronic diseases, such as diabetes, obesity, and cardiovascular disease, in cognitive function and mental health, in the rehabilitation of musculoskeletal injuries and neurological disorders, and in sport promoting, healing, and recovery. We believe that this Special Issue will be of great interest to researchers, clinicians, and practitioners working in the fields of sports sciences and rehabilitation, and to policymakers and the general public interested in promoting physical activity and healthy lifestyles.

To date, technological advancements, including artificial intelligence or machine learning analysis, have drastically influenced rehabilitative approaches in different fields and have influenced the clinical research, the diagnosis, and the management of musculoskeletal disorders [5,6].

Chiang et al. [7] assessed the effects of a 6 min fast-walking protocol on muscle activity in individuals with flat-foot, using a motion capture system (Vicon Motion Systems Ltd., Oxford, UK) with eight infrared cameras operating at 100 Hz to capture and determine gait cycle. The flatfoot group showed a decrease in the median frequency of the tibialis anterior (from 116 Hz to 106 Hz) after 6 min of fast walking ($p < 0.001$), further confirming that the

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tibialis anterior was likely most fatigued. Moreover, the median frequency of the abductor hallucis in the flatfoot group increased (from 189 Hz to 215 Hz) after 6 min of fast walking ($p < 0.001$).

In this context, de Sire et al. [8] performed a proof-of-principle study on professional football players. The authors performed an sEMG analysis of four muscles of the dominant leg (rectus femoris (RF), vastus medialis (VM), biceps femori (BF), and medial hamstrings (MH)) to evaluate the short-term effects of a neuromuscular warm-up on the knee stabilizer muscles' activation pattern, demonstrating an improvement of RF (from 181.72 ± 97.73 ms at T0 to 335.63 ± 225.95 ms at T1), VM (175.18 ± 87.25 ms at T0; 322.63 ± 163.35 ms at T1), of BF (128.1 ± 64.2 ms at T0; 201.90 ± 103.79 ms at T1), and MH (130.4 ± 54.1 ms at T0; 204.63 ± 108.57 ms at T1). Thus, a neuromuscular warm-up exercise program might improve the pre-activation timing of the knee stabilizer muscles.

Narita et al. [9] assessed the effects of a joint mobilization apparatus in terms of range of motion recovery in patients with Distal radius fractures. This innovative equipment comprised a laptop for video viewing, head-mounted virtual reality (VR) display, and vibrator (combined tendon vibratory and visual stimulus). The authors reported significant advantages in a ghost group in terms of the arcs of motion in patients with normal and low BMI ($p < 0.001$) and in probability of recovery of wrist flexion–extension RoM from day 14 to 82 ($p < 0.001$) compared to standard therapy alone. Vlažná et al. [10] demonstrated the reliability and validity of dynamometric protocols for trunk-muscle function (strength and endurance), including the lumbar extensors. Tognolo et al. [11] explored the relationship between clinical tests, ultrasound findings, and selected field-based wheelchair skills tests (WST) in a cohort of quadriplegic wheelchair rugby athletes, suggesting that ultrasound is a valuable tool in shoulder diagnostic and that dominant shoulder joint and rotator cuff muscle damage may be affected by chronic manual wheelchair use, while the non-dominant shoulder joint conditions seem related to the performance on the WST.

## 3. Rehabilitative Interventions for Musculoskeletal Disorders

Knee osteoarthritis is one of the main targets in the rehabilitation field, considering the role that physical exercise might perform in combination with intraarticular injections of corticosteroids, hyaluronic acid, platelet-rich-plasma, and oxygen-ozone therapy [12–14].

In this scenario, two papers [15,16] investigated the role of two techniques combined with physical exercise to improve functioning in patients with knee osteoarthritis.

First, Scaturro et al. [15] explored the use of intra-articular hybrid hyaluronic acid injection treatment in overweight patients with knee osteoarthritis, demonstrating a statistically significant ($p < 0.01$) improvement in cardiocirculatory capacity as measured by distance covered in a 6MWT post treatment, from a mean of 164.3 ± 52.9 m at T0 to a mean of 254.9 ± 52.6 m at T1. Moreover, a significant reduction ($p < 0.01$) in disease severity assessed by WOMAC was also observed at T1; median WOMAC was 56 before treatment, plummeting to 26 after viscosupplemention. Second, a reduction in pain severity as assessed via VAS was recorded, from a mean score of 8 at T0 to a mean score of 5 at T1; this was also found to be statistically significant ($p < 0.01$).

Third, de Sire et al. [16] investigated the effectiveness of combined treatment using physical exercise and ultrasound-guided radiofrequency ablation of genicular nerves in patients with knee osteoarthritis, showing a statistically significant reduction in pain at the 1-month evaluation (T1) (NPRS: 7.48 ± 1.74 vs. 3.63 ± 1.68; $p < 0.001$). Moreover, all patients showed a significant decrease in disability at T1 as suggested by the reduction in KOOS score from 21.45 ± 7.33 to 44.97 ± 10.77 ($p < 0.001$). Considering the KOOS domains, there was a statistically significant difference at T1 ($p < 0.001$) in all except for the "symptoms domain". In addition, a significant improvement in terms of HR-QoL was recorded in both EQ-5D (0.48 ± 0.06 vs. 0.67 ± 0.07; $p < 0.001$) and EQ-VAS (49.4 ± 4.3 vs. 79.4 ± 5.8; $p < 0.001$) [16].

Moreover, Pesce et al. [17] investigated the role of Irisin from exercise to cognitive performance. The study examined the role of irisin, a protein released during exercise, in

cognitive performance. The authors conducted a systematic review of previous studies and found that irisin may have a positive effect on cognitive performance, particularly in older adults. Ozimek et al. [18] suggested the presence of cytoprotective effects in two phytopreparations (Ligusticum wallichii and Eleutherococcus extract) in experimental animals during physical activity.

Another paper published in this Special Issue by Frizziero et al. [19] investigated the therapeutic efficacy of a new acupressure mat device associated with a specific rehabilitation program in patients with nonspecific chronic low back pain. The intervention group showed a decreasing in VAS score ($p < 0.001$) compared to control group.

Lastly, in 2022, Morone et al. [20] submitted a systematic review on the PETTLEP model (a cognitive-behavioral approach) of motor imagery and sport performance. The authors found that motor imagery training using the PETTLEP model can improve sport performance, particularly in tasks that require precision and accuracy.

## 4. Conclusions

Taken together, the studies presented in this Special Issue highlight the importance of physical exercise as a tool for improving health, enhancing performance, and facilitating rehabilitation. Furthermore, they demonstrate the potential for exercise-based interventions to improve outcomes across a range of populations, from healthy individuals to those with chronic conditions.

In conclusion, the articles included in this Special Issue on "Physical Exercise in Sports Sciences and Rehabilitation: Physiology, Clinical Applications, and Real Practice" have provided a comprehensive overview of the current state of knowledge in this important field. Physical exercise provides from the effects of exercise on cognitive performance to the application of motor imagery in sport performance, covering a broad range of topics, providing valuable insights for researchers, clinicians, and practitioners alike. Furthermore, the use of new technologies in terms of diagnosis therapeutic management of musculoskeletal diseases could perform a pivotal role in rehabilitation field.

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