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Game schedule congestion affects weekly workloads but not individual game demands in semi-professional basketball

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ABSTRACT: To quantify and compare workloads encountered by basketball players during individual games played across 1-, 2-, and 3-day periods in the same week, and during weeks where 1, 2, and 3 games are scheduled. Eight semi-professional male players were monitored. External workload was determined as absolute and relative ($\cdot min^{-1}$) PlayerLoad (PL), and total and high-intensity jumps, accelerations, decelerations, and changes of direction (COD). Internal workload was determined as absolute and relative summated heart rate zones (SHRZ), session-rating of perceived exertion (sRPE), and RPE. Game workloads were tabulated considering the order in which they were scheduled weekly (game 1, 2, or 3), and each week considering the number of games scheduled (1, 2, or 3 games). Analysing weekly workloads, duration was higher during 3-game than 1- and 2-game weeks ($P < 0.05$, ES = 6.65-18.19). High-intensity decelerations and COD were higher during 3-game than 1-game weeks ($P < 0.05$, ES = 1.26–1.55). Absolute PL, jumps, accelerations, decelerations, COD, and high-intensity jumps and accelerations were higher during 3-game than 1- and 2-game weeks ($P < 0.05$, ES = 0.69–2.63). Absolute SHRZ and sRPE were higher during 3-game than 1- and 2-game weeks ($P < 0.05$, ES = 0.86–2.43). Players completed similar individual game workloads regardless of the number of games played on consecutive days in the week. Workloads were similar during 1- and 2-game weeks, while the addition of a third game significantly increased the overall weekly workloads encountered.

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INTRODUCTION

Understanding the demands encountered during basketball training and game-play provides important information to practitioners regarding management of player workloads [1]. Player workloads are typically expressed using external and internal metrics. External workload represents the training and competition stimuli imposed, while internal workload reflects the physiological or perceptual reactions of players to the imposed demands [1, 2]. Although internal workloads will ultimately dictate performance-related outcomes, it is the external workloads that must be manipulated to bring about the desired responses from players [3]. Hence, monitoring player workloads across pre- and in-season phases allows practitioners to effectively prescribe and periodize workloads to promote favourable physical and physiological adaptations [1].

While basketball practitioners seek to carefully prescribe player workloads, in some scenarios they may have restricted control over the loading placed upon players. For example, various situational variables such as facing higher-ranked opponents [4], playing at away venues [5], and the occurrence of overtime periods [6] increase the workloads encountered by players during games. While some game-related situational variables may augment acute player workloads during individual games, other factors may have a wider impact on the weekly workloads encountered. Specifically, competition scheduling may require more extensive consideration by basketball coaches than other situational variables given that scheduling requirements are known well in advance of games. In turn, basketball practitioners can plan player workloads to promote favourable adaptations and optimal readiness for games [7] dependant upon the schedule faced.

In basketball, teams can be exposed to congested schedules with multiple games played in close succession [8], which can affect the weekly workloads encountered by players [7]. For instance, if congested schedules severely heighten the weekly workloads experienced by players, basketball practitioners may taper training across the week to avoid excessive spikes in loading [7, 8]. However, for basketball practitioners to make decisions regarding management of player workloads considering game scheduling, it is important that a sufficient evidence base is first established on this topic. To date, limited work [7, 9, 10] has examined differences in weekly workloads during 1- (non-congested) and 2-game (congested) weeks. Specifically, using the session-rating of perceived exertion (sRPE) model to quantify workload, Manzi et al. [9] observed higher loading during 1-game (2928 ± 303 AU) than 2-game (2791 ± 239 AU) weeks in professional male basketball players and Clemente et al. [10] found a moderate increase in loading during 1-game than 2-game weeks in professional male basketball players. Conte et al. [7] also showed greater loading in 1- (2451 ± 470 AU) compared to 2-game (2320 ± 747 AU) weeks in collegiate male players. While these findings are important, it should be noted that existing data are indicative of subjective, perceptual internal loading and different trends may be apparent using more objective internal metrics as well as external workload measures [2, 11]. Furthermore, existing research explored teams in professional European and American Division I collegiate competitions, which may not translate to other geographical regions and playing levels where game scheduling varies. Therefore, more research is needed to better understand the impact of competition scheduling on player workloads in broader contexts than what has been reported [7, 9].

Although studies have quantified the effect of competition schedule congestion on weekly player workloads [7, 9, 10], only one study [12] has examined the workloads encountered by players during individual games played on consecutive days during congested periods. Pino-Ortega et al. [12] examined differences in game demands across consecutive games, with increases in external workload intensities evident during later games; however, data were collected across a 3-day tournament. Consequently, these data are likely not representative of game demands during a regular, in-season competition where training and game demands and scheduling requirements are varied, but rather indicative of a single, brief, tournament-style competition. Quantifying changes in player workloads across consecutive games during the in-season phase, in addition to the weekly workloads encountered, will help basketball practitioners understand the impact of competition scheduling on player loading and whether fluctuations are related to changes in training demands, game demands, or a combination of these factors. Therefore, the purpose of this study was to quantify and compare the external and internal workloads in individual games played across 1-, 2-, and 3-day periods and across weeks where 1, 2, and 3 games are scheduled in basketball players.

MATERIALS AND METHODS

Experimental approach to the problem

Players were monitored during all training sessions and games for the entire 2018 season, running from April to August. During the in-season, 1–3 training sessions were held per week (players participated in 0–3 training sessions per week), with games played between Friday and Sunday. Therefore, a week was considered from Monday to Sunday, to ensure games played in each round were captured within the same 7-day period. Data were collected across all 15 weeks of the regular season and included 11 single-game weeks, 2 double-headers (2 games played on consecutive days), and 1 triple-header (3 games played on consecutive days). The training and game schedule along with session duration is presented in Table 1.

Across the season, the team had 8 wins and 10 losses. All training sessions consisted of games-based training with variations in player numbers, court size and tactical strategies delivered across

TABLE 1. In-season team training and game schedule with duration (min).

In-season week	Day					
	Monday	Wednesday	Thursday	Friday	Saturday	Sunday
1	Training (56)	Training (44)		Home (90)		
2	Training (77)	Training (98)				Training (93)
3	Training (70)			Away (103)	Away (95)	
4	Training (75)	Training (70)		Home (103)		
5	Training (76)	Training (60)			Away (92)	
6	Training (76)	Training (62)				Home (101)
7		Training (64)			Away (126)	Away (108)
8			Training (93)		Home (126)	
9	Training (76)	Training (55)		Home (93)		
10	Training (80)	Training (93)			Away (104)	
11		Training (74)		Away (107)	Away (100)	Away (98)
12	Training (78)	Training (76)			Home (100)	
13	Training (74)			Home (91)	Training (89)	
14	Training (79)	Training (90)			Home (89)	
15		Training (86)			Home (102)	

Note: No training sessions or games were held on a Tuesday or where cells are shaded grey; mean session/game duration across all players participating is shown in parentheses; Home = home game, Away = away game.

the season. All training was directly prescribed by the coaching staff with no input from the research team. No restrictions were placed regarding minutes played during games in order to accurately reflect the game demands encountered. All data were included in single games (game 1); however, game data during congested schedules were only included where players received playing time during games 1 and 2 (double headers) or games 1, 2, and 3 (triple header). Similarly, data for weekly workloads were only kept if players received minutes during games 1, 1–2, and 1–3 for single-game weeks, double-headers, and triple-headers, respectively.

Subjects

Eight semi-professional male basketball players (age: 24.4 ± 3.2 years, stature: 194.7 ± 1.3 cm, body mass: 93.1 ± 16.4 kg, semi-professional playing experience: 5.0 ± 1.9 years) from the same basketball team volunteered to participate in this study. The team competed in the Queensland Basketball League, which is a second-tier, Australian basketball competition. The players included in the present study were those who were routinely monitored across the season at the request of coaching staff. Players who attended training but were not expected to receive regular playing time were not monitored and therefore were not considered for inclusion in this study. All players were pre-screened to identify any injuries or health conditions preventing them from safely participating in the study before providing voluntary, written informed consent. The study was approved by an Institutional Human Research Ethics Committee.

Procedures

Prior to the first training session, anthropometric data were collected for each player including stature using a portable stadiometer (Seca 213, Seca GMBH, Hamburg, Germany) and body mass using electronic scales (BWB-600, Tanita Corporation, Tokyo, Japan). For all training sessions and games, players were fitted with microsensors (OptimEye s5, Catapult Innovation, Melbourne, Australia), which were held between the scapulae in specially designed neoprene vests (Catapult Innovations, Melbourne, Australia). Chest-worn heart rate (HR) monitors (T31, Polar Electro, Kempele, Finland) were also affixed to each player and held at the level of the xiphoid process. Following each training session and game, players reported individualized ratings of perceived exertion (RPE) to a member of the research team within 30 min of completing the training session or game using Borg's 1–10 Category Ratio Scale [13].

After each session, microsensor and heart rate (HR) data were downloaded to a personal computer for further analysis using proprietary software accompanying the microsensors (OpenField version 8, Catapult Innovations, Melbourne, Australia). Warm-ups were excluded; however, rest periods were included in all analyses to provide a representation of the overall intensity of each training session and game [2]. External workload was reported as absolute (arbitrary units [AU]) and relative ($AU \cdot min^{-1}$) PlayerLoad (PL), derived from tri-axial accelerometers housed within the microsensors. PL represents the square root of the sum of the squared rate of change in acceleration across the x, y, and z planes multiplied by a scaling factor of 0.01 [14, 15]. Additionally, inertial movement analysis (IMA) variables, derived from the microsensors, were detected according to the direction travelled by each player. Specifically, the frequency of all and high-intensity (>3.5 $m \cdot s^{-2}$) accelerations (-45° to 45°), decelerations (-135° to 135°), and changes of direction (COD; -135° to -45° for left and 45° to 135° for right COD) were recorded. Jumps were detected using proprietary algorithms and also reported as the frequency of total and high-intensity (>40 cm) jumps. All IMA variables were reported as absolute and relative ($\cdot min^{-1}$) counts. The reliability of PL (CV = 0.9–1.9%) [16] and IMA-derived external workload variables (CV = 3.1–6.7%) [17] have been previously supported in team sports.

To determine internal workload, HR data were exported in 1-s epochs into a customized spreadsheet for analysis (Microsoft Excel version 15, Microsoft Corporation, Redmond, USA). Internal workload was determined using a modified summated-heart-rate-zones (SHRZ) workload with each HR response placed into pre-defined zones which incrementally increased by 2.5% HR_{max} (highest HR obtained during any training session or game during the season) [18] starting at 50% HR_{max}. Time spent in each zone was then multiplied by a corresponding weighting which incrementally increased by 0.25 between 1.0 (50–52.4% HR_{max}) and 5.75 (97.5–100% HR_{max}) [19]. The sum of the accumulated weightings for each training session or game was used to determine absolute SHRZ (AU) and SHRZ relative to session duration ($SHRZ \cdot min^{-1}$) [2]. In addition, individualized RPE was multiplied by the duration of the session (min) to calculate sRPE (AU) [13], while the RPE score collected after each session was taken as the relative internal perceptual workload (AU) to represent the intensity of the session.

Statistical analyses

Mean ± standard deviation (SD) were calculated for all workload variables. Separate linear mixed models with Bonferroni post hoc tests were conducted to compare game demands according to the order the individual games were played consecutively each week (games 1, 2, and 3) and between weekly workloads when 1-, 2-, and 3-game weeks were scheduled. In the analyses, game order or the number of games per week (three levels) was included as a fixed term and player (n = 8) was included as a random term to account for multiple samples obtained from each player. For all pairwise comparisons, effect sizes with 90% confidence intervals were calculated and interpreted as *trivial*: >0.2, *small*: 0.2–0.59, *moderate*: 0.6–1.19, *large*: 1.2–1.99, and *very large*: ≥2 [20]. Where confidence limits of effect sizes crossed ±0.2, effects were deemed *unclear* [21]. All analyses were conducted using IBM SPSS Statistics (Version 24, IBM Corporation, Armonk, USA) and Microsoft Excel (Version 15, Microsoft Corporation, Redmond, USA). Statistical significance was accepted where $P < 0.05$.

RESULTS

Mean ± SD game workloads according to the order in which they were played each week are presented in Table 2, with statistical outcomes for pairwise comparisons shown in Table 3. sRPE and RPE were *moderately* higher during game 2 than game 3 (P >0.05).

Mean ± SD weekly workloads according to the number of games scheduled are presented in Table 4, with statistical outcomes for pairwise comparisons shown in Table 5. Duration was higher during 3-game than 1- and 2-game weeks (P <0.05, *very large*). Relative PL was higher during 1-game compared to 2-game weeks (P >0.05, *moderate*). High-intensity accelerations and decelerations were performed more frequently during 3-game (P <0.05, *large-very large*) and 2-game (P >0.05, *moderate*) compared to 1-game weeks. Relative total jumps were significantly (P <0.05) higher during 1-game compared to 2-game weeks (*moderate*). Absolute PL, high-intensity and total jumps, accelerations, decelerations, and COD were significantly (P < 0.05) higher during 3-game compared to 1-game weeks, with effect magnitudes ranging from *large* to *very large*. Absolute PL as well as high-intensity and total jumps and accelerations, total decelerations, and total COD were significantly (P <0.05) higher during 3-game compared to 2-game weeks, with effect magnitudes ranging from *moderate* to *large*. Relative total jumps and total high-intensity COD were higher during 3-game compared to 2-game weeks (P >0.05, moderate).

Absolute SHRZ and sRPE were significantly (P <0.05) higher during 3-game compared to 1-game (*very large*) and 2-game (*moderate*) weeks.

DISCUSSION

Our data suggest that players encounter similar workloads during games irrespective of the order they are played each week. However, the number of games played each week alters the overall

TABLE 2. External and internal game workloads (mean ± standard deviation) according to the order in which they were scheduled each week in semi-professional, male basketball players.

Variable	Game 1 (N = 85)	Game 2 (N = 17)	Game 3 (N = 6)
External workload			
Game duration (min)	102 ± 11	101 ± 6	98 ± 0
Absolute PL (AU)	541 ± 187	575 ± 166	529 ± 221
Relative PL (AU·min^{-1})	5.34 ± 1.77	5.71 ± 1.71	5.39 ± 2.26
High-intensity jumps (count)	17 ± 10	17 ± 9	17 ± 14
Relative high-intensity jumps (count·min^{-1})	0.17 ± 0.10	0.16 ± 0.09	0.17 ± 0.14
Total jumps (count)	56 ± 21	62 ± 24	65 ± 21
Relative total jumps (count·min^{-1})	0.55 ± 0.21	0.61 ± 0.23	0.66 ± 0.21
High-intensity ACC (count)	8 ± 4	10 ± 5	10 ± 6
Relative high-intensity ACC (count·min^{-1})	0.08 ± 0.04	0.10 ± 0.05	0.10 ± 0.06
Total ACC (count)	62 ± 22	66 ± 23	59 ± 26
Relative total ACC (count·min^{-1})	0.61 ± 0.22	0.65 ± 0.23	0.60 ± 0.26
High-intensity DEC (count)	11 ± 7.0	11 ± 7	9 ± 5
Relative high-intensity DEC (count·min^{-1})	0.11 ± 0.07	0.10 ± 0.06	0.09 ± 0.05
Total DEC (count)	113 ± 49	172 ± 249	104 ± 44
Relative total DEC (count·min^{-1})	1.12 ± 0.47	1.67 ± 2.29	1.06 ± 0.45
High-intensity COD (count)	23 ± 14	26 ± 15	23 ± 14
Relative high-intensity COD (count·min^{-1})	0.23 ± 0.14	0.25 ± 0.14	0.23 ± 0.14
Total COD (count)	364 ± 122	418 ± 146	353 ± 139
Relative total COD (count·min^{-1})	3.59 ± 1.20	4.13 ± 1.40	3.60 ± 1.42
Internal workload			
Absolute SHRZ (AU)	278 ± 77	271 ± 65	238 ± 99
Relative SHRZ (AU·min^{-1})	2.73 ± 0.69	2.68 ± 0.61	2.43 ± 1.01
sRPE (AU)	706 ± 211	737 ± 164	588 ± 232
RPE (AU)	6.89 ± 1.75	7.29 ± 1.57	6.00 ± 2.37

Note: § indicates significantly (P <0.05) different to game 1, PL = PlayerLoad™, AU = arbitrary units, ACC = accelerations, DEC = decelerations, COD = changes-of-direction, SHRZ = Summated-Heart-Rate-Zones, sRPE = session-rating of perceived exertion, RPE = rating of perceived exertion.

weekly external and internal workloads encountered by players, with the addition of a third game exacerbating player demands.

Players encountered comparable objective external and internal workloads during individual games, regardless of whether they were played first, second, or third in non-congested and congested weeks across the season. While this study is the first to assess game demands considering the order in which they were scheduled in a competitive basketball league, additional insights may be drawn from tournament-style competitions where multiple games are played in close succession. Klusemann et al. [22] and Pino-Ortega et al. [12] assessed changes in physical and physiological demands across an elite junior basketball tournament imposing a congested schedule (7 games across an 8-day period [12] and 3 games in a 3-day period) [22]. Both studies [12, 22] reported an increase in high-intensity activity during games later in the tournament, compared to earlier games. A possible explanation for the increase in high-intensity activity in games completed later in the congested schedule relates to the tournament structure whereby the quality of opposition was higher and score-line margins were closer later in the tournament, given that teams were eliminated as the competitions progressed [12, 22]. In agreement with our data, however, Klusemann et al. [22] reported similar overall total and relative movement counts, suggesting that players encounter comparable global external workloads during individual games, regardless of the number of games played during a congested period.

In regards to internal workloads, Klusemann et al. [22] reported similar trends across games to the present study with *unclear* differences in peak HR and only *possible* differences in mean HR across the tournament. Together, our findings and those reported previously [22] suggest that internal workloads predicated on objective HR responses are consistent across individual games played in non-congested and congested periods. It should be recognized, however,

TABLE 3. Pairwise comparisons for external and internal game workloads according to the order in which they were scheduled each week in semi-professional, male basketball players.

Variable	Statistical comparisons (P value, effect size ± 90% CL)		
	Game 1 vs 2	Game 1 vs 3	Game 2 vs 3
External workload			
Game duration	1.0, 0.10 ± 0.52	1.0, 0.37 ± 0.83	1.0, 0.57 ± 0.92
Absolute PL	1.0, 0.18 ± 0.52	1.0, 0.06 ± 0.83	1.0, 0.25 ± 0.92
Relative PL	1.0, 0.50 ± 0.53	1.0, 0.0 ± 0.83	1.0, 0.50 ± 0.92
High-intensity jumps	1.0, 0.0 ± 0.52	1.0, 0.01 ± 0.83	1.0, 0.0 ± 0.93
Relative high-intensity jumps	1.0, 0.10 ± 0.52	1.0, 0.0 ± 0.83	1.0, 0.10 ± 0.93
Total jumps	0.85, 0.28 ± 0.52	0.91, 0.43 ± 0.83	1.0, 0.13 ± 0.94
Relative total jumps	0.92, 0.28 ± 0.52	0.66, 0.52 ± 0.84	1.0, 0.22 ± 0.94
High-intensity ACC	0.28, 0.48 ± 0.53	0.86, 0.49 ± 0.84	1.0, 0.0 ± 0.67
Relative high-intensity ACC	0.33, 0.48 ± 0.53	0.90, 0.48 ± 0.84	1.0, 0.0 ± 0.93
Total ACC	1.0, 0.18 ± 0.52	1.0, 0.13 ± 0.83	1.0, 0.29 ± 0.92
Relative total ACC	1.0, 0.18 ± 0.52	1.0, 0.04 ± 0.83	1.0, 0.21 ± 0.92
High-intensity DEC	1.0, 0.0 ± 0.52	1.0, 0.29 ± 0.83	1.0, 0.30 ± 0.92
Relative high-intensity DEC	1.0, 0.15 ± 0.52	1.0, 0.29 ± 0.83	1.0, 0.17 ± 0.93
Total DEC	0.12, 0.54 ± 0.53	1.0, 0.18 ± 0.83	0.53, 0.31 ± 0.92
Relative total DEC	0.11, 0.54 ± 0.53	1.0, 0.13 ± 0.83	0.59, 0.30 ± 0.92
High-intensity COD	1.0, 0.21 ± 0.52	1.0, 0.0 ± 0.83	1.0, 0.20 ± 0.93
Relative high-intensity COD	1.0, 0.14 ± 0.44	1.0, 0.0 ± 0.69	1.0, 0.14 ± 0.78
Total COD	0.34, 0.43 ± 0.53	1.0, 0.09 ± 0.83	0.85, 0.45 ± 0.92
Relative total COD	0.33, 0.44 ± 0.53	1.0, 0.01 ± 0.83	1.0, 0.38 ± 0.92
Internal workload			
Absolute SHRZ	1.0, 0.09 ± 0.52	0.64, 0.51 ± 0.83	1.0, 0.44 ± 0.92
Relative SHRZ	1.0, 0.07 ± 0.52	0.89, 0.42 ± 0.83	1.0, 0.34 ± 0.92
sRPE	1.0, 0.15 ± 0.52	0.54, 0.56 ± 0.83	0.39, 0.82 ± 0.93*
RPE	1.0, 0.23 ± 0.52	0.69, 0.49 ± 0.83	0.37, 0.68 ± 0.93*

Note: Bolded *P* value indicates significant ($P < 0.05$) difference, * indicates *moderate* effect, ^ indicates *large* effect, CL = confidence limits, PL = PlayerLoad^{TM}, ACC = accelerations, DEC = decelerations, COD = changes-of-direction, SHRZ = Summated-Heart-Rate-Zones, sRPE = session-rating of perceived exertion, RPE = rating of perceived exertion.

TABLE 4. Weekly external and internal workloads (mean ± standard deviation) according to number of games scheduled in semi-professional, male basketball players.

Variable	1-game week (N = 76)	2-game week (N = 13)	3-game week (N = 6)
External workload			
Duration (min)	187 ± 8	233 ± 18	368 ± 25§¥
Absolute PL (AU)	1036 ± 403	1259 ± 637	2137 ± 775§¥
Relative PL (AU·min^{-1})	5.61 ± 1.18	5.18 ± 2.04	5.74 ± 1.12
High-intensity jumps (count)	35 ± 21	38 ± 27	70 ± 36§¥
Relative high-intensity jumps (count·min^{-1})	0.19 ± 0.09	0.15 ± 0.10	0.19 ± 0.10
Total jumps (count)	129 ± 60	130 ± 79	266 ± 90§¥
Relative total jumps (count·min^{-1})	0.68 ± 0.19	0.52 ± 0.25§	0.72 ± 0.15
High-intensity ACC (count)	14 ± 7	21 ± 15	32 ± 18§¥
Relative high-intensity ACC (count·min^{-1})	0.08 ± 0.0	0.08 ± 0.01	0.08 ± 0.01
Total ACC (count)	115 ± 46	142 ± 72	241 ± 70§¥
Relative total ACC (count·min^{-1})	0.62 ± 0.14	0.58 ± 0.25	0.66 ± 0.15
High-intensity DEC (count)	20 ± 12	29 ± 26	36 ± 20§
Relative high-intensity DEC (count·min^{-1})	0.11 ± 0.06	0.12 ± 0.08	0.09 ± 0.03
Total DEC (count)	222 ± 100	271 ± 177	437 ± 158§¥
Relative total DEC (count·min^{-1})	1.21 ± 0.47	1.09 ± 0.56	1.19 ± 0.39
High-intensity COD (count)	43 ± 25	54 ± 44	85 ± 49§
Relative high-intensity COD (count·min^{-1})	0.23 ± 0.11	0.21 ± 0.12	0.22 ± 0.09
Total COD (count)	746 ± 306	874 ± 504	1495 ± 466§¥
Relative total COD (count·min^{-1})	4.01 ± 0.91	3.50 ± 1.48	4.03 ± 0.67
Internal workload			
Absolute SHRZ (AU)	512 ± 198	640 ± 306	1028 ± 366§¥
Relative SHRZ (AU·min^{-1})	2.75 ± 0.52	2.61 ± 0.93	2.73 ± 0.40
sRPE (AU)	1094 ± 436	1627 ± 633§	2233 ± 850§¥
RPE (AU)	5.96 ± 1.63	6.82 ± 2.08	5.98 ± 1.51

Note: § indicates significantly (P <0.05) different to 1-game weeks, ¥ indicates significantly (P <0.05) different to 2-game weeks, PL = PlayerLoad™; AU = arbitrary units; ACC = accelerations; DEC = decelerations; COD = changes-of-direction; SHRZ = Summated-Heart-Rate-Zones; sRPE = session-rating of perceived exertion; RPE = rating of perceived exertion.

that our data revealed *moderately* higher subjective, perceptual internal workloads (sRPE) and intensities (RPE) during the second game each week compared to the third game. It is possible that situational factors may have influenced this pattern in perceptual workloads. For example, the second and third games in our study were always played at away venues and resulted in losses [5], and other situational variables such as the score-line margin and level of opposition [12] may have impacted the individual games examined. Specifically, of the second (n = 3) and third (n = 1) games played consecutively, two were balanced (<8-point score-line margin), and all were played against teams occupying a higher ladder position [12], which may have increased perceptual game demands [12]. Nevertheless, it appears that the order in which a game is played does not exert a considerable impact on game demands, suggesting that more consideration may be needed regarding the training demands and their effect on the total weekly workloads encountered.

The number of games played per week markedly contributed to the weekly workload volumes encountered. Specifically, higher weekly workloads were evident during 3-game weeks than 1- and 2-game weeks. These data suggest that among semi-professional basketball players competing in the QBL, playing three games per week may significantly increase player workloads across the week. This study is the first to quantify workloads during 3-game weeks across the in-season phase in semi-professional basketball; therefore, comparisons between our findings and existing research are limited to studies examining workloads during 1- and 2-game weeks. Previous work has demonstrated higher (*small* to *large*) perceptual (sRPE) workloads during 1- compared to 2-game weeks in professional [9, 10], and

TABLE 5. Pairwise comparisons for weekly external and internal workloads according to number of games scheduled in semi-professional, male basketball players.

Variable	Statistical comparisons (P value, effect size ± 90% CL)		
	1- vs 2-game weeks	1- vs 3-game weeks	2 vs 3-game weeks
External workload			
Duration	0.06, 4.60 ± 0.93†	**<0.001,** 18.19 ± 3.05†	**<0.001,** 6.65 ± 2.54†
Absolute PL	0.35, 0.50 ± 0.60	**<0.001**, 2.53 ± 0.94†	**<0.001**, 1.29 ± 1.10^
Relative PL	0.85, 0.84 ± 0.59*	1.0, 0.01 ± 0.83	1.0, 0.57 ± 1.01
High-intensity jumps	1.0, 0.14 ± 0.59	**0.001**, 1.57 ± 0.88^	**0.009**, 1.07 ± 1.04*
Relative high-intensity jumps	0.57, 0.44 ± 0.59	1.0, 0.0 ± 0.83	1.0, 0.40 ± 0.99
Total jumps	1.0, 0.02 ± 0.59	**<0.001**, 2.2 ± 0.92†	**<0.001**, 1.65 ± 1.16^
Relative total jumps	**0.023,** 0.80 ± 0.59*	1.0, 0.21 ± 0.83	0.116, 0.89 ± 0.96*
High-intensity ACC	0.06, 0.82 ± 0.59*	**<0.001**, 2.21 ± 0.88†	**0.039**, 0.69 ± 0.96*
Relative high-intensity ACC	1.0, 0.01 ± 0.59	1.0, 0.0 ± 0.83	1.0, 0.0 ± 0.97
Total ACC	0.26, 0.54 ± 0.59	**<0.001**, 2.63 ± 0.90†	**<0.001**, 1.39 ± 0.99^
Relative total ACC	1.0, 0.25 ± 0.59	1.0, 0.28 ± 0.83	0.82, 0.36 ± 0.96
High-intensity DEC	0.14, 0.61 ± 0.59*	**0.03**, 1.26 ± 0.84^	1.0, 0.29 ± 0.96
Relative high-intensity DEC	1.0, 0.16 ± 0.59	1.0, 0.34 ± 0.84	1.0, 0.43 ± 1.0
Total DEC	0.49, 0.43 ± 0.59	**<0.001**, 2.06 ± 0.87†	**0.01**, 0.97 ± 0.88*
Relative total DEC	1.0, 0.24 ± 0.59	1.0, 0.04 ± 0.83	1.0, 0.19 ± 0.98
High-intensity COD	0.70, 0.39 ± 0.59	**0.002**, 1.55 ± 0.88^	0.08, 0.68 ± 1.02*
Relative high-intensity COD	1.0, 0.18 ± 0.59	1.0, 0.09 ± 0.83	1.0, 0.09 ± 0.97
Total COD	0.68, 0.38 ± 0.60	**<0.001**, 2.35 ± 0.93†	**0.001**, 1.26 ± 1.10^
Relative total COD	0.27, 0.51 ± 0.59	1.00, 0.02 ± 0.83	0.77, 0.41 ± 0.99
Internal workload			
Absolute SHRZ	0.20, 0.59 ± 0.60	**<0.001**, 2.43 ± 0.93†	**0.001**, 1.19 ± 1.09*
Relative SHRZ	1.0, 0.24 ± 0.59	1.0, 0.04 ± 0.83	1.0, 0.15 ± 0.98
sRPE	**0.002**, 1.14 ± 0.62*	**<0.001,** 2.41 ± 0.93†	**0.04,** 0.86 ± 1.04*
RPE	0.28, 0.51 ± 0.60	1.0, 0.01 ± 0.83	0.88, 0.44 ± 0.96

Note: Bolded *P* value represents significant difference ($P < 0.05$), * indicates *moderate* effect, ^ indicates *large* effect, † indicates *very large* effect, CL = confidence limits, AU = arbitrary units, ACC = acceleration, DEC = deceleration, COD = change-of-direction, SHRZ = Summated-Heart-Rate-Zones, sRPE = session-rating of perceived exertion, RPE = rating of perceived exertion.

collegiate [7] male players. Our data contrast with findings reported in these previous studies [7, 9], given that we observed higher sRPE workloads during 2- compared to 1-game weeks. While the mechanisms involved cannot be definitively determined, it is likely that differences in periodization and tapering strategies adopted across studies may be involved. For example, Manzi et al. [9] administered the same amount of sessions (training or games) during 1- and 2-game weeks, with the second game replacing a training session. Considering the study outcomes reported by Manzi et al. [9], training demands were likely reduced relative to the number of games played, with significantly lower workloads also reported during 1- and 2-game weeks compared to weeks where no games were played. Similarly, training workloads reported by Conte et al. [7] were higher during 1- than 2-game weeks, suggesting that training demands were adjusted to account for the addition of a second game. However, it is unclear whether these differences are due to varied demands during training sessions or differences in the number of training sessions scheduled. With reference to our study, it is likely that the number of training sessions scheduled impacted the weekly workloads encountered, with the team typically scheduling three sessions per week (two training sessions and one game or one training session and two games) during 1-and 2-game weeks. However, given the importance of training from a tactical perspective (e.g. team structures for specific opposition), training (1 session) was still scheduled during 3-game weeks regardless of the potential workload implications. Given that our data revealed higher sRPE but not other measures of workload volume during 2-game compared to 1-game weeks, it is possible that situational factors such as level of opposition altered the perceptual demands of the game, despite the absence of noticeable increases in objective external and internal workloads [5]. The variation in findings reported across studies therefore emphasizes the importance of generating team-specific data. In this regard, our results suggest that player monitoring may be particularly important in managing player workloads during heavily congested periods (3-game weeks), where the workloads encountered appear to be elevated.

When monitoring players during congested schedules, basketball practitioners should recognize that objective and subjective data are likely to provide different insights regarding the internal demands imposed, as players may be under increased cognitive stress during these periods [10]. Our data revealed significantly (*moderate)* higher sRPE during 2-game weeks compared to 1-game weeks, despite only *small*, non-significant differences in SHRZ workload. This differentiation is important as excessive workloads measured using different approaches can promote specific negative impacts on player health and performance via increased physical, physiological, or cognitive stress. For instance, excessive physical and physiological stimuli may predispose players to negative consequences such as illness or injury due to players reaching states of non-functional overreaching or overtraining [24]. Alternatively, excessive cognitive fatigue, may inflate perceptual internal workload and is more likely to affect attributes such as decision-making and reaction time, which may impact technical and tactical performance [25]. As such, our data support concurrent monitoring of objective and subjective workloads to holistically identify fluctuations in internal workload relative to the stimulus imposed. A combined approach to monitoring may therefore support coaching decisions regarding whether, and to what extent, training workloads or recovery strategies may need to be manipulated [26].

The results of the present study provide important insights for basketball practitioners regarding the game demands and weekly workloads encountered by semi-professional players during different schedules across a QBL season. However, some notable limitations of the study should be considered when interpreting our findings. First, data were collected on a single, semi-professional male basketball team and as such the findings may not be typical of other teams competing at different playing levels [27] or comprising players of different ages and sex [28]. Teams in different leagues and standards of play are exposed to varied schedules, possibly leading to different periodization strategies and workloads. Hence, it is important to determine the unique workload patterns experienced according to specific teams' playing schedules. Second, data were collected over a single season, and therefore only one 3-game week was encountered, which resulted in a smaller sample size in analyses involving the third game compared to those involving the first and second games. Third, it was not feasible due to the small sample size ($n = 8$) to separate our data based on factors that may influence training and game demands such as playing position (guards vs forwards vs centres) [12] or role (starting vs bench players) [7]. Consequently, further research is encouraged to understand differences in workload during congested schedules considering these factors, encompassing larger samples of players and across multiple seasons.

Understanding the effects of competition scheduling on game demands and weekly workloads provides important insight for basketball practitioners, which may be useful for training prescription and player management strategies. While the present study indicates that players may maintain similar external and internal workloads during games played across consecutive days in a single week (up to 3 games), competition scheduling appears to impact the total weekly workloads encountered. The similar individual game demands and weekly workload intensities during congested schedules may be advantageous for coaching staff in scenarios where in-game monitoring is restricted due to player preferences or league rules prohibiting the use of microsensors during competition. Assuming that other situational variables that impact player workloads are considered (e.g. game location [23, 29], and score-line margin [23]), basketball coaches may be able to develop normative values for in-game workloads to accompany data collected during training to manage player workloads [5]. When considering weekly workloads, basketball practitioners should carefully manage the training demands administered to players during congested portions of the season, particularly during 3-game weeks, as players may encounter significant increases in loading, placing them at an increased risk of maladaptive responses or performance decrements. Furthermore, objective and subjective workload measures revealed different trends in weekly workloads and should be monitored concurrently to effectively prescribe periodized training plans in light of congested scheduling.

CONCLUSIONS

Our data suggest that semi-professional male basketball players are exposed to similar in-game external and internal workloads irrespective of the number of games played during a congested or non-congested weekly schedule. In contrast, scheduling impacted the weekly external and internal workloads encountered by players, where higher demands were encountered during congested schedules, especially during 3-game weeks.

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