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Comparison of the most demanding scenarios during different in-season training sessions and official matches in professional basketball players

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ABSTRACT: The purpose of this study was to compare physical demands during the most demanding scenarios (MDS) of different training sessions and official matches in professional basketball players across playing positions. Thirteen professional basketball players were monitored over a 9-week competitive season using a local positioning system. Peak physical demands included total distance, distance covered at > 18 km·h^{-1}, distance and number of accelerations (≥ 2 m·s^{-2}) and decelerations (≤ -2 m·s^{-2}) over a 60-second epoch. Analysis of variance for repeated measures, Bonferroni post-hoc tests and standardised Cohen's effect size (ES) were calculated. Overall, almost all physical demands during the MDS of training were lower (-6.2% to -35.4%) compared to official matches. The only variable that surpassed competition demands was distance covered at > 18 km·h^{-1}, which presented moderate (ES = 0.61, p = 0.01) and small (ES = 0.48, p > 0.05) increases during training sessions four and three days before a competition, respectively. Conversely, the two previous practices before match day presented trivial to very large decreases (ES = 0.09–2.66) in all physical demands. Furthermore, centres achieved the lowest peak value in total distance covered during matches, forwards completed the greatest peak distance at > 18 km·h^{-1}, and guards performed the greatest distance and number of high-intensity accelerations and decelerations. In conclusion, physical demands during the MDS of different training sessions across the microcycle failed to match or surpass peak values during official matches, which should be considered when prescribing a training process intended to optimise the MDS of match play.

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INTRODUCTION

Basketball is a court-based team sport in which both the aerobic and anaerobic energy systems are highly stressed through a combination of intermittent high-intensity accelerations, decelerations, jumps and sprints based on specific actions such as dribbling, shooting, rebounding or defending [1]. A comprehensive knowledge of the physical demands during basketball competition is crucial for better training load prescription geared towards optimising individual and team performance.

Advances in technology have allowed the use of inertial micro-sensors and local positioning systems to describe physical demands using average values during basketball training and competition [2]. Additionally, microtechnology has helped to compare basketball training sessions and matches, with controversial results regarding which activity produced higher physical exertion [3–6]. Due to the importance of finding the optimal balance between training load and match performance, available research in team sports applying the concept of tapering suggests that physical demand parameters, such as total distance covered and sprints, should be reduced during the training session the day before the match [7, 8]. In this regard, previous research has used microtechnology to examine average physical demands during training and competition loads in the course of in-season microcycles in elite soccer players [8, 9], although it has yet to be analysed in professional basketball players.

Although it is the most common technique, the use of average values to examine players' physical demands to optimise the training process in team sports could result in the underestimation of the most demanding scenarios (MDS) in a match [10], also referred to in the existing literature as most demanding passages and worst-case scenarios [11–13]. More recently, advanced technology has permitted the examination of the MDS during competition in numerous intermittent outdoor team sports [14]. This novel methodology quantifies pre-defined time epochs with the greatest demands on any physical outcome chosen using a rolling average. For instance, available research has reported a 25% difference between average demands and MDS in soccer [10] and 38% in rugby seven [15] in total distance covered using 5-min and 2-min time intervals, respectively. To date, the description of the MDS in a basketball match has only been reported in elite under-18 [16] and semi-professional basketball players [13, 17] with no previous research conducted in professional basketball.

In addition to being useful in studying possible changes in basketball activities, microtechnology has also been used to examine differences in average demands on professional basketball players across specific playing positions during training [18] and competition [19, 20]. Positional roles have also been analysed in elite under-18 basketball players using a rolling average to quantify the MDS [16]. Specifically, Vázquez-Guerrero et al. [16] reported that guards covered a total distance of 123.4 m and accumulated a total of 7.3 accelerations ≥ 2 $m \cdot s^{-2}$ and 6.9 decelerations ≤ -2 $m \cdot s^{-2}$ during a 60-s epoch, whereas forwards and centres covered a total distance of 120 and 113 m and accumulated 6.7 and 6.2 accelerations ≥ 2 $m \cdot s^{-2}$ and 6.1 and 5.3 decelerations ≤ -2 $m \cdot s^{-2}$ during the same 60-s MDS, respectively. To date, the authors are not aware of any studies that have investigated the peak physical demands on professional basketball players across playing positions.

The aim of this study was therefore to compare physical demands during the most demanding 60-second scenarios of different training sessions and official competition in professional male basketball players across playing positions. Knowing these changes in peak physical demands during in-season microcycles could help coaches, athletic performance staff and medical staff to optimise training and match performance.

MATERIALS AND METHODS

Experimental approach to the problem

A nonexperimental, descriptive, comparative design was used to examine the differences between the MDS of training and competition across playing positions. Local positioning system data were collected from 17 competitive league matches and 39 training weeks in the 2018–19 season. However, this study only included for further analysis the 9 in-season weeks in which players had six days between competitive matches and involved a minimum of four training sessions with a clear focus on an upcoming official league match. All competitive matches and training sessions were completed on the same official basketball court in similar environmental conditions. Players were excluded from the study if they completed less than 5 training sessions and did not participate in any competitive match. Furthermore, players who did not finish a full training session or those who played less than 10 min in a match were also excluded, resulting in a total of 428 individual observations. Table 1 shows the duration of each training session and match completed during in-season weeks and the total number of single records across a training session or match and the three different playing positions: guards (n = 7), forwards (n = 3) and centres (n = 3). As a working hypothesis, it was assumed that official matches would present peak values significantly higher than training sessions across all playing positions.

Participants

The thirteen professional male basketball players (mean ± SD, age: 19.8 ± 1.7 years; height: 199.9 ± 8.2 cm; and body mass: 91.8 ± 15.9 kg) who participated in this research belonged to a reserve squad of a Spanish Euroleague team and competed in the Spanish second division (LEB Oro). Players were routinely monitored during all training sessions and matches in the course of the competitive season, so no ethics committee approval was needed [21]. Nevertheless, the study fulfilled the provisions of the Declaration of Helsinki [22] and all the players agreed to participate by providing their written consent.

Training periodisation

The structured microcycle is the basic organization in the holistic structured training methodology of Futbol Club Barcelona [23, 24], which has been developed with the purpose of preparing athletes to

TABLE 1. The duration (means ± SD) and total of individual observations across different session types and playing positions.

Session	Duration (min)	Guards	Forwards	Centres	All positions
MD-4	109.4 ± 14.5	36	24	17	77
MD-3	128.6 ± 32.2	43	23	21	87
MD-2	109.3 ± 22.2	44	24	20	88
MD-1	87.9 ± 16.8	46	24	19	89
MD	109.3 ± 7.6*	41	26	20	87

Note: MD-4 is match day minus four; MD-3 is match day minus three; MD-2 is match day minus two; MD-1 is match day minus one; and MD is match day. * MD duration includes all stoppages in match, such as time-outs and free throws and breaks between periods, which are 3 min between the first and second quarter and between the third and fourth quarter, and 15 min between the second and third quarter.

TABLE 2. General goals and specific training contents across the structured microcyle in basketball

Session	Goals	Contents
MD-4	General goal	To develop basketball players' basic skills
	Coadjuvant training	Structural
	Optimizing training	Individual skills, small sided matches and modified 5-on-5 drills
MD-3	General goal	To accumulate the highest weekly basketball-specific load and optimise the team's playing model
	Coadjuvant training	Specific qualities
	Optimizing training	Simulated 5-on-5 competition
MD-2	General goal	To develop specific speed in basketball
	Coadjuvant training	Group preventive
	Optimizing training	Half-court 5-on-5 plus 1 or 2 waves
MD-1	General goal	To prepare players tactically for the next match
	Coadjuvant training	Individual preventive
	Optimizing training	Moderate-intensity drills and half-court 5-on-5
MD	General goal	To physically and mentally activate players
	Coadjuvant training	Individual preventive
	Optimizing training	Walk-through 5-on-5 and positional shooting drills

Note: MD-4 is match day minus four; MD-3 is match day minus three; MD-2 is match day minus two; MD-1 is match day minus one; MD is match day (light-load non-monitored training session on the morning).

compete in team sports and is based on two types of training: coadjuvant (general off-court training) and optimising (sport-specific, on-court training) [25, 26]. Based on the recommendations of Akenhead et al. [9], the MDS of training sessions were examined with respect to the number of days before an official match (MD minus). In line with Martín-García et al. [8], physical, technical and tactical components were integrated in all training sessions, which were contextualised in Table 2.

Physical demand parameters

Similar to previous research [14, 16], total distance covered in metres, distance covered at > 18 $km\cdot h^{-1}$ in metres, distance at high-intensity acceleration (≥ 2 $m\cdot s^{-2}$) and deceleration (≤ -2 $m\cdot s^{-2}$) in metres, and number of high-intensity accelerations (≥ 2 $m\cdot s^{-2}$) and decelerations (≤ -2 $m\cdot s^{-2}$) were measured. The analysis of the MDS consisted of identifying the peak physical demands for each player and each outcome mentioned above during each training and match session using a rolling (or moving) average over a 60-second epoch. With a local positioning system (WIMU PRO, RealTrack Systems S.L., Almería, Spain) that includes ultra-wide band technology (18 Hz sample frequency), the brand-specific software identified 1080 consecutive data points (e.g., 18 samples/s for 60 s) and rolling average values were calculated using the current and the 1062 preceding samples. It is important to note that the MDS for each variable was calculated independently and may have come from different game moments. The results show the average values of MDS during basketball training and match play and the 60-s pre-defined epoch was chosen because it has already been used in previous research and, moreover, it facilitates comparisons with average physical demands [13, 17, 27].

Procedures

Player movements during training and matches were recorded using a local positioning system (WIMU PRO, RealTrack Systems S.L., Almería, Spain). Based on the manufacturer's recommendations, the tracking units were placed in a custom-made vest located in the centre of the upper back using an adjustable harness (IMAX, Lleida, Spain). These inertial devices (81x45x16 mm, 70 g) include four 3D accelerometers (full-scale output ranges are ± 16 g, ± 16 g, ± 32 g, ± 400 g, 100 Hz sample frequency), a gyroscope (8000º/s full-scale output range, 100 Hz sample frequency), a 3D magnetometer (100 Hz sample frequency), a GPS (10 Hz sample frequency) and an ultra-wide band positioning system (18 Hz sample frequency). Furthermore, each unit has an 8 GB flash memory, a gigahertz microprocessor and a high-speed USB interface to record, store and upload data. This ultra-wide band positioning system includes six antennas, three of them placed 12 metres away from each baseline of the basketball court. For better signal emission and reception, antennas were located forming a rectangle at a height of seven and half metres above the wooden floor and 17 metres apart. WIMU PRO has been shown to have good/acceptable accuracy and inter- and intra-unit reliability for ultra-wide band positioning in indoor sports [28]. Data were downloaded and analysed using the system-specific software (SPRO, version 955, RealTrack Systems, Almería, Spain).

Statistical analysis

Descriptive statistics data are presented using means, SD (± SD) and difference percentage. The data were analysed using an analysis of variance (ANOVA) for repeated measures and Bonferroni post-hoc tests. Statistical analyses were performed using JASP v0.9.2 software (University of Amsterdam, https://jasp-stats.org/) and the statistical significance was set at $p \leq 0.05$. Furthermore, differences between the training sessions and the corresponding official basketball matches by playing positions were examined using standardised (Cohen's d) mean differences and their respective 90% confidence intervals (90% CI). Thresholds for effect size (ES) statistics were < 0.20, trivial; 0.20–0.59, small; 0.60–1.19, moderate; 1.20–1.99, large; and > 2.0, very large [29].

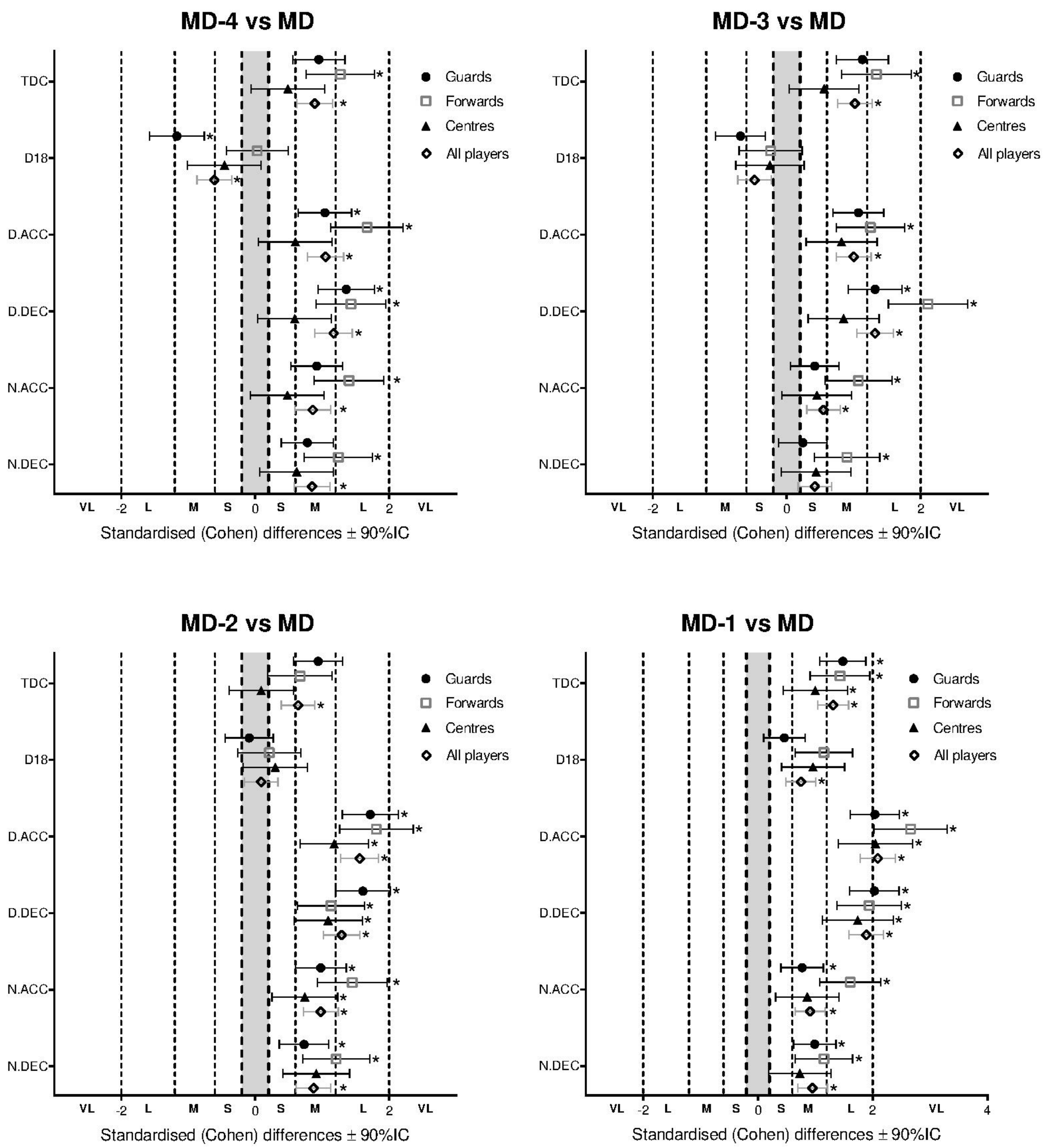

FIG. 1. Standardised differences (Cohen's d) and the 90% confidence intervals for the most demanding scenarios during 60-s epochs. Note: Significant difference is reported with * at the right end of the 90% CI bar. MD-4 is match day minus four; MD-3 is match day minus three; MD-2 is match day minus two; MD-1 is match day minus one; MD is match day; TDC is total distance covered in metres; D18 is distance covered at > 18 $km \cdot h^{-1}$ in metres; D.ACC is distance at high-intensity acceleration (≥ 2 $m \cdot s^{-2}$) in metres; D.DEC is distance at high-intensity decelerations (≤ -2 $m \cdot s^{-2}$) in metres; N.ACC is number of high-intensity accelerations (≥ 2 $m \cdot s^{-2}$); N.DEC is number of high-intensity decelerations (≤ -2 $m \cdot s^{-2}$); VL is very large effect; L is large effect; M is moderate effect; S is small effect.

TABLE 3. Physical demands parameters of the most demanding 60-second scenarios for professional basketball players across playing positions.

Physical Demand Parameter	Playing Position	MD-4 Means (SD)	MD-4 % Diff	MD-3 Means (SD)	MD-3 % Diff	MD-2 Means (SD)	MD-2 % Diff	MD-1 Means (SD)	MD-1 % Diff	MD Means (SD)
Total distance covered (m)	Guards	128.0 ± 16.6	-9.2	125.6 ± 16.5	-10.9	126.8 ± 18.9	-10.0	118.2 ± 19.4	-16.1	140.9 ± 9.8
	Forwards	122.4 ± 17.1	-12.4	121.5 ± 16.9	-13.0	131.2 ± 15.8	-6.2	116.6 ± 20.9	-16.6	139.8 ± 9.2
	Centres	119.9 ± 20.3	-6.3	119.8 ± 17.4	-6.3	126.5 ± 19.8	-1.1	110.7 ± 21.9	-13.4	127.9 ± 10.5
	All players	124.4 ± 17.7	-9.6	123.1 ± 16.8	-10.5	127.9 ± 18.2	-7.0	116.2 ± 20.3	-15.6	137.6 ± 11.1
Distance > 18 km·h^{-1} (m)	Guards	31.3 ± 9.2	**+46.3**	30.1 ± 16.0	**+40.7**	22.1 ± 7.9	**+3.3**	17.3 ± 10.0	-19.2	21.4 ± 7.7
	Forwards	24.8 ± 10.3	-1.2	27.7 ± 13.2	**+10.4**	23.3 ± 10.1	-7.2	16.4 ± 8.0	-34.7	25.1 ± 7.2
	Centres	27.3 ± 10.5	**+18.2**	25.1 ± 8.6	**+8.7**	21.1 ± 5.5	-8.7	15.3 ± 8.8	-33.8	23.1 ± 7.5
	All players	28.4 ± 10.1	**+24.0**	28.2 ± 13.8	**+23.1**	22.2 ± 8.1	-3.0	16.6 ± 9.2	-27.5	22.9 ± 7.6
Distance at acceleration ≥ 2 m·s^{-2} (m)	Guards	40.4 ± 8.5	-17.9	40.8 ± 7.3	-17.1	34.6 ± 8.6	-29.7	31.2 ± 9.2	-36.6	49.2 ± 8.4
	Forwards	34.2 ± 7.7	-28.6	35.8 ± 10.5	-25.3	32.4 ± 8.4	-32.4	27.5 ± 6.4	-42.6	47.9 ± 8.7
	Centres	36.2 ± 11.8	-15.6	34.2 ± 10.6	-20.3	31.3 ± 9.0	-27.0	25.0 ± 6.2	-41.7	42.9 ± 10.6
	All players	37.5 ± 9.4	-20.7	37.9 ± 9.5	-19.9	33.3 ± 8.6	-29.6	28.9 ± 8.3	-38.9	47.3 ± 9.3
Distance at deceleration ≤ -2 m·s^{-2} (m)	Guards	33.1 ± 7.8	-25.1	34.1 ± 6.8	-22.9	31.2 ± 7.7	-29.4	26.9 ± 8.6	-39.1	44.2 ± 8.4
	Forwards	31.1 ± 7.9	-25.6	27.0 ± 7.0	-35.4	30.3 ± 12.6	-27.5	25.2 ± 9.9	-39.7	41.8 ± 7.0
	Centres	32.7 ± 8.3	-13.9	30.9 ± 6.8	-18.7	28.6 ± 7.4	-24.7	23.2 ± 7.1	-38.9	38.0 ± 9.7
	All players	32.4 ± 7.9	-23.0	31.5 ± 7.4	-25.2	30.6 ± 9.2	-27.3	25.7 ± 8.7	-39.0	42.1 ± 8.6
Accelerations ≥ 2 m·s^{-2} (counts)	Guards	8.4 ± 2.4	-20.0	9.6 ± 2.1	-8.6	8.2 ± 2.5	-21.9	8.4 ± 3.2	-20.0	10.5 ± 2.2
	Forwards	7.5 ± 1.1	-25.7	7.78 ± 1.9	-23.0	7.3 ± 1.3	-27.7	6.8 ± 1.6	-32.7	10.1 ± 2.4
	Centres	8.5 ± 2.5	-14.1	8.6 ± 2.3	-13.1	7.6 ± 2.9	-23.2	7.4 ± 2.5	-25.3	9.9 ± 3.3
	All players	8.2 ± 2.1	-19.6	8.9 ± 2.2	-12.7	7.8 ± 2.4	-23.5	7.8 ± 2.8	-23.5	10.2 ± 2.5
Decelerations ≤ -2 m·s^{-2} (counts)	Guards	8.2 ± 2.2	-17.5	9.3 ± 2.7	-6.1	8.1 ± 2.7	-18.2	7.5 ± 2.6	-24.2	9.9 ± 2.3
	Forwards	6.7 ± 1.9	-29.8	7.4 ± 2.0	-22.1	6.8 ± 1.8	-28.4	6.7 ± 2.3	-29.5	9.5 ± 2.6
	Centres	8.0 ± 2.1	-17.5	8.4 ± 2.5	-13.4	7.1 ± 2.3	-26.8	7.6 ± 2.4	-21.6	9.7 ± 3.3
	All players	7.7 ± 2.2	-21.0	8.6 ± 2.6	-11.3	7.5 ± 2.4	-22.7	7.3 ± 2.5	-24.7	9.7 ± 2.6

Note: % Diff is percentage of difference between training and competition; bolded % Diff shows differences where training values are higher than competition; MD-4 is match day minus four; MD-3 is match day minus three; MD-2 is match day minus two; MD-1 is match day minus one; and MD is match day.

RESULTS

Descriptive values for the MDS of different training sessions and official basketball matches across playing positions are presented in Table 3. The results revealed that distance covered at > 18 km·h^{-1} was the only physical parameter in which players achieved higher peak values during training sessions compared to official competition. More particularly, differences between MDS during the MD-3 preparatory session and matches ranged between +8.7% and +40.7%. In contrast, the other five variables showed the highest MDS values during matches, and the lowest differences were found in the MD-4 and MD-3 sessions. Furthermore, the MD-1 session presented the lowest values in all physical variables and the largest MDS differences with MD across playing positions (-13.4% to -42.6%).

Figure 1 shows ES and statistical differences between the four different training session types (MD-4, MD-3, MD-2 and MD-1) and official matches (MD) across playing positions. MD-4 and MD-3 sessions presented a similar pattern: while distance covered at > 18 km·h^{-1} showed small to moderate increases during training sessions, the other five physical demands parameters showed small to very large MDS decreases in comparison to MD. More particularly, the largest decrease (ES = 2.11) was found in the forward position for the distance at high-intensity decelerations during the MD-3 training type. In contrast to distance covered at > 18 km·h^{-1} during MD-4 and MD-3, all six physical demand parameters presented lower values of MDS with a decreased tendency during MD-2 and MD-1 compared to official matches. By way of example, distance at high-intensity acceleration and deceleration presented moderate to large decreases in MD-2, whereas large to very large decreases were observed in MD-1 compared to MD. Moreover, the forward position presented the greatest difference (ES = 2.66) in distance at high-intensity acceleration between MD-1 and MD.

DISCUSSION

The purpose of this study was to examine the MDS in basketball training and competition across playing positions. The main finding of this research was that 60-second peak values for the majority of the physical demand parameters examined were higher during official matches than training for any basketball playing position. Nevertheless, distance covered at > 18 km·h^{-1} was the only load variable that was greater than MD-4 (ES = 0.61, p = 0.01) and MD-3 (ES = 0.48, p > 0.05) preparation sessions in all players compared to MD. Therefore, athletic staff and basketball coaches should consider using the MDS of match play to examine the relationship between training and competition in order to optimise individual physical performance.

In contrast to this study, showing overall higher physical demands in the MDS of basketball match play, available research has reported greater average accelerometer-derived values during training compared to competition in male basketball players [4, 5]. However, the work in question examined back-to-back pre-season friendly matches, which may not replicate official match demands because coaches may consider these sessions to be preparatory and players are not competition-fit. Furthermore, the use of average physical demands could also explain the results, since inactivity periods during training (e.g. coaching instruction) could be longer and more frequent than during matches (e.g. free-throws and substitutions), which would limit the occurrence of greater MDS [30]. Nevertheless, this limitation could be resolved by excluding or reducing rest periods and using a rolling average for MDS identification. Similar to this research, Fox et al. [17] found greater peak values during official matches than training with moderate to large differences across six different time epochs ranging from 0.5 to 5 minutes. The so-called "effort rationale" term might justify the higher physical demands values during regulated basketball matches because of the involvement of real opponents, fans and their consequent motivation and focus [4].

When comparing the different types of basketball training sessions, MD-4 and MD-3 present the highest MDS results. Moreover, their increased total training volume (Table 1) and the priority for high-specificity drills such as 5-on-5 simulated matches show that they should be regarded as high-load training sessions. However, a total of five physical demand parameters, i.e. total distance covered, distance at high-intensity acceleration and deceleration, and number of high-intensity accelerations and decelerations, failed to match or surpass the match's peak values. Specifically, this study found moderate to large differences in total distance covered (ES MD-4 = 0.89, p < 0.001; ES MD-3 = 1.02, p < 0.001), and distance at acceleration (ES MD-4 = 1.05, p < 0.001; ES MD-3 = 1.00, p < 0.001) and deceleration (ES MD-4 = 1.17, p < 0.001; ES MD-3 = 1.32, p < 0.001) with physical demand values ranging from -9.3% to -23.0% below the MDS of match play for all playing positions. Conversely, the only load variable examined that surpassed competition demands was distance covered at > 18 km·h^{-1}, which presented moderate (ES = 0.61, p = 0.01) and small (ES = 0.48, p > 0.05) increases during MD-4 and MD-3, respectively. The fact that only distance covered at > 18 km·h^{-1} was overloaded during training sessions shows that MD-4 and MD-3 contained a minimum of one drill in which players were forced to run several times from baseline to baseline at high speed, accumulating several metres at > 18 km·h^{-1}. Although this study could not identify the specific basketball tasks in which the MDS were found, these results suggest that the preparatory drills proposed during MD-4 and MD-3 did not match the physical demands in the most intense periods of official competition.

In contrast to MD-4 and MD-3, MD-2 and MD-1 presented a progressive reduction in training volume (Table 1) and a small to very large reduction in the MDS during sessions. These values are in line with previous studies in different team sports [7, 8], in which coaches tend to reduce physical demand parameters the day(s) before a competition following a tapering strategy to allow enough recovery time before the upcoming match. However, available research in professional female basketball players did not reveal significant differences in average values of an accelerometer-derived variable between three training sessions before difficult matches using inertial microsensors [31]. In addition to match difficulty, caution should be exercised with recommendations about stressing the most intense periods of training-play during MD-2 and MD-1, since this study investigated peak values instead of average physical demands.

Although playing positions showed trivial to small differences during the MDS of training in relation to MD, this study obtained comparable results to previous research using peak values to examine physical demands in sub-elite basketball players [16]. In particular, Vázquez-Guerrero et al. [16] concluded that centres achieved the lowest MDS results in total distance covered, forwards and guards completed the greatest high-intensity running (18.1–24.0 km·h^{-1}), and guards performed the highest number of, and covered the greatest distance in, high-intensity accelerations (≥ 2 m·s^{-2}) and decelerations (≤ -2 m·s^{-2}) in under-18 basketball players monitored during official tournament matches. Similarly, this research showed that centres obtained the lowest peak value in total distance covered during MD, which could be related to this position remaining near the three-second zone in more static positions for tactical reasons. Furthermore, although the available research has shown that centres can complete the greatest distances at above 18 km·h^{-1} [19], this investigation found that forwards presented the greatest MDS of match-play in distance covered at > 18 km·h^{-1}, which could be attributed to the fact that forwards are shorter and have a lower body mass than centres [32] and seem to be better prepared to achieve higher results during the most demanding 60-second scenarios. Finally, this study also concluded that the highest values of MDS in distance and number of high-intensity accelerations and decelerations are found in guards, followed by forwards and centres. In addition to the rationale that smaller players require less force to achieve the same or higher accelerations due to their lower body mass [18], this acceleration profile also reflects the specificity of basketball positional roles, where guards are required to perform the greatest number of high-intensity actions, such as full-court and half-court defence, and isolated and combined offensive movements to create advantages [32].

Regarding limitations of this study, it is important to highlight that this research did not specify the training tasks in which MDS were found during training. Thus, it is not possible to identify the specificity level of basketball drills and to determine whether peak values were discovered at the beginning or at the end of training sessions. Secondly, the MDS utilized were individual for each player and could occur at different moments during training and league matches. Moreover, it was impossible to relate the MDS to any contextual factors such as having (or not) possession of the ball [33, 34, 35]. Finally, another potential limitation could be the exclusive use of the 60-second time epoch to investigate the most demanding passages of training and match-play. Therefore, future research should consider the analysis of different match-specific time epochs, such as 30 or 90 seconds, to obtain a better understanding of the MDS during basketball competition and to consequently optimise individual player preparation.

CONCLUSIONS

In conclusion, this study showed that most of the peak physical demands examined were higher during official matches than in practice sessions across the in-season structured microcycle. Nevertheless, understanding the MDS during different training sessions across the structured microcycle could help basketball coaches to ensure the optimisation of their loading practice sessions, such as MD-4 and MD-3, and to enhance their short-term tapering strategies in MD-2 and MD-1 prior to a competition. Additionally, the differences found between playing positions could help to bolster training methodologies based on individualization. For example, it is worth noting that while forwards overstress the MDS of high-speed running in comparison with the other two positions, guards tend to overload the MDS related to distance and number of high-intensity accelerations and decelerations during official matches. Therefore, basketball practitioners might consider overstressing peak physical demand values above the MDS of match-play to promote training adaptations across playing positions as needed, such as pre-season and specific overloading phases during the season. Finally, basketball coaches and strength and conditioning professionals may use the MDS of match-play to set the upper limit threshold in the training process and manage the duration of drills and their interruptions to prepare players optimally for the most intense periods of official competition. By way of example, prescribing 5-on-5 scrimmages with some changes in FIBA rules, such as not stopping after fouls, avoiding free throws and encouraging players to make a rapid out-of-bounds ball reposition, would probably reduce match stoppages and promote the desired overload to stimulate greater peak physical demands during training.

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Conflict of interest

The authors did not report any potential conflict of interest.

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