Strength and Conditioning in Modern Basketball: An Evidence-Based Perspective

La preparación física en el baloncesto moderno: una perspectiva basada en la evidencia científica

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Abstract:

This paper provides an updated review of physical preparation (PP) in modern basketball, integrating recent findings across three core pillars: strength-power, specific endurance, and load management. It outlines the role of velocity-based training (VBT), the value of sport-specific plyometric tasks, and the shift from traditional aerobic work toward high-intensity interval training (HIIT). Moreover, it delves into the dual monitoring of internal and external load, identifying deceleration as a key marker in injury prevention. Finally, it addresses emerging challenges such as movement-type individualized training, sport-specific fatigue, and evolving methodological and technological perspectives that shape the contemporary strength and conditioning professional's role.

Keywords:

Physical preparation, training load, basketball, decelerations, injury prevention, HIIT, monitoring.

Resumen:

Este trabajo presenta una revisión actualizada de la preparación física (PF) en el baloncesto moderno, integrando hallazgos recientes en torno a tres pilares fundamentales: fuerza-potencia, resistencia específica y gestión de la carga. Se describe el papel del entrenamiento basado en la velocidad (VBT), la importancia de la integración de tareas pliométricas específicas, y la progresiva sustitución del trabajo aeróbico convencional por métodos de alta intensidad intermitente (HIIT). Asimismo, se profundiza en la relevancia del monitoreo dual de la carga, interna y externa, y se señala la deceleración como un marcador clave en la prevención de lesiones. Finalmente, se analizan desafíos emergentes como la individualización del entrenamiento por tipo de movimiento, la fatiga específica y las nuevas perspectivas tecnológicas y metodológicas que configuran el rol del preparador físico actual.

Palabras claves:

Preparación física, carga entrenamiento, baloncesto, deceleraciones, prevención de lesiones, HIIT, monitorización.

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1. Introduction to the Research Topic (Definition, Importance, and Context)

1.1. Definition and Characteristics of Modern Basketball

Physical preparation (PP) in basketball is defined as the systematic and planned process of optimizing players' conditional capacities (strength, power, endurance, and speed) and coordinative abilities in order to maximize technical-tactical performance in competition and minimize injury risk, while also understanding how playing position affects the physical, physiological, technical, and tactical demands required in basketball, all of which are essential for optimizing training processes and competition performance (Martinho et al., 2025).

Basketball, in its current context (NBA, EuroLeague, FIBA), is characterized as an intermittent and acyclic sport with high neuromuscular demands. Players repeatedly perform explosive actions at very high intensity, such as short-distance sprints (5–15 m), accelerations, decelerations, changes of direction (CoD), jumps, and landings (Petway et al., 2020). In this context, a game requires a high number of accelerations (> 2.5 m/s²) and decelerations, which are key indicators of high-intensity load and accumulated fatigue in players (Espasa-Labrador et al., 2023).

1.2. Importance and Context in Sport

In elite sport, PP is a fundamental pillar of athlete health and supports career longevity. However, the current increase in match density (e.g., double EuroLeague rounds) requires precise fatigue management and recovery capacity that only optimized, evidence-based PP can provide. The difference between success and injury often lies in the quality of the monitoring process and the individualization of load (Pernigoni et al., 2024).

In the field of Physical Activity (PA) and Physical Education (PE), the study of PP in basketball provides a model for understanding the importance of lower-limb power (jumping, CoD) as a key factor in musculoskeletal health and in the prevention of falls and sports injuries. This is highly transferable to youth player populations, where the most recent studies highlight the effectiveness of warm-ups that include neuromuscular stimuli to reduce injury risk and improve neuromuscular function, thereby emphasizing the importance of structured injury prevention strategies in youth sport (Paravlic et al., 2024).

2. What We Know So Far (Synthesis of Recent Evidence, with Emphasis on the Last 5 Years)

Recent scientific evidence has redefined training methodology in basketball, focusing on three pillars: strength-power, specific endurance, and load management.

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2.1. Strength and Power Optimization (The Player's "Engine")

Basketball performance is highly correlated with vertical jump power and the ability to perform rapid and efficient changes of direction (CoD) (Pinelli et al., 2025).

- Velocity-Based Training (VBT): This is the dominant paradigm in current strength training (over the last five years). VBT allows training load to be prescribed and fatigue levels to be monitored in real time, ensuring that movement intent remains maximal at all times (Zhang et al., 2021).
- Plyometric and Tactical Integration: The evidence highlights the need to progress from general plyometrics to basketball-specific plyometrics and shock training. This includes reactive single-leg jumps, jumps with landing and immediate transition into a sprint or CoD, integrating neuromuscular demands with the decision-making inherent to the game. It has been suggested that the integration of cognitive-motor dual tasks and open-skill elements into warm-up routines can improve both readiness and concentration for explosive performance, as well as enhance players' reactive capacities (Shalom et al., 2025).

2.2. Specific Endurance and High-Intensity Interval Training (HIIT)

Given the intermittent nature of basketball, traditional aerobic training has been almost completely replaced by sport-specific HIIT (Capric et al., 2025). Coaches should consider complementing HIIT with sport-specific skill training and carefully planning its pacing, ideally incorporating HIIT during the preseason or postseason for optimal effectiveness. However, more research is needed to explore the differential effects of HIIT across different age groups and playing levels (Cao et al., 2025).

2.3. Training Load Management and Injury Prevention

The scientific evidence is clear: the main predictor of injury is an acute change in training load (the Acute:Chronic Workload Ratio, or ACWR) (Gabbett, 2016). Therefore, monitoring load is essential, with particular attention to decelerations.

- Dual Load Monitoring: A dual approach is used that combines external load (recorded through technology such as GPS, inertial trackers, distance covered, and accelerations) and internal load (recorded through the athlete's physiological response, such as RPE or Rating of Perceived Exertion, heart rate, and wellness variables) (Gamonales et al., 2023).
- Control of Decelerations: Recent research in basketball has identified that the number and magnitude of high-intensity decelerations are a more significant injury risk factor than sprints. It has been suggested that many defensive movements involve reacting to the ball and the opponent. There are many passive movements during defense, and speed changes rapidly. If many passive movements occur during defense, a greater physical load is imposed, which may lead to fatigue (Koyama et al., 2022).

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3. Challenges and Future Perspectives (Current Gaps, New Directions, and Practical Applications)

Despite these advances, PP in basketball faces several challenges, many of which are driving future lines of research.

3.1. Current Challenges and Gaps in the Evidence

1. Contextualization of Chronic Load: Most research has focused on ACWR using total load data. The major challenge is to individualize ACWR by movement type (e.g., jump ACWR, deceleration ACWR) in order to obtain more precise injury risk models (Towner et al., 2023).
2. The Phenomenon of Sport-Specific Fatigue/Recovery: It is particularly important to optimize recovery because players devote a much greater proportion of their time to recovery than to training (Calleja-González et al., 2016). Possible solutions include the use of practical tools that do not require specific facilities, the development and validation of low-cost recovery devices, the promotion of player education in recovery strategies, and further research to expand scientific knowledge in this field (Pernigoni et al., 2022).

3.2. Future Perspectives and New Directions

- Artificial Intelligence (AI) and Predictive Models: The future lies in the integration of Big Data and AI to create predictive models (Machine Learning) of performance and injury. AI will not only help estimate risk (injury probability), but also prescribe the optimal daily training dose for each player (Viniue, 2025).
- Individualization Based on Genetics and Nutrition: The study of genetic polymorphisms (e.g., those related to carbohydrate metabolism or collagen synthesis) and precision nutrition will allow recovery strategies and supplementation to be personalized at an unprecedented level in basketball (Escribano-Ott et al., 2022).
- Integrated Cognitive-Motor Training: Training will increasingly consolidate not only physical components, but also mental training and decision-making under fatigue. This includes the use of virtual or augmented reality to simulate high-intensity game scenarios that enhance mental sharpness in critical moments of physical fatigue. In the context of a professional team, where the time until the next match determines workload dynamics, this promotes increasing uncertainty and specificity throughout the microcycle, thereby increasing cognitive load (Fuster et al., 2025).

3.3. Practical Applications for the Strength and Conditioning Coach

The modern strength and conditioning coach must be both a data scientist and an educator, capable of translating information into useful and applied practice.

This practical application can be summarized as follows:

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1. Use of VBT: For strength training during the competitive phase, to ensure movement quality and avoid unnecessary fatigue.

2. Wellness Monitoring: A daily check-in (sleep, soreness, perceived fatigue) is just as important as GPS load, suggesting that sport science professionals should closely monitor athletes' training status across different training and competition periods in order to respond more effectively when modifying training or recovery plans (Chou et al., 2021).

3. Emphasis on Decelerations and Landings: Routinely implementing eccentric strength exercises and neuromotor control work during the landing phase to reduce the risk of knee and ankle injuries (Antoranz et al., 2024).

4. Key Conclusions (Brief Synthesis and Final Message)

Physical preparation in contemporary basketball is a highly sophisticated field that requires a scientific, individualized, and multimodal approach. Sustained success depends not only on volume or intensity, but on the correct training dose for each player, determined through technology and validated by scientific evidence. A player's ability to maintain explosive power and rapid decision-making in the final quarter is the direct result of intelligent load management, with eccentric injury prevention and VBT-based individualization as central pillars. The integration of AI and Big Data will transform the strength and conditioning coach into the architect of longevity and optimal performance (Viniue, 2025).

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