Contextual factors influencing basketball training and competition demands: a systematic review

Authors

Pierpaolo Sansone[1], Enrique Alonso Perez Chao[2, 3], Feng Li[4], Lorenzo Gasperi[5], Miguel A. Gómez-Ruano[5], Daniele Conte[6]

Affiliations

1 Department of Education and Sport Sciences, Pegaso Telematic University, Naples, Italy
2 Department of Physiotherapy, Faculty of Medicine, Health and Sports, European University of Madrid, Villaviciosa de Odón, 28670 Madrid
3 Faculty of Sports Sciences, Universidad Alfonso X el Sabio, Villanueva de la Canada, Spain
4 China Basketball College, Beijing Sport University, Beijing, China
5 Facultad de Ciencias de la Actividad Física y del Deporte, Universidad Politécnica de Madrid, Madrid, Spain
6 Department of Movement, Human and Health Sciences, University of Rome Foro Italico, Roma, Italy

Keywords

situational variables, external load, internal load, team sports, complex systems

received 02.10.2024
accepted after revision 30.01.2025
published online 16.03.2025

Bibliography

Int J Sports Med 2025; 46: 390–401
DOI 10.1055/a-2533-0917
ISSN 0172-4622

Georg Thieme Verlag KG, Oswald-Hesse-Straße 50, 70469 Stuttgart, Germany

Correspondence

Dr. Pierpaolo Sansone
Department of Education and Sport Sciences,
Pegaso Telematic University
Naples
Italy
ppsansone@gmail.com

ABSTRACT

This systematic review described the effects of contextual factors on basketball training and competition demands. A comprehensive search and process led to the inclusion of 28 articles representing 646 basketball players. Fourteen contextual factors were identified. A decrease in external load variables was evident in the fourth quarter of games compared to the first quarter (effect sizes: small–large). The impact of game locations on load variables was inconsistent. Game outcomes did not influence external or internal loads. Conversely, close games were associated with higher physical and physiological demands than unbalanced games (effect sizes: moderate–very large). Higher external game loads were found in won quarters (effect size: small) and during scoring streaks (effect size: moderate). In youth male teams, those with superior performance covered less distances and exhibited better locomotor ratios compared to lower-level counterparts. Weekly external and internal training loads were adjusted according to the opponent's level in adult males. Internal game loads were found to be consistent across different season phases. Weekly total loads were higher during periods of congested schedules (effect sizes: moderate–very large), with training loads being reduced to offset the increased demands of game loads (effect size: moderate). This review offers basketball practitioners' insights into the external and internal loads that can be anticipated based on the contextual factors of training and competition.

Introduction

Basketball is a team sport that can be conceptualized as a complex adaptive system composed of numerous interacting elements continuously adapting and evolving in response to environmental shifts and internal dynamics [1]. Within this system, deterministic patterns emerge from the interactions of players, coaches, and strategies, creating predictable outcomes under certain conditions. However, these deterministic patterns coexist with the inherent unpredictability and adaptability of the system, as teams and players adjust their behaviors in response to both anticipated and unforeseen changes in the game environment [2]. Given that both training and competitions in basketball present distinct but often unpredictable demands, it is essential to analyze each context separately [3, 4]. While training sessions are designed to be controlled and targeted towards skill development and physical conditioning, they can still involve elements of unpredictability, albeit to a reduced extent than competitive games. Competitions, on the other hand, introduce higher levels of variability and psychological and cognitive pressures, presenting challenges that are often more unpredictable and intense. Due to this complexity, it is essential to analyze the various scenarios and conditions inherent in the practices and games, as they have been shown to impact physical performances of basketball players [5, 6]. Consequently, both external and internal loads may be influenced by numerous contextual factors, which should be considered when analyzing these demands [7].

According to the training load models [8], the external load represents the dose imposed by training or games, while the internal load represents the psychophysiological responses occurring in the athlete's systems consequent to the external load imposed. Numerous studies have focused on analyzing how contextual factors influence external and internal games and training loads, including game quarters [9, 10], game locations [6, 11], game and drill outcomes [6, 12], score differentials [13], quarter outcomes and scoring [13, 14], the quality of the teams and opponents [15, 16], season phases [17], schedule congestion [18, 19], match-day minus programming [20], and league ranking [11]. Overall, evidence suggests that both external and internal loads are affected by specific training and game contexts. Contextual factors during games and training sessions can determine various loads and consequently alter players' recovery and fatigue status [21, 22] and adaptation processes [23], which are main concerns for basketball performance staff. Therefore, systematically reviewing the contextual factors studied and the analysis of which factors can modify loads and how (increase, decrease or no changes) can provide basketball coaches and practitioners with a clearer idea of the expected loads according to contextual factors. Furthermore, it can highlight the factors that need higher considerations and those understudied assisting basketball scientists in designing further studies on this matter. Therefore, it would be of great help for basketball practitioners to have their disposal systematic information on the different stimuli provided by basketball training and games according to contextual factors.

Given the large number of studies examining the influence of contextual factors on basketball demands separately, it is essential to consolidate all findings. Therefore, the aim of this systematic review was to describe the effects of contextual factors on the external and internal training and game loads in basketball, evaluating these factors separately during games, during training, and in a combined context (training and games).

Materials and Methods

Search strategy

This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement guidelines 2020 [24]. A literature search was performed on June 6, 2024, using the electronic databases PubMed, Scopus, and Web of Science. The following search string was used: (contextual OR situational OR game-related OR "game related" OR location OR outcome OR season OR phase OR "recovery cycle" OR opponent OR level OR congest* OR schedule OR score OR different* OR travel OR result OR balance* OR unbalance* OR opposition OR league OR "scoring streak") AND (external OR internal OR perceived OR perceptual OR load OR match OR game OR training OR competition* OR perform* OR physical OR physiolog* OR workload* OR running OR high-speed OR distance OR sprint* OR jump* OR acceler* OR ACC OR deceleration* OR DEC OR "change of direction * " OR COD OR change-of-direction* OR speed OR PlayerLoad OR "Player Load" OR PL OR microsensor* OR demand* OR "heart rate" OR RPE OR "session RPE" OR session-RPE OR match OR exertion OR effort OR device OR TRIMP OR Edwards OR Banister OR SHRZ OR Summated-Heart-Rate-Zone* OR "arbitrary unit * ") AND basketball. Additional relevant articles were identified through searches of the websites of pertinent sports science journals.

Inclusion and exclusion criteria

Two authors (PS and DC) performed the database screening. Duplicates were then removed using the software EndNote (Clarivate Analytics). Afterward, both authors (PS and DC) independently reviewed each study by screening the title, abstract, and full text. Studies were considered for inclusion if they met the following criteria: (1) written in English, Spanish, or Italian; (2) included players over 16 years of age either male or female male and female; (3) evaluated at least one contextual factor; (4) measured at least one external or internal load variable as a dependent variable; (5) performed statistical analyses evaluating load variables according to contextual factors; and (6) reported load data for players across all playing positions together. Studies involving injured athletes, wheelchair basketball players, or athletes under 16 years of age were excluded. The reference lists of the studies included were also screened for additional relevant articles. Case studies, conference communications, editorials, opinion articles, reviews, presentations, theses, book chapters, or posters were excluded.

For this systematic review, training and game load variables were classified as either external or internal [8, 25] load variables. External load variables, representing players' average or peak physical demands, included any relevant measures obtained through video-based time-motion analysis, microtechnology, accelerometry, global positioning systems, or local positioning systems. Internal load variables, representing players' average or peak psychophysiological responses, included the heart rate (HR) and derived calculations, e.g. the mean HR, peak HR, HR percentages, and summated HR zones (SHRZ), blood lactate, and perceptual variables such as ratings of perceived exertion (RPE) and derived calculations (session RPE load, monotony, and strain).

Quality assessments

To assess the methodological quality of studies, quality assessment was performed by two authors (PS and DC) using a modified version of the Downs and Black checklist. This checklist is composed of 27 total items, of which 11 were selected (▶ **Table 1**) for their relevance to our study aim, as previously done in systematic re-

▶ **Table 1** Modified Black and Downs checklist used to assess the methodological quality of included studies.

Item	Question
	Reporting
1	Is the hypothesis/aim/objective of the study clearly described?
2	Are the main outcomes to be measured clearly described in the Introduction or Methods section?
3	Are the characteristics of the patients included in the study clearly described?
4	Are the main findings of the study clearly described?
5	Does the study provide estimates of the random variability in the data for the main outcomes?
6	Have actual probability values been reported (e.g. 0.035 rather than < 0.05) for the main outcomes except where the probability value is less than 0.001?
	External validity
7	Were the subjects asked to participate in the study representative of the entire population from which they were recruited?
8	Were those subjects who were prepared to participate representative of the entire population from which they were recruited?
	Internal validity – bias
9	If any of the results of the study were based on "data dredging," was this made clear?
10	Were the statistical tests used to assess the main outcomes appropriate?
11	Were the main outcome measures used accurate (valid and reliable)?

views in applied sports science [26, 27]. Each item was scored as "1" (yes) or "0" (no/unable to determine), with the scores for each of the 11 items finally summed to provide the article quality score. Disagreements on the quality assessments were discussed, and a third author (EAPC) was consulted, if consensus could not be reached.

Data extraction

Two authors (PS and DC) independently reviewed the included studies to extract the following information: (1) the study characteristics (authors and year), (2) details about the sample (sex, age, and competitive level), (3) the context in which load variables were monitored (training, competition, or both), (4) the quantity of data collected (i.e. the number of games and weeks of monitoring), (5) the specific external and/or internal load variables monitored, (6) the contextual factors considered for the analyses, and (7) the study results. Data were extracted to separate Excel spreadsheets, which were then cross-checked between authors to ensure the quality and accuracy of the extraction. Disagreements were resolved through discussion, with a third author (EAP) consulted to achieve consensus. Data are presented as mean and standard deviation, or as estimated marginal means with a 95 % confidence interval. Only statistically significant findings ($p < 0.05$) are reported. When available, effect sizes (ESs) were extracted, if reported in individual studies.

Results

Selection of studies and quality assessments

▶ **Fig. 1** presents the results of the systematic search process. The search from databases produced 23,958 records, from which 13,188 duplicates were removed, leaving 10,770 records for evaluation. Of these 1,123 records, including books, book chapters, and conference papers, were excluded, resulting in 9,647 records screened for the title and the abstract. After applying the predetermined inclusion and exclusion criteria, 9,514 records were eliminated, leading to 133 full texts sought for retrieval. Following the application of the inclusion criteria, 17 studies were included. Additionally, the reference lists of the included studies and relevant journal sites were screened for potentially interesting articles (snowball technique); from this process, 20 additional articles were identified and screened, and 11 of these were included. In total, 28 articles [6, 9–15, 17–20, 28–43] were included in this systematic review.

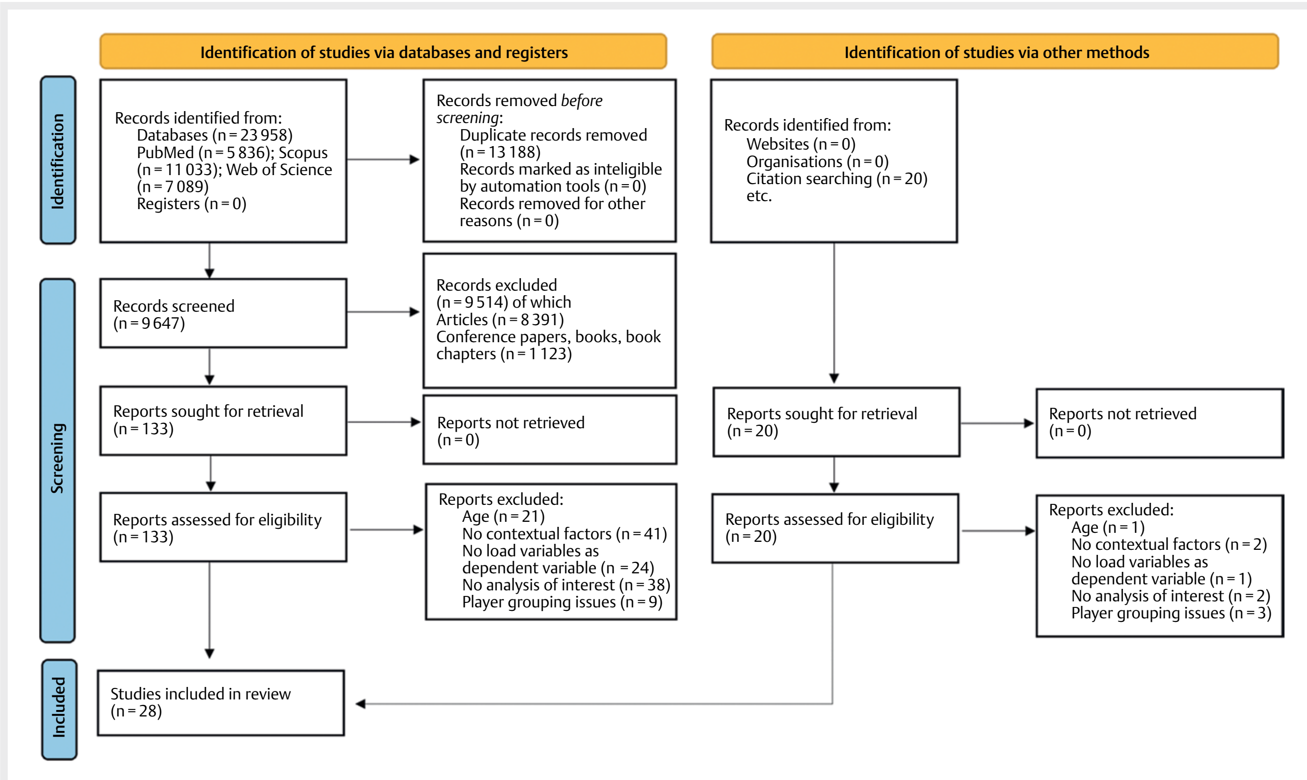
▶ **Table 2** presents the results of the quality assessment. The methodological quality and bias of the 28 included studies was 10.4 of 11 (range: 9–11). No study was excluded based on the quality assessment or bias. ▶ **Tables 3–5** present the characteristics of the included studies that evaluated contextual factors during games, during training, and in a combined context of both training and games combined, respectively. The selected studies involved 646 basketball players aged 16–34 years.

Game quarters

Eight studies [9, 10, 15, 28, 32, 35, 36, 43] compared the game physical demands across different quarters. Two studies [9, 32] monitored professional male players during official games, finding statistically higher physical performances in the first quarter compared to the fourth quarter for several variables, including the total distance covered [9], PlayerLoad (PL) [9], accelerations (ACC) [9], high-intensity ACC (hi-ACC) [32], decelerations (DEC), and jumps [9] (ESs: small–large). Additionally, García et al. [9] found that the total distance covered, PL, ACC, DEC, and jumps were also higher in the third quarter compared to the fourth quarter (ES: moderate).

Three studies [30, 35, 43] focused on professional females. Delextrat et al. [30] found a decrease in the time spent on high-intensity movements in the fourth quarter compared to the first and third quarters (ESs: small–moderate), a decrease in running and sprinting in the fourth quarter compared to first quarter (ESs: small–moderate), and an increase in time spent standing in the third quarter compared to the first quarter (ES: *small*). Similarly, another study [35] reported that the total time spent in sedentary behavior and very light intensity activities were lower in the first and third quarters compared to the second and fourth quarters. In contrast, no differences in high-intensity activities were found across game quarters in professional female players in the study by Conte and colleagues [43].

Four studies [10, 15, 28, 36] monitored elite youth male players. Decreases from the first quarter to the fourth quarter were found for several external load variables, including the time spent in high-intensity activities [28], relative distance [15], average [15], and peak [10] high-speed running (HSR), and average [15] and peak [10] PL (ESs: small–very large). However, no differences were found



▶ **Fig. 1** Flowchart of the study screening and selection processes [23].

for ACC and DEC [10, 15]. Furthermore, Vázquez et al. [36] found increases in the locomotor ratio (PL per meter covered) at low speeds and decreases in the locomotor ratio at higher speeds from the first quarter to the fourth quarter. Higher physical performances were also found in the third quarter compared to the fourth quarter (the time spent in high-intensity activities [28], peak PL [10], average [15], peak [10] distance, and high-intensity running [15]; ESs: small–moderate), as well as in the first quarter compared to the second quarter (the time spent in high-intensity activities [28], average [15] and peak [10] PL, average [15] and peak distance [10], and high-intensity running [15]; ESs: small–moderate). One study [28] monitored internal loads across quarters and found higher average HRs in the first quarter compared to the fourth quarter.

Game location

The game location was analyzed by three studies [6, 29, 31]. Peak demands in male players under 18 years of age did not differ between the home and away games [29]. Differently, Fox et al. [6] found higher values in away games for several external (PL, jumps, hi-ACC, DEC, changes of direction [COD]) and internal (RPE, sRPE) load variables (ESs: moderate–large) for male semi-professional players. Similarly, Garcia et al. [31] showed that the game location explained 19.9 % of the variance in the RPE scores reported by semi-professional females.

Game and drill outcomes

Four studies [6, 13, 31, 37] assessed the effects of the game outcome. Alonso Pérez-Chao et al. [13] found no differences in external peak demands between the won and lost games in male players under 18 years of age. Similarly, two studies [31, 37] found no effect of the game outcome on perceived internal loads of semi-professional [31] and youth [37] female players. For semi-professional male players, Fox et al. [6] found higher external workload volumes (jumps, hi-ACC, and hi-DEC) and intensities (hi-ACC and hi-DEC per minute) during losses compared to wins (ESs: moderate–very large).

The effects of the training drill outcome on external load variables were assessed by Castillo and colleagues [12] in professional male players. Results indicate that more cruising and HSR were performed in game-based drills won compared to those lost (ESs: small–moderate), while no meaningful differences were observed in the total distance, distance covered at walking, jogging, distance at low and hi-ACC and hi-DEC, PL, number of steps and jumps.

Sansone et al. [11] assessed the influence of the previous game outcome on weekly internal training loads accumulated by semi-professional male players, revealing no differences between weeks coming after won or lost games.

Game score differential

Two studies [6, 31] assessed the effects of game score differential. Fox and colleagues [6] evaluated both external and internal loads in starting male players, reporting several differences based on the score differential. For external loads, PL, COD, ACC, hi-ACC, total and relative DEC were higher during balanced games (≤ 8-point margin) compared to unbalanced games (> 8-point margin) (ESs: moderate–large). Differently, relatively high-intensity jumps and

▶ **Table 2** Methodological quality assessment of the included studies.

Study	Downs and black checklist question number											
	Reporting						External validity		Internal validity bias			
	1	2	3	4	5	6	7	8	9	10	11	Total
Abdelkrim et al. [28]	1	1	1	1	1	0	1	1	1	1	1	10
Alonso-Perez-Chao et al. [10]	1	1	1	1	1	1	1	1	1	1	1	11
Alonso-Perez-Chao et al. [17]	1	1	1	1	1	0	1	1	1	0	1	9
Alonso-Perez-Chao et al. [13]	1	1	1	1	1	1	1	1	1	1	1	11
Alonso-Perez-Chao et al. [29]	1	1	1	1	1	0	1	1	1	1	1	10
Castillo et al. [12]	1	1	1	1	1	1	1	1	1	1	1	11
Clemente et al. [20]	1	1	1	1	1	1	1	1	1	0	0	9
Conte et al.[43]	1	1	1	1	1	1	1	1	1	1	1	11
Delextrat et al. [30]	1	1	1	1	1	1	1	1	1	1	1	11
Ferioli et al. [38]	1	1	1	1	1	1	1	1	1	1	1	11
Fox et al. [6]	1	1	1	1	1	1	1	1	1	1	1	11
Fox et al. [14]	1	1	1	1	1	0	1	1	1	1	1	10
Fox et al. [18]	1	1	1	1	1	1	1	1	1	1	1	11
Garcia et al. [9]	1	1	1	1	1	1	1	1	1	1	1	11
Garcia et al. [39]	1	1	1	1	1	0	1	1	1	1	1	10
Garcia D et al. [31]	1	1	1	1	1	0	1	1	1	0	1	9
Howard et al. [40]	1	1	1	1	1	1	1	1	1	1	1	11
Ibanez et al. [32]	1	1	1	1	1	1	1	1	1	0	1	10
Leite et al. [41]	1	0	1	1	1	0	1	1	1	1	1	9
Palmer et al. [33]	1	1	1	1	1	1	1	1	1	1	1	11
Pino-Ortega et al. [15]	1	1	1	1	1	1	1	1	1	0	1	10
Salazar et al. [34]	1	1	1	1	1	1	1	1	1	0	1	10
Sansone et al. [11]	1	1	1	1	1	1	1	1	1	1	1	11
Sansone et al. [37]	1	1	1	1	1	1	1	1	1	1	1	11
Sansone et al. [42]	1	1	1	1	1	1	1	1	1	1	1	11
Staunton et al. [19]	1	1	1	1	1	1	1	1	1	1	1	11
Staunton et al. [35]	1	1	1	1	1	1	1	1	1	1	1	11
Vazquez et al. [36]	1	1	1	1	0	1	1	1	1	1	1	10

jumps per minute were significantly higher during unbalanced games than balanced games (ESs: large). For internal loads, SHRZ, RPE, and sRPE were higher during balanced games (ESs: moderate–very large). In contrast, Garcia et al. [31] did not find any influence of game score differential on RPE in semi-professional female players.

Quarter outcomes and scoring

The effect of quarter outcomes was evaluated by two studies [13, 14]. Alonso-Pérez-Chao et al. [13] monitored male players under 18 years of age and found that quarters won produced higher 1-min HSR distance and 5-min PL compared to the quarters lost (ESs: *small*). No differences were found for other peak external load variables (total distance, ACC, and DEC). In contrast, another study [14] found no significant differences between quarters won and lost in external and internal load variables for semi-professional male players.

One study [13] assessed external peak demand differences in male players under 18 years of age according to the quarter score difference and found that these remained substantially consistent. Small differences were identified for high quarter point differences (7.51 ± 3.75 points), which elicited greater peak demands for PL, DECs, and HSR distances compared to quarters with low point differences (2.47 ± 2.67 points) (ESs: small).

Palmer et al. [33] assessed the external loads of male and female professional and semi-professional players during different scoring streaks (defined as game passages in which a team scored at least three times in a row). Results show that on-court activity intensity was generally consistent between streak types, with a slightly greater proportion of moderate–vigorous (all teams combined, ES: small) activity undertaken during streaks against when compared to the regular play, while no differences were found for recovery, and light activities. For professional women, a greater proportion of maximal activity was found during scoring streaks compared to streaks by opponents (ES: moderate).

Team and opponent qualities

Two studies [15, 36] monitored the physical performances of elite male youth players according to the team quality. Pino-Ortega et al. [15] found that better teams covered lower relative distances

▶ **Table 3** Characteristics of studies evaluating contextual factors during basketball games.

Study	Sample, sex, age	Competitive level	Context	External load variables	Internal load variables	Technology and instruments	Contextual factors evaluated
Power et al. [27]	38, M, under 19 y	Professional	Official Tunisian national play-off games	Standing still, walking, jogging, running, sprinting, jumping, low, moderate, high-specific movements	Mean HR	Video-based time-motion analysis; Polar S610 monitors	Game quarters
Alonso-Perez-Chao et al. [10]	13, M, 16.6 ± 1.0 y	Youth	Nine international home games	Peak (30 s, 45 s, 1 min, 2 min, and 5 min) distance, PL, standing-walking, jogging, running, HSR, ACC, DEC	–	ClearSky S7, Catapult Sports	Game quarters
Alonso Pérez-Chao et al. [13]	13, M, 16.6 ± 1.0 y	Youth	Nine official regional division games	Peak (30 s, 1 min, 5 min) TD, PL, standing-walking, jogging, running, HSR, ACC, DEC	–	Vector S7, Clearsky LPS, Catapult Sports	Game outcome, quarter outcome, quarter score difference
Ben Abdelkrim et al. [28]	12, M, 16.6 ± 1.0 y	Youth	16 Official regional division games	Peak (1 min, 5 min) PL	–	Vector S7, Catapult Sports	Game location
Sansone et al. [42]	12, F, 27.0 ± 4.0 y	Professional	Five official games (three national leagues and 2 Euroleague)	Standing/walking, jogging, running, sprinting, jumping, low, moderate, high-specific movements; with and without the ball	–	Video-based time-motion analysis	Game quarters
Alonso-Pérez-Chao et al. [29]	42, F, adult	Professional	18 Official national league games	Standing still, walking, jogging-running, sprinting, jumping, low-,moderate- and high-intensity specific movements, static exertions	–	LINCE multiplatform software	Game quarters
Fox et al. [6]	5, M, 24.4 ± 3.2 y	Semiprofessionals	19 Official state-level games	Absolute and relative (per min) PL, hi-jump, jumps, hi-ACC, ACC, hi-DEC, DEC, hi-COD, COD	Absolute and relative SHRZ, RPE, sRPE	Catapult S5; Polar T31, Borg CR-10	Game outcome, game location, score differential
Fox et al. [14]	8, M, 23.1 ± 3.8 y	Semiprofessionals	18 Official State-level games	Relative and peak (15 s, 30 s, 1 min, 2 min, 3 min, 4 min, 5 min) PL, hi-ACC, ACC, hi-DEC, DEC, hi-COD, COD, hi-Jump, jumps	Relative SHRZ	Catapult S5, Polar T31	Quarter outcome
García et al. [9]	13, M, 19.8 ± 1.7 y	Professionals	17 Official national games	Peak velocity, TD, D18, PL, ACC > 2 $m \cdot s^{-2}$, DEC < 2 $m \cdot s^{-2}$, jumps, impacts	–	Wimu PRO, Realtrack Systems	Game quarters
Delextrat et al. [30]	12, F, 25.9 ± 7.2 y	Semiprofessionals	24 Official national games	–	RPE	Borg scale (1982)	Opponent level, game location, season phase, game outcome, game score differential
Garcia et al. [31]	94, M, 17.6 ± 0.8 y	Youth	13 Official international games	ACC, DEC	–	Wimu PRO, Realtrack Systems	Game quarters
Ibáñez et al. [32]	37 players, M and F, adult	Professionals and semiprofessionals	62 Official national and state-level games	AvF_{NET}, % time spent in the inactive, light, moderate-vigor-ous, maximal, and supramaximal activities	–	GT9X Link Actigraph	Scoring streaks
Pino-Ortega et al. [15]	94, M, 17.6 ± 0.8 y	Youth	13 Official international games	Relative distance, HIR, relative PL, ACC, DEC, peak speed, peak ACC	–	Wimu PRO, Realtrack Systems	Game quarters, team quality
Palmer et al. [33]	11, M, 16.9 ± 0.7 y	Youth	32 Games from three leagues (adult regional; youth regional; youth international)	Relative PL, hi-ACC, ACC, hi-DEC, DEC, hi-COD, COD, hi-jump, jumps	–	Catapult T6	Leagues
Salazar et al. [34]	10, F, 27 ± 5 y	Professionals	18 Official national games	AvFNET, % time spent in sedentary, very light, light, moderate, vigorous, maximal and supramaximal activities	–	ActiGraph link	Game quarters
Staunton et al. [35]	94, M, 17.4 ± 0.7 y	Youth	13 Official international games	Locomotor ratios (PL/m covered) at low and high speeds	–	Wimu PRO, Realtrack Systems	Game quarters, team quality

ACC, accelerations; AvF_{NET}, average instantaneous net force; COD, changes of the direction; D18, distance covered > 18 $km \cdot h^{-1}$; DEC, decelerations; F, females; hi-ACC, high-intensity ACC ; hi-COD, high-intensity changes of direction; hi-DEC, high-intensity DEC; hi-jump, high-intensity jumps; HSR, high-speed running; M, males; PL, PlayerLoad; RPE, rating of perceived exertion; SHRZ, summated heart rate zones; sRPE, session rating of perceived exertion load; TD, total distance.

▶ **Table 4** Characteristics of studies evaluating contextual factors during basketball training.

Study	Sample, sex, age	Competitive level	Context	External load variables	Internal load variables	Technology and instruments	Contextual factors evaluated
Castillo et al. [12]	14, M, 20 ± 2.3 y	Professionals	Eight game-based drills	Relative (/min) total distance, walking, jogging, cruising, HSR, sprinting, maximal speed, low-ACC, hi-ACC, low-DEC, hi-DEC, PL, steps, jumps	–	Wimu PRO, Realtrack Systems	Drill outcome
Clemente et al. [20]	15, M, 27.1 ± 5.2 y	Professionals	Full basketball season	–	sRPE	CR-10	MD-, schedule congestion
Sansone et al. [11]	14, M, 25 ± 6 y	Semiprofessionals	Full basketball season	–	sRPE	CR-10	Season phases, recovery cycle, previous game outcome, previous opponent level, upcoming opponent level
Vázquez-Guerrero et al. [36]	7, F, 16.1 ± 0.9 y	Youth	Full basketball season	–	RPE	CR-10	Game outcome
Staunton et al. [19]	9, M, 27 ± 5 y	Professional	6 in-season weeks	AvFNET, Impulse, % time spent in sedentary, very light, light, moderate, vigorous, maximal and supramaximal activities	–	ActiGraph Link	Opponent level

AvF_{NET}, average instantaneous net force; CR-10, category-ratio 10 scale; F, females; hi-ACC, high-intensity ACC; hi-DEC, high-intensity decelerations; HSR, high-speed running; low-ACC, low-intensity ACC; low-DEC, low-intensity decelerations; M, males; MD-, match-day minus; PL, PlayerLoad; RPE, rating of perceived exertion; sRPE, session rating of perceived exertion load.

than worse teams (ES: small), while no differences were found for HIR, ACC, DEC, peak speed, and peak ACC. In the study by Vázquez and colleagues [36], the locomotor ratio at lower speeds showed no differences, while at higher speeds, better teams had lower locomotor ratio scores.

Regarding the opponent quality, Garcia et al. [31] evaluated its effect on internal game loads accumulated by semi-professional female players and found that the quality of opposition accounted for 18 % of the variance in RPE scores.

Two studies [11, 19] evaluated whether the upcoming opponent level influences weekly training loads in male players. For external loads, it was found that more activity at very light intensity was performed during weeks with an easy match schedule compared to weeks characterized by a hard match schedule [19]. Regarding internal loads, these were lower when the upcoming opponent was of high level, compared to low and medium level opponents (ESs: small–moderate) [11].

Season phases

Two studies [31, 38] compared the game loads between different phases of the season. Ferioli et al. [38] showed that the sRPE loads accumulated by professional male players did not differ between regular-season and playoff games. Similarly, Garcia et al. [31] found no effect of the season phase on RPE scores reported by semi-professional female's players.

Six studies [11, 17, 38, 40–42] evaluated training loads across different season phases. For physiological variables, one study [17] found similar peak HR and respiratory ratios between the preseason and in-season phases in professional males, while Howard et al. [40] registered significant decreases in the time spent in HR zones 1, 2, 3 and 4 in the second half of the season compared to the first in collegiate females. For perceived internal loads, two studies [11, 38] found higher weekly sRPE during the regular season compared to the playoffs, with greater differences identified in professional players [38] (ES: very large) than semi-professionals [11] (ES: small). One study [41] evaluated training monotony and strain, which were higher in the preseason than during the in-season phases in male players.

Two studies [38, 42] monitored total (training and games combined) internal loads across season phases. In professional males, Ferioli et al. [38] found higher weekly loads during the regular season than during the playoffs. Comparing the preseason with the in-season phase, professional females had higher weekly loads (ES: moderate), monotony (ES: moderate), and strain (ES: large) during the preseason phase than the in-season phase [42].

Schedule congestion

Fox et al. [18] evaluated the effects of having 1, 2, or 3 games scheduled in a week on total (training + games) weekly loads. Overall, the number of games played each week altered both the external and internal loads. For external loads, high-intensity ACC and DEC were higher during 3-game weeks (ESs: large–very large) and 2-game weeks (ESs: moderate) compared to 1-game weeks. Absolute PL, high-intensity and total jumps, ACC, DEC, and COD were

▶ **Table 5** Characteristics of studies evaluating contextual factors during basketball training and games (combined).

Study	Sample, sex, age	Competitive level	Context	External load variables	Internal load variables	Technology and instruments	Contextual factors evaluated
Alonso-Perez-Chao et al. [17]	11, M, 26.4 ± 4.6 y	Professionals	Six pre-season friendly games and – 49 training sessions	–	Peak HR, peak RR	Firstbeat SPORTS team pack	MD-, season phases
Clemente et al. [20]	10, M, 28.3 ± 5.7 y	Professional	Final 6 weeks of the regular season and entire 6-weeks playoff phase	–	sRPE	CR-10	Season phases
Fox et al. [18]	8, M, 24.4 ± 3.2 y	Semiprofes-sionals	15 in-season weeks	Absolute and relative (/min) PL, hi-jump, jumps, hi-ACC, ACC, hi-DEC, DEC, hi-COD, COD	Absolute and relative SHRZ, RPE, sRPE	Catapult S5; Polar T31, Borg CR-10	Schedule congestion
Ferioli et al. [38]	13, M, 19.8 ± 1.7 y	Professionals	Nine in-season weeks, including 17 games	TD, D18, dACC > 2 $m \cdot s^{-2}$, dDEC < 2 $m \cdot s^{-2}$, ACC > 2 $m \cdot s^{-2}$, DEC < 2 $m \cdot s^{-2}$	–	Wimu PRO, Realtrack Systems	MD-
García et al. [39]	12, F, 18.9 ± 1.3 y	Collegiate	5 in-season mo	–	HR zones 1–5	Polar Team PRO	Season phases
Howard et al. [40]	8, M, 21.9 ± 3.4 y	Professionals	19 weeks	–	sRPE, monotony, strain	–	Season phases
dos Santos Leite et al. [41]	17, F, 19.6 ± 3.1 y	Professionals	11 weeks, from the pre-season to the in-season	–	sRPE, monotony, strain	Catapult S5, Polar T31	Season phases

ACC, accelerations; COD, changes of direction; CR-10, category-ratio 10 scale; D18, distance covered > 18 $km \cdot h^{-1}$; dACC, distance covered accelerating; dDEC, distance covered decelerating; F, females; DEC, decelerations; hi-ACC, high-intensity ACC; hi-COD, high-intensity changes of direction; hi-DEC, high-intensity DEC; hi-jump, high-intensity jumps; HR, heart rate; M, males; MD-, match-day minus; PL, PlayerLoad; RPE, rating of perceived exertion; RR, respiratory rate; SHRZ, summated HR zones; sRPE, session rating of perceived exertion load; TD, total distance.

significantly higher during 3-game weeks compared to 2-game weeks (ESs: moderate–large) and 1-game weeks (ESs: large–very large). Conversely, relative total jumps were significantly higher during 1-game weeks compared to 2-game weeks (moderate). Regarding internal loads, absolute SHRZ and sRPE were significantly higher during 3-game weeks compared to 1-game (*ESs:* very large) and 2-game (ESs: moderate) weeks.

The effect of schedule congestion on weekly training loads was evaluated in two studies [11, 20], and both found higher weekly sRPE in regular weeks compared to congested weeks (ESs: moderate).

Match-day minus (MD-)

Two studies [17, 20] evaluated training loads on different match-day minus (MD-). Alonso-Pérez-Chao and colleagues [17] monitored peak internal loads in professional males and found that MD + 1 had a lower peak HR, peak respiratory ratio, and peak ventilatory equivalents compared to all other MD- days (ESs: moderate–very large). Clemente et al. [20] monitored perceived (sRPE) loads in professional males showing higher internal loads during MD-3 and MD-2 days, with a decrease on MD-1 and MD-0.

Leagues

One study [34] monitored the game external loads in players under 18 years of age across different leagues. The results showed that competing in international tournaments elicited higher loads in all variables (PL, ACC, DEC, DEC, COD, jumps and hi-jumps) (ESs: small–moderate), while playing in the adult league (fourth national division) elicited higher hi-COD and hi-ACC (ES: small).

Discussion

The aim of this systematic review was to describe the effects of various contextual factors – such as game quarters, game locations, game and drill outcomes, score differentials, quarter outcomes and scoring, team and opponent quality, phases of the season, schedule congestion, match day timing, and league position – on the demands of training and competition in basketball. This review evaluates these factors separately during games, during training, and in a combined context of both training and games.

The quality of the studies included was high, overall. Some points which were more frequently critical were the presentation of the random variability of the outcome variables, the accuracy in presenting actual *p*-values, and the appropriate choice of the test for statistical analyses. Further basketball research on contextual factors should consider increasing the quality of these aspects to provide more robust evidence for basketball practitioners as well as academics.

Concerning game quarters, a consistent decline in physical performance is observed in the fourth quarter across all populations (male, female, and youth) when compared to the first quarter [10, 15, 28, 30], and, in some studies, also to the third quarter [9, 35]. The effect size of these declines can be meaningful, often reaching large magnitudes. This decline might result from two main factors including fatigue accumulation, which affects various performance metrics. These include volume-related variables, such as distances covered and PL as well as neuromuscular demands like hi-ACC, hi-DEC, hi-COD, and peak PL. The cumulative fatigue from basketball activity appears to impair the player's capacity to sustain high-intensity performance during the last passages of the game [44]. Additionally, situational variables such as the specific characteristics of the players, time played, tactical strategies, game pace, the increased frequency of time-outs, and stoppages for changes in possession or free-throws during the last quarter also come into play [10, 45]. These factors together contribute to the observed decline in physical performance during the fourth quarter. Given this information, coaches can anticipate reductions in the physical performance of players during the later stages of the game, compared to the first quarter and partially also to the third quarter. To limit these negative outcomes, coaches should consider adjusting their tactical approach and set plays to account for this decline. For instance, coaches could manipulate the game pace and implement specific set plays which are more or less demanding on specific players based on their fatigue status. Importantly, managing the playing time might be the more effective strategy to minimize fatigue accumulation throughout the game.

The impact of game location on performance remains unclear and does not present major consistent trends across populations. For youth players, the game location typically does not affect performance metrics significantly [29]. In contrast, semi-professional males experience higher loads when playing in different locations [6], which may be attributed to increased playing times rather than the location itself. Semi-professional females, on the other hand, show variations in their RPE based on the game location [31]. Considering these discrepancies across populations, further studies are necessary to clarify whether the game location affects basketball training and game loads.

The outcome of games and training drills typically does not influence load metrics in youth males [13], youth females [37], or adult females [31]. However, in semi-professional male players, higher external loads are observed during losses [6]. This is likely due to increased efforts implemented by teams to recover from being behind in the score. Overall, game load metrics seem to not vary substantially depending on the overall game outcome, while significant results were found for specific game quarters and scoring streaks, as discussed below. Discrepancies between populations may be attributed to specific team and league contexts, which might play an important role when determining external and internal loads. In training, winning game-based drills result in more HSR, suggesting that greater effort during successful drills may lead to more favorable offensive opportunities [12].

The results regarding game score differential do not have a significant effect in female semi-professional categories [31], suggesting that perceived exertion does not vary considerably between games with different victory margins. However, in the male semi-professional category, close games (those with a smaller score differential) were associated with an increase in several external variables, both in terms of volume and intensity [6]. This suggests that closer games in the male category are more competitive, requiring greater physical effort from the players in order for the team to secure the win. These findings highlight a difference in competitive dynamics between sexes in the semi-professional realm, where men appear to face greater external physical demands in tightly contested games. However, further studies are needed to draw definitive conclusions on the effects of score differential across populations in basketball. Additionally, it was observed that quarters won and those with a higher score difference were characterized by higher physical outputs, possibly indicating that teams need to increase their pace to score, generate momentum, and win quarters [13, 14]. However, a previous study assessing scoring streaks found no substantial differences overall [33], suggesting that tactical aspects might be more determinant in creating momentum and winning game quarters or phases. The distinct competitive dynamics observed between male and female sport semi-professionals emphasize the varying importance of physical effort and strategic planning in each. In male categories, the increased physical demands during closely contested games and pivotal quarters suggest that a higher physical output is crucial in determining game outcomes. In contrast, the consistent physical and perceived efforts across different game situations in female categories might indicate a greater reliance on strategy and tactical execution to influence the course and results of the game.

The analysis of game demands across different phases of the season revealed that these demands remain consistent, as confirmed by two independent studies [31, 38]. However, when examining training demands, notable variations are observed. Specifically, studies assessing internal loads indicate that while physiological training demands remain relatively stable throughout the season [17], subjective measures such as sRPE exhibit significant fluctuations [11, 38, 42]. Specifically, these metrics peak during the preseason, decrease during the regular season, and are the lowest during the playoffs [11, 38, 42]. This pattern reflects common training strategies designed to prepare players intensively in the preseason, maintain fitness levels during the regular season, and minimize excessive fatigue during the playoff phase, thereby optimizing performance when it is most critical.

The analysis of schedule congestion reveals that playing a higher number of games within a week results in increased external and internal loads on the players [18]. However, when focusing exclusively on training demands, it is observed that internal loads are lower during congested weeks compared to regular weeks [11, 20]. This suggests that coaches strategically reduce the training demands during weeks with more games, likely as a compensatory measure to balance the additional physical and physiological demands imposed by the increased game frequency. In this context, it is essential to consider each player's specific circumstances, such as the number of games they play, to appropriately adjust training loads and effectively manage their overall physical demands. External loads are notably lower the day after a game to facilitate recovery and are also reduced on the day immediately preceding a game as part of a tapering strategy. Conversely, the highest training loads are typically imposed 72–48 hours before a game. In basketball, this approach is employed strategically: higher training loads are scheduled in the middle of the week, with a decrease in intensity the day before the game to optimize players' readiness and performance during competition.

In youth sports, the level of demand varies significantly across different types of competitions. International games are found to be more demanding compared to regional and national games [34]. This increased demand can be attributed to several factors inherent to higher-level competitions, such as the presence of more skilled opponents, greater competitive intensity, and higher stakes associated with international tournaments. Consequently, players in international leagues are exposed to more rigorous challenges, which necessitate enhanced preparation and adaptation to meet the elevated performance standards required at this advanced level during competition.

Study limitations

This systematic review has some limitations. Across included studies, the heterogeneity of sample sizes, monitoring technologies, dependent variables and statistical tests limited our ability to provide quantitative indications for practitioners. Additionally, tactical constraints might influence external and internal loads during games, which is a limitation of the studies included and therefore also of our synthesis. Similarly, different coaching philosophies related across different teams might have influenced the findings of single studies and therefore our review.

Practical applications

Our findings offer useful practical translation in many ways for basketball coaches and performance staff. First, to mitigate performance declines in the fourth quarter, it is essential to manage playing times across games, as well as enhance players' resistance to fatigue with suitable conditioning strategies (i.e. game-based conditioning, repeated sprint ability, and high-intensity interval training).

Increasing physical outputs can help generate momentum, score streaks, and win quarters. Therefore, training drills simulating game scenarios should encourage increasing physical outputs, which might lead to beneficial scoring opportunities and scoring streaks.

During training players for close games is crucial as they require higher physical demands; thus, incorporating close-score drills during training can better prepare players for competitive moments. Physical efficiency can be achieved by investing on the team's tactical coordination to minimize unnecessary movements and enhance physical qualities for a better locomotor ratio.

Additionally, it is important to avoid excessive loads and closely monitor players' health during the preseason, which is characterized by the highest training loads. During congested weeks, reducing training demands (i.e. by manipulating the training volume and/or intensity) can help balance the increased external and internal loads imposed by the additional games. Furthermore, avoiding excessive loads right before games can enhance player's readiness and performance.

Finally, international competitions may impose greater game demands, so training plans should be tailored to the specific league and competition level to ensure that players are adequately prepared. Additionally, both academics and practitioners must consider these variations in competitive demands when interpreting study samples. Understanding that international youth games impose higher demands compared to regional and national competitions is crucial for the accurate analysis and application of research findings.

Conclusions

This systematic review identified that different contextual factors, such as game quarters, game locations, or game outcomes, significantly affecting the basketball players' physical demands during training and competitions. Performance tends to decline in the fourth quarter due to accumulated fatigue, particularly affecting high-intensity actions. The impact of game locations varies, with semi-professional players experiencing different loads depending on where they play (home or away). Close games, especially for male semi-professionals, require more physical effort. By consolidating the findings from various studies, this review offers valuable insights for coaches, sports scientists, and practitioners, enabling them to better tailor training programs and game strategies according to the specific contextual factors. These insights highlight the importance of adjusting training and game strategies to better manage player fatigue and optimize performance. Future research should continue to explore the nuanced effects of these elements, particularly in under-researched areas such as training load adjustments across different competitive levels and sex differences in load management.

Conflicts of interest

The authors declare that they have no conflicts of interest.

References

[1] Ramos-Villagrasa PJ, Navarro J, García-Izquierdo AL. Chaotic dynamics and team effectiveness: Evidence from professional basketball. Eur J Work Organ Psychol 2012; 21: 778–802. DOI: 10.1080/1359432X.2012.669525

[2] Pol R, Balagué N, Ric A, Torrents C, Kiely J, Hristovski R. Training or Synergizing? Complex Systems Principles Change the Understanding of Sport Processes. Sports Med Open 2020; 6: 28. DOI: 10.1186/s40798-020-00256-9

[3] Fox JL, Stanton R, Scanlan AT. A Comparison of Training and Competition Demands in Semiprofessional Male Basketball Players. Res Q Exerc Sport 2018; 89: 1–9. DOI: 10.1080/02701367.2017.1410693

[4] Schelling X, Torres L. Accelerometer load profiles for basketball-specific drills in elite players. J Sports Sci Med 2016; 15: 585–591

[5] Sansone P, Gasperi L, Makivic B, Gomez-Ruano MA, Tessitore A, Conte D. An ecological investigation of average and peak external load intensities of basketball skills and game-based training drills. Biol Sport 2023; 40: 649–656

[6] Fox JL, Stanton R, Sargent C, O'Grady CJ, Scanlan AT. The Impact of Contextual Factors on Game Demands in Starting, Semiprofessional, Male Basketball Players. Int J Sports Physiol Perform 2019; 10: 1–7. DOI: 10.1123/ijspp.2019-0203

[7] Pérez-Chao EA, Portes R, Gómez MÁ, Parmar N, Lorenzo A, Jiménez-Sáiz SL. A Narrative Review of the Most Demanding Scenarios in Basketball: Current Trends and Future Directions. J Hum Kinet 2023; 89: 231–245. DOI: 10.5114/jhk/170838

[8] Impellizzeri FM, Marcora SM, Coutts AJ. Internal and External Training Load: 15 Years On. Int J Sports Physiol Perform 2019; 14: 270–273

[9] García F, Vázquez-Guerrero J, Castellano J, Casals M, Schelling X. Differences in physical demands between game quarters and playing positions on professional basketball players during official competition. J Sports Sci Med 2020; 19: 256–263

[10] Alonso-Pérez-Chao E, Gómez MÁ, Lisboa P, Trapero J, Jiménez SL, Lorenzo A. Fluctuations in External Peak Demands Across Quarters During Basketball Games. Front Physiol 2022; 13: 1–10. DOI: 10.3389/fphys.2022.868009

[11] Sansone P, Gasperi L, Tessitore A, Gomez MA. Training load, recovery and game performance in semi-professional male basketball: Influence of individual characteristics and contextual factors. Biol Sport 2021; 38: 207–217. DOI: 10.5114/BIOLSPORT.2020.98451

[12] Castillo D, Raya-González J, Clemente FM, Conte D, Rodríguez-Fernández A. The effects of defensive style and final game outcome on the external training load of professional basketball players. Biol Sport 2021; 38: 483–490. DOI: 10.5114/BIOLSPORT.2021.101124

[13] Alonso Pérez-Chao E, Gómez MÁ, Scanlan A, Ribas C, Trapero J, Lorenzo A. Influence of game and quarter results on external peak demands during games in under-18 years, male basketball players. Biol Sport 2023; 40: 365–375. DOI: 10.5114/BIOLSPORT.2023.116010

[14] Fox JL, Green J, Scanlan AT. Not All About the Effort? A Comparison of Playing Intensities During Winning and Losing Game Quarters in Basketball. Int J Sports Physiol Perform 2021; 1378–1381

[15] Pino-Ortega J, Rojas-Valverde D, Gómez-Carmona CD et al. Impact of Contextual Factors on External Load During a Congested-Fixture Tournament in Elite U ' 18 Basketball Players. Front Psychol 2019; 10: 1–11. DOI: 10.3389/fpsyg.2019.01100

[16] Zhang S, Gomez MÁ, Yi Q, Dong R, Leicht A, Lorenzo A. Modelling the relationship between match outcome and match performances during the 2019 FIBA basketball world cup: A quantile regression analysis. Int J Environ Res Public Health 2020; 17: 1–11. DOI: 10.3390/ijerph17165722

[17] Alonso-Pérez-Chao E, Ribas C, Gómez MA, Portes R, Jiménez SL, Lorenzo A. Should we train as we compete? Games might be the best scenario to reach the internal peak demands in professional basketball players. Med Sport 2022; 75: 45–58. DOI: 10.23736/S0025-7826.22.03936-9

[18] Fox JL, O'Grady CJ, Scanlan AT. Game schedule congestion affects weekly workloads but not individual game demands in semi-professional basketball. Biol Sport 2020; 37: 59–67. DOI: 10.5114/biolsport.2020.91499

[19] Staunton C, Wundersitz D, Kingsley M. The Effect of Match Schedule on Accelerometry-Derived Exercise Dose during Training Sessions throughout a Competitive Basketball Season. Sports 2018; 6: 69. DOI: 10.3390/sports6030069

[20] Clemente FM, Mendes B, Bredt SDGT et al. Perceived Training Load, Muscle Soreness, Stress, Fatigue, and Sleep Quality in Professional Basketball: A Full Season Study. J Hum Kinet 2019; 67: 199–207. DOI: 10.2478/hukin-2019-0002

[21] Pernigoni M, Ferioli D, Calleja-Gonzalez J et al. Match-related fatigue in basketball: A systematic review. J Sports Sci 2024; 42: 1727–1758. DOI: 10.1080/02640414.2024.2409555

[22] Mihajlovic M, Cabarkapa D, Cabarkapa DV, Philipp NM, Fry AC. Recovery Methods in Basketball: A Systematic Review. Sports 2023; 11: 230. DOI: 10.3390/sports11110230

[23] Ferioli D, Bosio A, Bilsborough JC, La Torre A, Tornaghi M, Rampinini E. The preparation period in basketball: training load and neuromuscular adaptations. Int J Sports Physiol Perform 2018; 13: 991–999. DOI: 10.1123/ijspp.2017-0434

[24] Page MJ, McKenzie JE, Bossuyt PM et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. Syst Rev 2021; 10: 1–11. DOI: 10.1186/s13643-021-01626-4

[25] Sansone P, Conte D, Li F, Tessitore A. Investigating the effects of athlete-reported pre-training well-being and recovery on subsequent training loads in basketball players. J Sports Med Phys Fitness 2023; 63: 957–963. DOI: 10.23736/s0022-4707.23.14954-1

[26] Sansone P, Rago V, Kellmann M, Alcaraz PE. Relationship Between Athlete-Reported Outcome Measures and Subsequent Match Performance in Team Sports: A Systematic Review. J Strength Cond Res 2023; 37: 2302–2313. DOI: 10.1519/JSC.0000000000004605

[27] Power CJ, Fox JL, Dalbo VJ, Scanlan AT. External and Internal Load Variables Encountered During Training and Games in Female Basketball Players According to Playing Level and Playing Position: A Systematic Review. Sports Med Open 2022; 8: 107. DOI: 10.1186/s40798-022-00498-9

[28] Ben Abdelkrim G, El Fazaa S, El Ati J. Time-motion analysis and physiological data of elite under-19-year-old basketball players during competition. Br J Sports Med 2007; 41: 69–75. DOI: 10.1136/bjsm.2006.032318

[29] Alonso-Pérez-Chao E, Trapero J, Ribas C, Sosa C, Ángel Gómez M, Lorenzo A. External peak demands are not affected by playing venue (home vs away) during official male basketball games. Int J Perform Anal Sport 2023; 23: 334–342. DOI: 10.1080/24748668.2023.2238164

[30] Delextrat A, Badiella A, Saavedra V, Matthew D, Schelling X, Torres-Ronda L. Match activity demands of elite Spanish female basketball players by playing position. Int J Perform Anal Sport 2015; 15: 687–703. DOI: 10.1080/24748668.2015.11868824

[31] Garcia D, Escobar R, Pinar M. Effect of Situational Factors on the Rate of Perceived Exertion of Liga Femenina 2 Players. Revista de Psicologia del Deporte 2021; 30: 292–297

[32] Ibáñez SJ, Gantois P, Rico-González M, García-Rubio J, Ortega JP. Profile of Accelerations and Decelerations in Young Basketball Players. App Sci 2024; 14: 1–17. DOI: 10.3390/app14104120

[33] Palmer JA, Bini R, Wundersitz D, Kingsley M. On-Court Activity and Game-Related Statistics during Scoring Streaks in Basketball: Applied Use of Accelerometers. Sensors 2022; 22: 4059. DOI: 10.3390/s22114059

[34] Salazar H, Garcia F, Svilar L, Castellano J. Physical Demands in Three Different Basketball Competitions Played By the Same Under-18 Players. Montenegrin J Sports Sci Med 2021; 10: 59–64. DOI: 10.26773/mjssm.210909

[35] Staunton C, Wundersitz D, Gordon B, Kingsley M. Accelerometry-Derived Relative Exercise Intensities in Elite Women's Basketball. Int J Sports Med 2018; 39: 822–827. DOI: 10.1055/a-0637-9484

[36] Vázquez-Guerrero J, Fernández-Valdés B, Gonçalves B, Sampaio JE. Changes in locomotor ratio during basketball game quarters from elite under-18 teams. Front Psychol 2019; 10: 2163. DOI: 10.3389/fpsyg.2019.02163

[37] Sansone P, Gasperi L, Gomez-Ruano M, Tessitore A. The influence of physical fitness qualities, individual characteristics and contextual factors on youth basketball players' perceived exertion and recovery responses to official games. J Sports Med Phys Fitness 2024; 64: 609–614. DOI: 10.23736/S0022-4707.24.16026-4

[38] Ferioli D, Scanlan AT, Conte D, Tibiletti E, Rampinini E. The business end of the season: A comparison between playoff and regular-season workloads in professional basketball players. Int J Sports Physiol Perform 2021; 16: 655–662. DOI: 10.1123/ijspp.2020-0405

[39] García F, Schelling X, Castellano J, Martín-García A, Pla F, Vázquez-Guerrero J. Comparison of the most demanding scenarios during different in-season training sessions and official matches in professional basketball players. Biol Sport 2022; 39: 237–244. DOI: 10.5114/biolsport.2022.104064

[40] Howard M, Sanders GJ, Kollock RO, Peacock CA, Freire R. The Effect of Daily Heart Rate Workloads on Preseason, Midseason, and Postseason Oxygen Consumption in Division i Basketball. J Strength Cond Res 2024; 38: 704–708. DOI: 10.1519/JSC.0000000000004692

[41] dos Santos Leite S, Prestes J, Urtado CB et al. Objective and subjective variables for monitoring of different season cycles in basketball players. Rev Bras Med Esporte 2012; 18: 229–233. DOI: 10.1590/S1517-86922012000400002

[42] Sansone P, Li F, Confessore E, Tessitore A. Monitoring training load and perceived recovery indicators during the preseason and in-season phases in professional female basketball players. J Sports Med Phys Fitness 2024; 64: 1–7. DOI: 10.23736/S0022-4707.24.16000-8

[43] Conte D, Favero TG, Lupo C, Francioni FM, Capranica L, Tessitore A. Time-motion analysis of Italian elite women's basketball games: Individual and team analyses. J Strength Cond Res 2015; 29: 144–150. DOI: 10.1519/JSC.0000000000000633

[44] Alonso-Pérez-Chao E, Lorenzo A, Scanlan A, Lisboa P, Sosa C, Gómez MÁ. Higher Playing Times Accumulated Across Entire Games and Prior to Intense Passages Reduce the Peak Demands Reached by Elite, Junior, Male Basketball Players. Am J Mens Health 2021; 15: 155798832110543. DOI: 10.1177/15579883211054353

[45] Sosa C, Alonso Pérez-Chao E, Trapero J et al. External Physical Demands during Official Under-18 Basketball Games: Consideration of Overtime Periods. J Hum Kinet 2024; 94: 181–190. DOI: 10.5114/jhk/185682