REVIEW ARTICLE

Monitoring internal and external load management in female basketball: A narrative review

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ABSTRACT

Monitoring load management in female basketball is essential for optimizing performance and minimizing injury risks. This narrative review consolidates current practices and advancements in monitoring both internal and external loads among female basketball players. A comprehensive literature search was conducted across PubMed, Scopus, and Web of Science databases to identify research focusing on load management in female basketball. Methods utilized for monitoring internal loads include heart rate tracking, rate of perceived exertion (RPE), and biochemical markers, while external loads are assessed through GPS tracking, accelerometers, local positioning systems (LPS), and ultra-wideband (UWB) technology. Recent technological advancements, particularly the use of LPS and UWB systems, have significantly enhanced the precision and reliability of load monitoring, providing real-time, accurate data on player movement and performance. These systems complement traditional methods, offering valuable insights into the physical demands and well-being of athletes. Integrating both internal and external load monitoring is vital for developing tailored training programs that optimize player performance and reduce injury risks. Future research should focus on standardizing protocols and exploring novel technologies to further enhance load management strategies in elite women's basketball.

Keywords: Workload, Female basketball, Performance analysis, Match analysis, Training analysis.

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INTRODUCTION

Basketball is a collective sport that involves high-intensity, intermittent actions, requiring players to combine technical, tactical, and physical abilities to succeed (Matthew & Delextrat, 2009). The sport is characterized by frequent changes in speed and direction, jumps, sprints, and physical contact, making it highly demanding both physically and mentally (Narazaki et al, 2009). In sports science, workload refers to the total physical and physiological demands placed on athletes during training and competition. Gabbett (2016) defines workload as the cumulative amount of stress that is applied to an athlete's body, which, when properly managed, can enhance performance and reduce injury risks. Monitoring workload is essential to prevent overtraining, allowing for the optimization of training programs and recovery strategies (Gabbett, 2016).

Internal load (IL) refers to the physiological and psychological stress experienced by athletes during training and competition. Understanding the external load demands of basketball games is fundamental for effective training planning and programming Reina et al. (2019). Despite some prior research, there is a notable scarcity of information on external load (EL) during official games in high-level women's basketball. This scarcity is evident in professional female basketball as well, where limited studies have focused on quantifying external load during competitive matches. Given this gap, it is essential to examine the existing studies that address this issue.

For instance, Reina et al. (2019) examined training and competition load in elite female basketball players, highlighting the need for more detailed and specific studies in this area. Similarly, Matthew & Delextrat (2009) investigated the physiological demands on elite female basketball players, finding that they experience significant cardiovascular and metabolic stress during competition. These studies underscore the importance of understanding both internal and external loads to optimize performance and reduce injury risks.

Svilar et al. (2018) have further emphasized the need for more precise methodologies to track and analyse both types of loads in basketball. Similarly, Puente et al. (2017) highlighted that tailored approaches to load monitoring are crucial for optimizing performance and minimizing injury risks. Despite these efforts, a pressing need remains for more comprehensive and current research to develop evidence-based training and recovery strategies specifically suited to elite women's basketball players (Impellizzeri et al., 2019).

Furthermore, recent efforts have been made to investigate external load differences between elite basketball teams involved in separate competitions. For instance, a study by Ujaković et al. (2024) explored differences in load demands, highlighting the increasing focus on this topic. External load, which includes factors such as movement patterns, distances covered, accelerations, and decelerations, has been analysed in depth by Conte et al. (2015) and Reina et al. (2019), offering key insights into the physical requirements of players. In parallel, internal load, which is driven by physiological markers like heart rate and blood lactate concentration, has been thoroughly examined by Matthew and Delextrat (2009) and Rodríguez-Alonso et al. (2003), demonstrating the significant physiological demands faced by athletes during competition. Those findings underline the importance of understanding both external and internal loads to optimize training and improve performance in female basketball players.

METHODOLOGY AND RESULTS

The search for articles related to the monitoring of both external load and internal load in female basketball was conducted using a comprehensive approach across multiple scientific databases, including Web of Science (WOS), PubMed, and MEDLINE.

Table 1. Data extracted from the articles reviewed.

Authors	Year	Quartile	Subject	Gender	Competition	Quantification	Technology used	Results
Arenas-Pareja et al.	2023	Q2	Menstrual Cycle Influence on Load in Basketball	Female	Challenge women's league	14 training sessions, IL and EL	WIMUPROTM (Real Track Systems, Almería, Spain) with Ultra-wideband (UWB) and Clue mobile app	Different phases of the menstrual cycle affect both internal and external load, impacting recovery and performance.
Conte et al.	2015	Q1	Time-motion analysis in basketball	Female	Serie A1 women's Italian first division basketball	5 home games (3 Serie A1 games and 2 Euroleague games), EL	Camera (Sony HD AVCHD HDR CX115, Tokyo, Japan) and Time motion analysis	Short, frequent sprints interspersed with lower intensity periods.
Delextrat et al.	2015	Q3	Match activity analysis	Female	Spanish National Division 1 League (Liga Femenina 1)	3 matches for each team, EL	Lince Multiplatform sport analysis software	Highlights distinct movement patterns by playing position.
Lorenzo Gasperi et al.	2023	Q4	Performance influenced by menstrual cycle phase	Female	Lithuanian Women's Basketball League (LMKL)	External load (Player Load per minute), Internal load (RPE), Pre-game recovery (TQR), Menstrual phase	Microsensors (Catapult S5), Excel spreadsheet for RPE and TQR, Menstrual phase calculated by calendar method	Better shooting and rebounding performances during the follicular phase. Higher RPE and better pre-game recovery linked to better performance
Narazaki et al.	2009	Q1	Physiological demands of basketball	Female	National Collegiate Athletic Association (NCAA) Division II	IL and EL	The VO2 was measured by the system with a sampling frequency of 0.05 Hz, while HR was monitored using a Polar watch (Polar Electro Oy, Kempele, Finland) and RPE was assessed using Borg's original (i.e., 6–20) scale (Borg, 1982)	High physiological demands, intermittent high-intensity activity.
Peterson & Quiggle	2016	Q3	Wearable device validation	Female	Division I National Collegiate Athletics Association basketball	Data collection began 3 weeks prior to competition and concluded amidst the final week of regular season competition. EL	Catapult Optimeye (Catapult Sports, Melbourne, Australia),Tensiomyiography and accelerometer device	Effective for monitoring performance during competition.
Reina et al.	2017	Q4	Training and competition load	Female	Extremadura state level competition (Spain)	2 games, a friendly match and a competition game, IL and EL	Heart rate band Garmin®, Wimu® device	Intense competition loads not replicated in training.
Scanlan et al.	2012	Q2	Physiological demands in competition	Female	Queensland Basketball League	8 competitive matches, IL	Accusport Lactate Analyser (Boehringer, Mannheim, Germany), Polar Team System (Polar Electro, Oy, Kempele, Finland)	High physical demands, particularly in short bursts of activity.
Svilar et al.	2018	Q2	Load monitoring system in basketball	Female	Spanish	IL and EL, two basketball leagues, ACB (Liga Endesa, 1st Spanish Division) and the Euroleague, in the 2016/2017 season.	S5 devices (Catapult Innovations, Melbourne, Australia) and RPE	Significant load differences observed across competitions.
Vencúrik et al.	2017	Q3	External and internal load analysis	Female	Slovenian	IL and EL	Canon HG10 (Canon Inc., Tokyo, Japan), telemetric system Suunto Team (Suunto Oy, Vantaa, Finland)	Variations in load during different match intensities.

Each database was thoroughly explored to identify relevant studies that addressed the quantification and analysis of these loads in elite and professional female basketball players. The articles retrieved from these searches were systematically organized in Table 1, where detailed information about each study is provided. The key insights and findings from these studies are critically analysed and discussed in the subsequent sections, highlighting their contributions to the understanding of load management in female basketball.

Understanding internal load: Concepts and measurements

Key methods for monitoring internal load in female basketball players include heart rate monitoring, rate of perceived exertion (RPE), and biochemical markers (Impellizzeri, Marcora, & Coutts, 2019). Heart rate monitoring is a widely used method that provides insights into cardiovascular strain (Vencúrik, Šťastný, & Leskošek, 2017; Matthew & Delextrat, 2009). Studies, such as those by Vencúrik et al. (2017), highlight its importance in understanding the internal load during various exercise intensities. RPE is another effective tool that involves athletes rating their perceived exertion on a scale, typically from 6 to 20, providing a subjective measure of internal load. Biochemical markers, including cortisol and creatine kinase, offer objective measures of physiological stress and muscle damage, respectively (Mexis et al., 2023). Research by Matthew & Delextrat (2009) demonstrated the utility of these markers in assessing stress and recovery in elite athletes. These methods collectively help in tailoring training programs to individual needs, optimizing performance, and minimizing the risk of overtraining and injuries. Understanding and effectively measuring internal load are critical for developing comprehensive load management strategies in female basketball (Gabbett, 2016; Kellmann, 2010).

Further, Narazaki et al. (2009) studied the physiological demands of competitive basketball by measuring oxygen consumption, heart rate, and blood lactate concentration during practice games. The findings indicated that aerobic metabolism plays a significant role in basketball, suggesting the importance of aerobic conditioning for players. Similarly, Scanlan et al. (2012) highlighted the demands placed on female basketball players during competitive games, emphasizing the necessity of monitoring internal load to optimize training and performance.

The physiological demands of competitive female basketball are characterized by a high reliance on both aerobic and anaerobic energy systems, as demonstrated by the work of Narazaki et al. (2009). Their research found that players maintain an average VO2 of 33.4 mL/kg/min, representing 66.7% of their VO2max during games. This high aerobic demand underscores the importance of endurance conditioning to support the intermittent high-intensity efforts required throughout a basketball match. Despite spending 56.8% of game time walking, players engage in frequent bursts of high-intensity activity, covering 4500–5000 meters per game.

Further supporting these findings, research into heart rate and blood lactate levels has provided a more detailed picture of the internal load sustained by players. Vencúrik et al. (2017) found that female players operate at approximately 88.4% of their HRmax throughout games, suggesting that maintaining high-intensity conditioning is crucial across all positions. Similarly, the work of Rodriguez-Alonso et al. (2003) showed elevated blood lactate levels in female players during competition, further highlighting the significant anaerobic demands of the sport.

Given the intensity of female basketball, monitoring internal load through physiological markers such as heart rate and blood lactate is critical. As demonstrated by Vencúrik et al. (2017), consistent heart rate data across player positions indicates that basketball places a uniform demand on players. This suggests that load management strategies should focus on conditioning all players to handle prolonged high-intensity efforts.

Additionally, lactate monitoring, as discussed by Rodriguez-Alonso et al. (2003), helps to capture the anaerobic stress placed on athletes, making it a valuable tool for tailoring recovery and training intensities.

Assessing external load: Techniques and tools

External load refers to the physical demands placed on athletes, which can be quantified using various tools and techniques. In female basketball, GPS tracking, accelerometers, and other wearable technologies are commonly employed (Conte et al., 2015; Reina et al., 2019; Scanlan et al., 2020). GPS tracking systems are valuable for measuring movement patterns, distances covered, and speeds during games and training sessions (Reina, García-Rubio, & Ibáñez, 2017; Boyd et al., 2013). Technology has revolutionized the way external loads are monitored in female basketball. Devices such as GPS tracking systems, accelerometers, and other wearable technologies are commonly used to measure movement patterns, distances covered, and speeds during training and games (Peterson & Quiggle, 2016). These devices provide detailed and real-time data on players' physical load, allowing for accurate assessment of their performance and well-being (Montgomery et al., 2010; Conte et al., 2015; Svilar et al., 2018). The incorporation of these technologies in female basketball has significantly improved the precision and ease of load monitoring, offered a better understanding of physical demands and helped to optimize training programs (Vázquez-Guerrero et al., 2019; Vickery et al., 2014).

Vickery et al. (2014) demonstrated the effectiveness of GPS in providing detailed activity profiles in elite women's field hockey, a method that can be effectively applied to basketball as well. Accelerometers, which measure acceleration forces, are another essential tool for quantifying the intensity and volume of physical activity (McGinnis et al., 2013). These devices are extensively used in sports science to monitor and analyse the physical demands placed on athletes during both training and competition. Boyd et al. (2013) further validated the use of 5 Hz GPS units, demonstrating their reliability in team sports. Moreover, wearable technologies, such as heart rate monitors and fitness trackers, offer real-time data on various physiological parameters, thereby enhancing the precision of external load monitoring (Scanlan et al., 2020; Staunton et al., 2021; Svilar et al., 2018). Time-motion analysis, as highlighted by Conte et al. (2015), is also crucial in understanding the physical demands of basketball. This is further supported by Narazaki et al. (2009), who provided insights into the physiological demands during competitive basketball, laying the foundation for assessing external load in female basketball. Together, these technologies and analytical methods form a robust framework for assessing external load, enabling coaches and sports scientists to optimize training regimens, improve performance, and reduce injury risk.

Additional studies have provided further insights into the external load demands in female basketball. For example, Reina et al. (2017) examined whether training loads reflect the demands of actual competition in women's basketball. Their findings indicated significant differences between training and competition, particularly in heart rate and steps per minute, suggesting that training programs should be adjusted to better match the intensity of competition. Conte et al. (2015) conducted a time-motion analysis of elite Italian women's basketball games, revealing that players engage in high-intensity activities (HIA) for approximately 8.5% of the total game time. The analysis found that the distances covered during sprints were predominantly short, ranging between 1 and 5 meters. This pattern of short, frequent sprints, interspersed with periods of lower-intensity movement, underscores the importance of developing repeated sprint ability (RSA), a critical component of performance in elite women's basketball. These insights inform training practices by emphasizing the need to focus on RSA to meet the physical demands of the sport. Peterson and Quiggle (2016) discussed the effectiveness of using wearable technology to monitor physical activity and recovery, emphasizing the importance of data accuracy and consistency. Conte et al. (2015) conducted a time-motion analysis of elite Italian women's basketball games, revealing that players engage in high-intensity activities

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However, the study by Reina, Mancha, and Ibáñez (2017) revealed that the external load demands in training sessions do not reach the same levels as during games. Players experience higher intensity in competition, both in terms of heart rate and distance covered per minute. This discrepancy between training and competition underscores the need to adjust training sessions to better reflect the actual physical demands of games. By doing so, performance can be improved and, more importantly, the risk of injury can be minimized.

Narazaki et al. (2009) complement these findings, emphasizing the intermittent nature of basketball, which requires both high-intensity activity and periods of active recovery. Players are constantly switching between different types of movement, such as running, walking, and sprinting, which increases the total physical load. This suggests that training should not only focus on intensity but also on the players' ability to quickly adapt to changes in activity.

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In line with these studies, Scanlan et al. (2012) observed that players perform a large number of short sprints and changes of direction during games, which creates a significant physical load. This is fundamental to preparing players for the rigors of the game and ensuring that they can maintain a high level of performance throughout the season.

Advancements in female player monitoring

Technological advancements have significantly enhanced the monitoring of internal and external loads in female basketball players. Wearable technology, such as smartwatches and fitness trackers, has become increasingly popular, providing real-time data on various physiological parameters (Conte et al., 2015; Svilar et al., 2018). The integration of wearable devices in female basketball has revolutionized performance monitoring by offering continuous data on heart rate, activity levels, and sleep patterns (Puente et al., 2017). Advanced software and analytics platforms have emerged, enabling sophisticated analysis of large datasets specific to female basketball players. Wearable technology has been applied extensively in team sports, including female basketball, where advanced analytics play a crucial role in interpreting complex data to inform training decisions (Conte et al., 2015). For example, studies have used biometric sensors to measure sweat composition and muscle oxygenation, providing deeper insights into the physiological state of female basketball players. Accurate monitoring tools are essential for understanding the differences between internal and external load during competition in female basketball, as highlighted by research on load management specific to this sport (Cavedon et al., 2015). These technological advancements facilitate a more comprehensive understanding of load management, helping to tailor training programs, monitor recovery, and ultimately enhance performance while reducing injury risks in female basketball players.

The studies examining the menstrual cycle's influence on internal and external loads in professional female basketball players reveal a nuanced relationship between performance, physiological stress, and injury risk. Gasperi et al. (2023) found that menstrual cycle phases, particularly the follicular phase, correlate with improved game performance metrics such as shooting efficiency and rebounds. The study by Arenas-Pareja et al. (2023) investigates the effects of the menstrual cycle on internal and external load variables in professional female basketball players. The research highlights how different phases of the menstrual cycle, particularly during menstruation and ovulation, significantly impact both physical exertion and recovery processes. Using detailed monitoring of heart rate, accelerations, and decelerations, the study provides evidence of the physiological fluctuations female athletes experience throughout their menstrual cycle. Moreover, Vico-Moreno et al. (2022) identified a significant association between irregular menstrual cycles and an increased risk of ankle and knee injuries, highlighting the importance of monitoring both physiological and biomechanical stress during the cycle. These findings align with Narazaki et al. (2009), who emphasized the overall physiological demands of basketball, underscoring the need for individualized training strategies that account for menstrual phases to optimize performance and reduce injury risks.

Advances in technology have enhanced the monitoring of internal and external loads in female basketball players. Gasperi et al. (2023) demonstrated that tracking systems combined with subjective measures, such as perceived exertion, allow for a detailed understanding of how performance metrics fluctuate across the menstrual cycle. This approach provides valuable insights into tailoring training and recovery strategies to individual athletes, ensuring optimal performance and reducing injury risks. Wearable technologies, including accelerometers and heart rate monitors, have further supported real-time load management, highlighting the importance of individualized monitoring in elite female basketball.

DISCUSSION

Integrating internal and external load monitoring in female basketball presents both challenges and benefits. A holistic approach to load management ensures a comprehensive understanding of an athlete's physiological and physical demands. Scanlan et al. (2012) highlighted the physiological and activity demands during competition, providing crucial data for tailored training programs. Reina et al. (2017) emphasized the importance of monitoring both training and competition loads to optimize performance and reduce injury risks, showing significant differences between internal and external load measures. Narazaki et al. (2009) revealed that female players experience unique physical stresses that must be addressed in training regimens, while Conte et al. (2015) identified distinct movement patterns and intensities in elite women's basketball games. Recent advances, like those from Gasperi et al. (2023), demonstrated that menstrual cycle phases affect performance metrics such as shooting efficiency and rebounds, while Arenas-Pareja et al. (2023) found peaks in external load values during ovulation. Peterson and Quiggle (2016) explored the relationship between accelerometer loads and TMG readings in female collegiate basketball, showing that TMG could effectively detect neuromuscular fatigue based on external load changes. Svilar et al. (2018) further emphasized that a combination of sRPE and accelerometery offers strong correlations, particularly with decelerations and changes of direction, reinforcing the need for combined internal and external monitoring.

Delextrat et al. (2015) focused on match activity by position, revealing that point guards performed more sprints and guards covered more ground compared to centres. Finally, Reina et al. (2017) demonstrated higher heart rate values and more steps per minute in real competition compared to training, highlighting the need for training loads to reflect competitive demands. In addition, Vencúrik et al. (2017) analysed heart rate responses in semi-elite female basketball players during competitive games, finding no statistically significant differences between positions or game halves, indicating that the physiological demands remain high

regardless of player roles or game phases. This reinforces the importance of implementing training programs that account for consistent physiological demands across various positions.

CONCLUSIONS

Internal and external load relationship

Research on elite female basketball players reveals a strong link between internal and external load. High-intensity actions like sprints and changes of direction dominate game dynamics, leading to significant internal physiological responses such as elevated heart rate and lactate levels. Monitoring both types of loads is crucial for optimizing performance and reducing injury risks.

Physiological responses to game intensity

External load metrics correlate with internal physiological strain, highlighting the importance of tracking both to manage player fatigue and recovery effectively. This dual-monitoring approach ensures athletes maintain peak performance throughout games and training.

Practical application

Advanced monitoring technologies

GPS and wearable sensors provide real-time data on movement and intensity, enabling dynamic training adjustments. This technology improves performance optimization and injury prevention, offering tailored training strategies based on precise, individualized data.

Gender-specific training protocols

Recognizing the physiological differences between male and female athletes, gender-specific training programs are essential. Tailoring load management to female athletes reduces the risk of overtraining and fatigue while optimizing performance.

Comprehensive load management

Combining internal and external load monitoring allows for personalized recovery strategies and balanced training intensities, preventing overtraining. This approach helps sustain player performance across the competitive season.

Uniform intensity across positions

All player positions experience high-intensity demands in elite basketball. Training programs must enhance both aerobic capacity and anaerobic power to meet these demands, ensuring readiness for the physical challenges of competition.

Repeated Sprint Ability (RSA) training

Conte et al. identified that players frequently engage in sprints covering distances between 1-5 meters. This highlights the necessity of focusing training on developing repeated sprint ability (RSA) to match the high-intensity demands during games.

Injury risk management

Studies by Gabbett and Drew & Finch emphasize the importance of balancing training loads. By maintaining this balance, coaches can minimize the risk of injury while ensuring that players perform at their peak during competitions.

The frequency with which these movements are performed during competition highlights the need for training sessions to include specific exercises that mimic these demands, such as repeated sprints and quick changes of direction.

AUTHOR CONTRIBUTIONS

Muñoz-Andradas G., conceptualization; Serrano C., Navarro R. M., Nenad D. and Muñoz-Andradas G., methodology; Muñoz-Andradas G., writing-original draft; Serrano C. and Navarro R. M., writing-review and editing; Nenad D. and Muñoz-Andradas G., visualization; Serrano C. and Navarro R. M., supervision.

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REFERENCES

Akenhead, R., & Nassis, G. P. (2016). Training load and player monitoring in high-level football: Current practice and perceptions. International Journal of Sports Physiology and Performance, 11(5), 587-593. https://doi.org/10.1123/ijspp.2015-0331

Arenas-Pareja, M. D. L. Á., López-Sierra, P., Ibáñez, S. J., & García-Rubio, J. (2023). Influence of Menstrual Cycle on Internal and External Load in Professional Women Basketball Players. Healthcare, 11(6), 822. https://doi.org/10.3390/healthcare11060822

Borne, R., Hausswirth, C., Bieuzen, F., & Mujika, I. (2020). Cardiorespiratory, hormonal, and perceptual responses to various recovery techniques following a high-intensity interval session in elite male athletes. Frontiers in Physiology, 11, 597676.

Boyd, L. J., Ball, K., & Aughey, R. J. (2013). The validity of a 5 Hz global positioning system unit for measuring displacement in team sports. Journal of Science and Medicine in Sport, 16(5), 441-444. https://doi.org/10.1016/j.jsams.2012.11.003

Bourdon, P. C., Cardinale, M., Murray, A., Gastin, P., Kellmann, M., Varley, M. C., & Cable, N. T. (2017). Monitoring athlete training loads: Consensus statement. International Journal of Sports Physiology and Performance, 12(2), S2-161-S2-170. https://doi.org/10.1123/IJSPP.2017-0208

Cavedon, V., Zancanaro, C., & Milanese, C. (2015). Different methods for monitoring training load and their relationships to the wellness status in elite women's basketball. Journal of Sports Medicine and Physical Fitness, 55(6), 596-605.

Conte, D., Favero, T. G., Lupo, C., Francioni, F. M., Capranica, L., & Tessitore, A. (2015). Time-motion analysis of Italian elite women's basketball games: Individual and team analyses. Journal of Strength and Conditioning Research, 29(1), 144-150. https://doi.org/10.1519/JSC.0000000000000633

Conte, D., Kolb, N., Scanlan, A. T., & Santolamazza, F. (2018). Monitoring training load and well-being during the in-season phase in National Collegiate Athletic Association Division I men's basketball. International Journal of Sports Physiology and Performance, 13(8), 1067-1074. https://doi.org/10.1123/ijspp.2017-0689

Delextrat, A., Badiella, A., Saavedra, V., Matthew, D., Schelling, X., & Torres-Ronda, L. (2015). Match activity demands of elite Spanish female basketball players by playing position. International Journal of Performance Analysis in Sport, 15(2), 687-703. https://doi.org/10.1080/24748668.2015.11868824

Drew, M. K., & Finch, C. F. (2016). The relationship between training load and injury, illness, and soreness: A systematic and literature review. Sports Medicine, 46(6), 861-883. https://doi.org/10.1007/s40279-015-0459-8

Foster, C., Florhaug, J. A., Franklin, J., Gottschall, L., Hrovatin, L. A., Parker, S., & Dodge, C. (2001). A new approach to monitoring exercise training. Journal of Strength and Conditioning Research, 15(1), 109-115. https://doi.org/10.1519/00124278-200102000-00019

Gabbett, T. J. (2016). The training-injury prevention paradox: Should athletes be training smarter and harder? British Journal of Sports Medicine, 50(5), 273-280. https://doi.org/10.1136/bjsports-2015-095788

Gasperi, L., Sansone, P., Gómez-Ruano, M. Á., Lukonaitienė, I., & Conte, D. (2023). Female basketball game performance is influenced by menstrual cycle phase, age, perceived demands, and game-related contextual factors. Journal of Sports Sciences, 1-12. https://doi.org/10.1080/02640414.2023.2285119

Granata, C., Oliveira, R. S., Little, J. P., Renner, K., & Bishop, D. J. (2019). Training intensity modulates changes in PGC-1α and p53 protein content and mitochondrial respiration, but not markers of mitochondrial content in human skeletal muscle. FASEB Journal, 33(4), 4772-4784.

Halson, S. L. (2014). Monitoring training load to understand fatigue in athletes. Sports Medicine, 44(2), 139-147. https://doi.org/10.1007/s40279-014-0253-z

Impellizzeri, F. M., Marcora, S. M., & Coutts, A. J. (2019). Internal and external training load: 15 years on. International Journal of Sports Physiology and Performance, 14(2), 270-273. https://doi.org/10.1123/ijspp.2018-0935

Kellmann, M. (2010). Preventing overtraining in athletes in high-intensity sports and stress/recovery monitoring. Scandinavian Journal of Medicine & Science in Sports, 20(2), 95-102. https://doi.org/10.1111/j.1600-0838.2010.01192.x

Malone, J. J., Lovell, R., Varley, M. C., & Coutts, A. J. (2017). Unpacking the black box: Applications and considerations for using GPS devices in sport. International Journal of Sports Physiology and Performance, 12(S2), S2-18-S2-26. https://doi.org/10.1123/ijspp.2016-0236

Matthew, D., & Delextrat, A. (2009). Heart rate, blood lactate concentration, and time-motion analysis of female basketball players during competition. Journal of Sports Sciences, 27(8), 813-821. https://doi.org/10.1080/02640410902926420

McGinnis, R. S., Cain, S. M., Davidson, S. P., Vitali, R. V., Perkins, N. C., & McLean, S. G. (2013). Quantifying the effects of load carriage using tri-axial accelerometers. Gait & Posture, 39(1), 518-522.

Mexis, D., Nomikos, T., Mitsopoulos, N., & Kostopoulos, N. (2023). Effect of a 6-week preseason training protocol on physiological and muscle damage markers in high-level female and male basketball players. Sports, 11(11), 229. https://doi.org/10.3390/sports11110229

Montgomery, P. G., Pyne, D. B., Hopkins, W. G., Dorman, J. C., Cook, K., & Minahan, C. L. (2010). The effect of recovery strategies on physical performance and cumulative fatigue in competitive basketball. Journal of Sports Sciences, 28(3), 277-283. https://doi.org/10.1080/02640410903428525

Narazaki, K., Berg, K., Stergiou, N., & Chen, B. (2009). Physiological demands of competitive basketball. Scandinavian Journal of Medicine & Science in Sports, 19(3), 425-432. https://doi.org/10.1111/j.1600-0838.2008.00789.x

Peterson, K. D., & Quiggle, G. T. (2017). Tensiomyographical responses to accelerometer loads in female collegiate basketball players. Journal of Sports Sciences, 35(23), 2334-2341. https://doi.org/10.1080/02640414.2016.1266378

Puente, C., Abian-Vicen, J., Areces, F., López, R., & Del Coso, J. (2017). Physical and physiological demands of experienced male basketball players during a competitive game. Journal of Strength and Conditioning Research, 31(4), 956-962. https://doi.org/10.1519/JSC.0000000000001577

Reina, M., García-Rubio, J., & Ibáñez, S. J. (2017). Is training carried out the same as competition? Analysis of load in women's basketball. Revista de Psicología del Deporte, 26(1), 9-13.

Rodríguez-Alonso, M., Fernández-García, B., Pérez-Landaluce, J., & Terrados, N. (2003). Blood lactate and heart rate during national and international women's basketball. Journal of Sports Medicine and Physical Fitness, 43(4), 432-436.

Scanlan, A. T., Dascombe, B. J., Reaburn, P., & Dalbo, V. J. (2012). The physiological and activity demands experienced by Australian female basketball players during competition. Journal of Science and Medicine in Sport, 15(4), 341-347. https://doi.org/10.1016/j.jsams.2012.03.003

Scanlan, A. T., Fox, J. L., Borges, N. R., & Tucker, P. S. (2020). Physical and physiological demands of open and closed-skill drills in basketball: Female athlete responses across drill types. Journal of Strength and Conditioning Research, 34(11), 3171-3178.

Scanlan, A. T., Fox, J. L., Milanović, Z., Stojanović, E., Stanton, R., & Dalbo, V. J. (2021). Individualized and fixed thresholds to demarcate player load intensity zones produce different outcomes in female basketball players. Journal of Strength and Conditioning Research, 35(7), 2046-2052. https://doi.org/10.1519/JSC.0000000000003001

Scanlan, A. T., Wen, N., & Dalbo, V. J. (2014). Training and game loads and acute: Chronic workload ratios are associated with injury risk in elite basketball. Journal of Science and Medicine in Sport, 17(4), 371-375. https://doi.org/10.1016/j.jsams.2013.10.003

Seshadri, D. R., Drummond, C., Craker, J., Rowbottom, J. R., Voos, J. E., & Drummond, M. J. (2017). Wearable sensors for monitoring the internal and external workload of the athlete. NPJ Digital Medicine, 2(1), 1-18. https://doi.org/10.1038/s41746-019-0149-2

Soligard, T., Schwellnus, M., Alonso, J. M., Bahr, R., Clarsen, B., Dijkstra, H. P., & Engebretsen, L. (2016). How much is too much? (Part 1) International Olympic Committee consensus statement on load in sport and risk of injury. British Journal of Sports Medicine, 50(17), 1030-1041. https://doi.org/10.1136/bjsports-2016-096581

Svilar, L., Castellano, J., & Jukić, I. (2018). Load monitoring system in top-level basketball team: Relationship between external and internal training load. Kinesiology, 50(1), 25-33. https://doi.org/10.26582/k.50.1.4

Ujaković, F., Salazar, H., Pleša, J., & Svilar, L. (2024). Elite basketball game external load varies between different teams and competition. Kinesiology, 56(1), 145-152. https://doi.org/10.26582/k.56.1.12

Vázquez-Guerrero, J., Jones, B., Fernández-Valdés, B., Moras, G., Reche, X., & Sampaio, J. (2019). Physical demands of elite basketball during an official U18 international tournament. Journal of Sports Sciences, 37(6), 1-8. https://doi.org/10.1080/02640414.2019.1647033

Vencúrik, T., Nykodým, J., & Vacenovský, P. (2016). Heart rate analysis of semi-elite female basketball players during competitive games. Studia sportiva, 10(2), 55-60. https://doi.org/10.5817/StS2016-2-5

Vico-Moreno, E., Sastre-Munar, A., Fernández-Domínguez, J. C., & Romero-Franco, N. (2022). Motor control and regularity of menstrual cycle in ankle and knee injuries of female basketball players: A cohort study. International Journal of Environmental Research and Public Health, 19(21), 14357. https://doi.org/10.3390/ijerph192114357

