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Peculiarities Of Sports Pharmacology In The Recovery Process Of Athletes

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Abstract

This article examines the role and specific characteristics of sports pharmacology in the recovery process of athletes after intensive physical activity and competitive loads. Particular attention is paid to the pharmacological and nutritional approaches used to support muscle recovery, restore energy reserves, maintain electrolyte balance, and prevent micronutrient deficiencies. The article analyses the potential benefits and limitations of dietary supplements, vitamins, minerals, and other pharmacological interventions. It also considers the importance of individual assessment, medical supervision, evidence-based practice, and compliance with anti-doping regulations. The findings emphasize that sports pharmacology should be integrated into a comprehensive recovery programme rather than used as an independent method of improving athletic performance.

Keywords: sports pharmacology, athletes, recovery process, physical activity, dietary supplements, vitamins, minerals, muscle fatigue, sports nutrition, anti-doping regulations.

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INTRODUCTION

Modern sport is characterized by increasing physical demands, intensive training programmes, and frequent competitions. Athletes are regularly exposed to significant physical and psychological stress, which may lead

to muscle fatigue, depletion of energy reserves, dehydration, electrolyte imbalance, and temporary reductions in physical performance. Therefore, the recovery process is an essential component of athletic preparation and long-term performance development.

Recovery refers to the physiological and psychological processes through which the body returns to an appropriate functional state after physical exertion. It involves the restoration of energy substrates, muscle tissue adaptation, regulation of metabolic processes, normalization of fluid and electrolyte balance, and recovery of the nervous system.

Sports pharmacology is an interdisciplinary field that examines the use, effects, benefits, and potential risks of pharmacological substances and selected nutritional supplements in sport. Its application in athlete recovery requires a scientific approach because different substances may affect the body in different ways depending on the athlete's age, sex, health status, training intensity, nutritional condition, and individual physiological characteristics.

The International Olympic Committee emphasizes that dietary supplements may contribute to an athlete's nutritional programme in specific circumstances. However, their use should be based on an individual nutritional assessment and reliable scientific evidence [1].

The purpose of this article is to examine the main characteristics of sports pharmacology in the recovery process of athletes, identify the potential role of selected substances, and explain the importance of safe and evidence-based pharmacological support.

METHODS

This study is based on a narrative analysis of scientific literature, international consensus statements, and research publications concerning sports pharmacology, sports nutrition, and athlete recovery.

The following research methods were applied:

- **Literature analysis:** examination of scientific publications related to sports pharmacology and recovery processes.
- **Comparative analysis:** comparison of different recovery strategies and their potential physiological effects.
- **Systematization:** classification of pharmacological and nutritional interventions according to their principal functions.
- **Generalization:** identification of common principles for the safe and effective application of recovery strategies.

The analysis focused on the following areas:

1. Restoration of energy reserves after physical activity.
2. Support of muscle recovery and adaptation.
3. Maintenance of hydration and electrolyte balance.
4. Prevention and correction of micronutrient deficiencies.
5. Medical safety and anti-doping compliance.

The article does not present a clinical experiment or prescribe medication. Its conclusions are based on the interpretation of published scientific evidence.

RESULTS

The role of sports pharmacology in athlete recovery Sports pharmacology may support the recovery process by addressing specific physiological needs. However, it should not be considered a substitute for adequate nutrition, sleep, hydration, and properly planned training loads.

The main areas in which pharmacological and nutritional interventions may be considered include:

- restoration of energy metabolism;
- maintenance of muscle function;
- correction of documented vitamin and mineral deficiencies;
- restoration of fluid and electrolyte balance;
- medical treatment of diagnosed injuries or illnesses.

The effectiveness of these interventions depends on the athlete's individual condition and the appropriateness of the selected method.

Main groups of substances used in recovery programmes Different substances and nutritional products may contribute to particular aspects of recovery. Their use should be determined by the athlete's nutritional status, medical needs, and the available scientific evidence.

Table 1. Main groups of substances and their potential roles in athlete recovery

Substance or group	Potential role	Important considerations
Protein and amino acids	Support muscle protein synthesis and tissue repair	Adequate daily protein intake is essential
Creatine monohydrate	Supports phosphocreatine availability and training adaptation	Benefits depend on the type of sport and training programme
Vitamins	Support normal metabolic and physiological functions	Supplementation is most justified when deficiency or increased requirements are identified
Minerals	Help maintain muscle function and electrolyte balance	Excessive intake may cause adverse effects
Carbohydrate products	Help replenish muscle glycogen after	Intake should correspond to training load and recovery

	demanding exercise	time
Electrolyte solutions	Support fluid and electrolyte replacement	Particularly relevant during prolonged exercise and substantial sweating
Anti-inflammatory medicines	May be used to treat specific medical conditions	Routine use for ordinary post-exercise soreness is not recommended without medical assessment

Protein is particularly important because it supplies amino acids required for muscle protein synthesis. When combined with appropriate resistance training, sufficient protein intake contributes to muscle adaptation and recovery.

Creatine monohydrate has been investigated extensively in sports science. Research indicates that it can improve certain training adaptations and may support recovery following some forms of muscle-damaging exercise. Nevertheless, its effects are not identical in all athletes or sporting disciplines [1].

Carbohydrates also play an important role in recovery. They contribute to the restoration of muscle glycogen, which is especially important for athletes who undertake repeated training sessions or competitions within a short period.

Vitamins and minerals in the recovery process Vitamins and minerals participate in numerous physiological processes, including energy metabolism, oxygen transport, muscle contraction, immune function, and tissue maintenance.

Iron is essential for haemoglobin production and oxygen transport. Iron deficiency may negatively affect endurance capacity and general physical performance. However, iron supplementation should be considered only after appropriate clinical assessment and laboratory testing.

Vitamin D contributes to bone health and normal muscle function. Athletes with insufficient vitamin D levels may require individualized nutritional or medical intervention.

Magnesium and potassium are involved in normal neuromuscular function and electrolyte regulation. Their adequate intake is important for maintaining physiological balance, particularly during periods of substantial physical exertion.

It is important to emphasize that excessive vitamin and mineral consumption does not automatically accelerate recovery. Unnecessary supplementation may cause adverse effects and should therefore be avoided.

Pharmacological support and muscle recovery Intensive physical activity can cause temporary muscle damage, inflammation, and delayed-onset muscle soreness (DOMS). These responses are part of the body's adaptation to exercise.

Some athletes use anti-inflammatory medications to reduce pain and discomfort. However, routine use of non-steroidal anti-inflammatory drugs (NSAIDs) after training may carry gastrointestinal, renal, and cardiovascular risks. It may also interfere with certain physiological adaptation processes. Therefore, such medicines should be used only when medically indicated and under professional supervision.

Nutritional compounds such as tart cherry products and curcumin have also been studied for their potential effects on inflammation and muscle soreness. Some studies report positive outcomes, but the evidence remains heterogeneous and is not sufficient to recommend them universally for all athletes [1].

The Recovery and Performance in Sport consensus statement emphasizes that recovery strategies should be selected according to the athlete's individual response to training and competition loads [2].

Hydration and electrolyte restoration Water and electrolytes are essential for maintaining normal physiological functions during and after exercise. Excessive sweating may lead to fluid loss and changes in sodium and other electrolyte levels.

The main objectives of hydration strategies include:

- replacing fluids lost through sweating;
- maintaining appropriate electrolyte balance;
- supporting cardiovascular function;
- facilitating thermoregulation;
- preventing dehydration-related reductions in performance.

For ordinary training sessions, water and a balanced diet are often sufficient. During prolonged exercise, intense heat exposure, or substantial sweat losses, electrolyte-containing drinks may be useful.

Hydration strategies should be individualized because both dehydration and excessive fluid consumption can be harmful.

Anti-doping regulations and the safety of pharmacological interventions One of the most important aspects of sports pharmacology is compliance with international anti-doping regulations. Athletes may unintentionally consume prohibited substances through contaminated supplements, incorrectly labelled products, or inadequately assessed medications.

The World Anti-Doping Agency (WADA) publishes the Prohibited List, which identifies substances and methods prohibited in sport. Athletes and their support teams should check the current list before using medications or supplements.

The International Olympic Committee also emphasizes that supplement use requires careful evaluation of scientific evidence, product quality, safety, and the potential risk of anti-doping violations [1].

Consequently, athletes should follow several important principles:

1. Use medicines only when there is a legitimate medical indication.
2. Consult a qualified sports physician before starting pharmacological treatment.
3. Check the anti-doping status of medicines and ingredients.
4. Avoid products with unclear composition or unverified claims.
5. Prefer independently tested supplements where supplementation is justified.
6. Keep records of medical treatments and supplement use.

DISCUSSION

The analysis demonstrates that sports pharmacology can contribute to athlete recovery when it is applied carefully and in accordance with scientific evidence. Nevertheless, pharmacological interventions should be regarded as one component of a broader recovery system.

The effectiveness of recovery depends on several interconnected factors, including training intensity, nutritional quality, sleep duration, hydration, psychological condition, and individual physiological characteristics.

The International Olympic Committee's consensus statement on dietary supplements indicates that only a limited number of supplements have sufficiently strong evidence for particular performance-related applications. It also stresses the importance of assessing the potential benefits against possible health and anti-doping risks [1].

Kellmann and colleagues argue that an appropriate balance between training stress and recovery is essential for maintaining performance and preventing excessive fatigue, non-functional overreaching, and overtraining [2].

From a practical perspective, the following principles should guide the organization of athlete recovery programmes:

First, individualization. Recovery interventions should be selected according to the athlete's health status, training objectives, sport discipline, and nutritional requirements.

Second, evidence-based selection. The use of medicines and supplements should be supported by reliable research rather than advertising claims or informal recommendations.

Third, medical supervision. Pharmacological treatment should be prescribed and monitored by qualified healthcare professionals.

Fourth, integrated recovery. Pharmacological and nutritional support should complement sleep, hydration, balanced nutrition, and appropriate training periodization.

Fifth, anti-doping compliance. Every medicine and supplement used by a competitive athlete should be checked against the applicable anti-doping regulations.

Recent literature also highlights the importance of controlling supplement quality, preventing contamination, and educating athletes about the risks of inadvertent doping [3].

Thus, the principal value of sports pharmacology lies not in the uncontrolled use of substances to accelerate recovery, but in the medically justified correction of specific physiological problems and the support of normal recovery mechanisms.

CONCLUSION

Sports pharmacology is an important interdisciplinary area in modern sport because it examines the potential contribution of medicines, vitamins, minerals, and selected nutritional supplements to the recovery and health of athletes.

The analysis leads to the following conclusions:

1. The recovery process is a complex physiological and psychological phenomenon that requires an integrated approach.
2. Adequate nutrition, hydration, sleep, and appropriate training management form the foundation of effective recovery.
3. Protein, carbohydrates, creatine, vitamins, and minerals may contribute to particular recovery-related needs when their use is scientifically justified.
4. Pharmacological substances should not be used indiscriminately. Their selection must be based on medical indications and individual assessment.
5. Anti-inflammatory medicines require particular caution because inappropriate or routine use may cause adverse health effects.
6. Compliance with WADA regulations and the verification of supplement quality are essential for protecting athletes from health risks and inadvertent anti-doping violations.

In conclusion, the effective application of sports pharmacology requires cooperation among sports physicians, nutritionists, coaches, and athletes. Its main objective should be to protect athlete health, support physiological adaptation, and promote safe and sustainable sports performance.

REFERENCES

1. Maughan, R. J., Burke, L. M., Dvorak, J., et al. (2018). IOC Consensus Statement: Dietary Supplements and the High-

Performance Athlete. *International Journal of Sport Nutrition and Exercise Metabolism*, 28(2), 104–125. https://doi.org/10.1123/ijsnem.2018-0020

2. Kellmann, M., Bertollo, M., Bosquet, L., et al. (2018). Recovery and Performance in Sport: Consensus Statement. *International Journal of Sports Physiology and Performance*, 13(2), 240–245. https://doi.org/10.1123/ijspp.2017-0759

3. Mancin, L., Close, G. L., Jeukendrup, A., et al. (2026). Reducing the Risk of Unintentional Doping From Supplements: A Practical Guide for Athletes and Support Teams. *Translational Sports Medicine*. https://doi.org/10.1155/tsm2/5919439

4. Thomas, D. T., Erdman, K. A., & Burke, L. M. (2016). Position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine: Nutrition and Athletic Performance. *Journal of the Academy of Nutrition and Dietetics*, 116(3), 501–528. https://doi.org/10.1016/j.jand.2015.12.006

5. Burke, L. M., Hawley, J. A., Wong, S. H. S., & Jeukendrup, A. E. (2011). Carbohydrates for Training and Competition. *Journal of Sports Sciences*, 29(sup1), S17–S27. https://doi.org/10.1080/02640414.2011.585473

6. Jäger, R., Kerksick, C. M., Campbell, B. I., et al. (2017). International Society of Sports Nutrition Position Stand: Protein and Exercise. *Journal of the International Society of Sports Nutrition*, 14, 20. https://doi.org/10.1186/s12970-017-0177-8

7. Kreider, R. B., Kalman, D. S., Antonio, J., et al. (2017). International Society of Sports Nutrition Position Stand: Safety and Efficacy of Creatine Supplementation in Exercise, Sport, and Medicine. *Journal of the International Society of Sports Nutrition*, 14, 18. https://doi.org/10.1186/s12970-017-0173-z

8. Sawka, M. N., Burke, L. M., Eichner, E. R., et al. (2007). American College of Sports Medicine Position Stand: Exercise and Fluid Replacement. *Medicine & Science in Sports & Exercise*, 39(2), 377–390. https://doi.org/10.1249/mss.0b013e31802ca597

9. World Anti-Doping Agency (WADA). (2026). *The 2026 Prohibited List: International Standard*. https://www.wada-ama.org/en/prohibited-list

10. Australian Institute of Sport. (n.d.). *AIS Sports Supplement Framework*. https://www.ais.gov.au/nutrition/supplements