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Should we train as we compete? Games might be the best scenario to reach the internal peak demands in professional basketball players.

Games might be the best scenario to reach the internal peak demands in basketball.

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BACKGROUND: the aim of this study was to compare the internal peak demands (PD) of different training sessions and official matches in professional basketball players.

METHODS: PD for heart rate (HR), respiratory rate (RR) and ventilation (VE) were collected during six games and 49 training sessions. Linear mixed model (MLM) was accomplished to identify differences of HR, RR and VE among various sessions.

RESULTS: Match day (MD) presents higher internal PD (small-moderate effects) for all variables compared to the practices. In turn, MD presents small to very large differences compared to the rest of the day codes for all variables. In addition, PD are substantially higher during MD than in season and pre-season. Moreover, for all variables, pre-season practices presented higher values (ES range = 0.15-0.29) than in-season practices. Additionally, PD were higher during friendly games and pre-season than during in-season practices.

CONCLUSIONS: Internal PD for all parameters monitored were higher during games than during practices. Additionally, internal PD were higher during friendly games and pre-season than in-season practices. Despite being friendly games, these findings revealed that the game is the scenario where higher internal PD are reached. It is crucial to quantify the peak demands to allow for optimal training of players to cope with these internal PD and successfully execute key technical-tactical skills during games.

Key words: heart rate, internal load, worst case scenario, team sports, most demanding periods.

Introduction.

Basketball is a dynamic, complex, intermittent, and high-intensity team sport in which the ability to perform technical-tactical skills while simultaneously coping with repeated accelerations, decelerations, changes of direction and jumps, is crucial for reaching success (18,20,24). One of the main objectives during training sessions is to prescribe the adequate external load (EL) (3), which is defined as the physical work performed (15), to stimulate specific adaptations and (3) to elicit the desired response (15). The psycho-physiological response during exercise (e.g. heart rate) is defined as internal load (IL) (15).

Match orientation is the most specific skill-based conditioning, involving the most realistic mental, physical, and physiological requirements (21). Knowing the physical and physiological demands of sports competition is the key to better prescribe match-specific exercise during training (22,26). In basketball, players usually need to perform at their highest level every week if they want to be in contention for the championship at the end of the competitive season (17). Thus, providing objective feedback to coaches about the workload intensity and, might allow basketball practitioners to adjust their training prescriptions in order to avoid maladaptation (23). In this regard, contextual factors (e.g. player status or games per week) allow coaching staff to better prescribe the optimal EL during the microcycle structure. Thus, the EL varies substantially based on factors such as the day of the week or training day, known as Day code (e.g., the practice session held the day before the game is referred to as Match day (MD) minus 1 (MD-1 or the practice session done the day after game is referred to as MD+1). Additionally, the moment during the season is reported as an important contextual factor to take into consideration. Previous findings have revealed higher workloads during pre-season than in-season practices (16).

One of the most common practice cues utilized by coaching staff during training routines is to design game-based scenarios focused on "competition intensities" trying to expose players to real game demands (2). In addition, the quantification and use of the most demanding scenarios encountered during basketball games, allow tailored designed training drills based on peak demands (PD) to be applied. In particular, this approach uses moving averages instead of average values, and then accounts for basketball performance specificities (2,10,28). PD has been quantified in basketball using different external variables (e.g., Player Load) (2,8–10). Nevertheless, available research has not reported the PD from an IL perspective. In fact, a novel number of descriptive studies analyzed the differences between game and practice sessions from an IL and EL perspective showing contradictory results (6,11,19). While some studies described more workload (IL and EL) during training sessions than games (11,19), others reported similar loads (6). However, these previous findings analyze the training and game demands based on average intensity measures. Thus, this approach does not allow us to capture the peak intensities (2,7,27).

For these reasons, the aim of this study was to analyze the differences of internal PD experienced between training sessions and games in basketball. A secondary twofold objective was: (i) to compare the internal PD between games and different types of sessions (based on day code) (ii) and to compare the internal PD between different periods of the season (games, pre-season practices and in-season practices). It was hypothesized that higher internal PD would be obtained during games.

Material and Methods.

Sample.

Elite basketball players (n = 11, mean ± SD: age 26.43 ± 4.59 years, height 196.53 ± 9.82 cm, body mass 97.88 ± 14.49 kg) competing in the Spanish professional basketball League (ACB) were monitored during six pre-season friendly games and forty-nine training sessions. The player's selection criteria included the players that completed (i) a minimum of 5 min box-score time in each game in at least three games, and (ii) a fifty percent of full practices (at least 25). Box-score time is the number of minutes that each player is on court during the game, excluding all breaks in play such as free-throws, fouls, out-of-bounds, break periods between quarters, time-outs, or time that the player was substituted out of the game. The research was approved by a local Investigation Ethics Committee and was designed according to the Declaration of Helsinki (12), with the Fortaleza actualization (13).

Procedures.

This observational study was developed for three months corresponding to the 2020-2021 season (from August to October). During each observation activity [game (n=6) and practice (n=45)], each player wore a Firstbeat TeamBelt from FirstBeat SPORTS Team Pack (Firstbeat Technologies Ltd., Jyväskylä, Finland) which is a lightweight, water and shock proof sensor which connects to a textile belt worn by athletes. This 9-axis motion sensor (10g including battery) collects data at 50 Hz frequency. All players were familiar with the technology, as they have been using these bands in every practice session of the previous season, prior to when the study data collection started. Each Firstbeat, which has proved to be a valid and reliable system for long term monitoring of heart rate, respiratory rate, and heart rate variability (5) were turned on prior to each activity (immediately before the start of the game or practice) and participants wore the same Firstbeat throughout the study period to avoid inter-sensor variation amongst athletes (4).

After each observation, the relative value per minute of each peak for each parameter for 1 min window was extracted from the Firstbeat Sports software (version 1.23.0) onto a Microsoft Excel (Microsoft® Excel® 2016 version 16.0.5017.1000, 64 bits) spreadsheet for further analysis. The parameters recorded were Peak Heart Rate (HR), Peak Respiration rate (RR) and Peak Ventilation (VE). Peak HR is the maximum HR measured in beats per minute (bpm). Peak RR is the maximum number of respirations per minute and Peak VE is the maximum amount of air entering the lungs per minute. The training load data was analyzed with respect to the number of days before or after a match is scheduled (MD minus or plus) (1). The day codes and the specific training orientation is described in table 1. In order to keep the same criterion, the day code has been applied prioritizing the following MD (e.g. three days after a game but two days before the following game has been referred as MD-2 instead of MD+3).

****INSERT TABLE 1 AROUND HERE****

Furthermore, all training sessions before the first official game were considered as pre-season observations (n = 23). In addition, the training sessions from the beginning of the official season were considered as in-season observations (n = 22).

Statistical analysis.

Mean, Standard Deviation (±SD) and Coefficient of Variation (% CV) of HR, RR and VE had been presented. Linear mixed model (MLM) for repeated measures was used to identify differences of HR, RR and VE among sessions (match day vs training session, match day vs rest of day codes and match day vs pre-season practices vs in-season practices). The fixed effects estimated the effects of sessions, day codes and period. 'Player' was used as the random effect to interpret player's progression for each variable. Session, day code and period were included as nominal predictor variables in the MLM. Session recorded two levels (Match day and Training session), day code recorded eight levels (Other, MD, MD+1, MD+2, MD+3, MD-1, MD-2, MD-3) and season period included three levels (In Season, Match Day, and Pre-Season).

Estimated magnitudes of difference in means and their 95% confidence limits were presented in standardised units and were evaluated qualitatively with the following scale: trivial, 0–0.2; small, 0.2–0.6; moderate, 0.6–1.2; large, 1.2–2.0; and very large, >2.0 (14). Descriptive analysis, MLMs and post-hoc tests were conducted using the statistical software IBM SPSS for Windows (version 23, IBM Corporation, Armonk, New York), while ES were calculated using a customized Microsoft Excel spreadsheet (version 16.0, Microsoft Corporation, Redmond, WA).

Results.

Descriptive statistics (mean, ± SD and % CV) of game and training sessions are presented in table 1. HR, RR and VE descriptive statistics during all eight-day codes (Other, MD, MD+1, MD+2 MD+3, MD-1, MD-2 and MD-3) and three different periods (match day, in season, and pre-season) are shown in table 3. The estimated effects (effect size ± 95% CI) of differences within pairwise comparisons between games and training sessions, as well as day codes and period times are presented in figures 1-5.

****INSERT TABLE 2 AROUND HERE****

Table 3 revealed how MD presents higher mean values for each variable compared to the other day codes. In addition, table 2 also reveals that MD+1 show the lowest values for all three variables comparing to the rest of the day codes. Figure 1 displayed peak HR, RR and VE standardized effect between game and training with 95% CI. Match day presents higher values and statistical differences when compared to training day for HR and VE (ES: -0.93; ES: -0.70 respectively). However, Match day presented small differences when compared to training session for RR (ES: -0.57, Small).

****INSERT TABLE 3 AROUND HERE****

****INSERT FIGURE 1 AROUND HERE****

Regarding to HR (figure 2), MD presents higher values and substantial differences from moderate to very large when comparing to the rest of the day codes (ES range = 0.70-3.74). In addition, all day codes indicate considerable differences when comparing to MD+1 (ES range = 1.11-3.54). Furthermore, all day codes barring MD+1 present statistical variability (from trivial to large) when comparing among them.

****INSERT FIGURE 2 AROUND HERE****

The MLM for RR within all day codes is presented in figure 3. All day codes present trivial to moderate ES differences, except MD and MD+1. MD reached large differences when compared to MD+1. In addition, MD also presents significantly higher values when compared to MD-1 (0.9, moderate), MD-3 (0.69, moderate) and MD+3 (0.76, moderate).

The MLM showed statistical differences when comparing MD+1 with the rest of the day codes (MD: -1.46; MD-1: -0.68; MD-2: -0.92; MD-3: -1.01; MD+2: -0.95; other: -1.01) except with MD+3 (0.55, small). Trivial to small statistical differences appear when comparing between the rest of the day codes.

****INSERT FIGURE 3 AROUND HERE****

The MLM for VE within all day codes is presented in figure 4. VE presents considerable differences when comparing MD+1 with the rest of the day codes (MD: -2.01; MD-1: -0.98; MD-2: -1.19; MD-3: -1.45; MD+2: -1.05; other: -1.20). Following the same pattern as the previous variables, MD also presents substantial higher values when comparing to all remaining day codes (MD-1: 1.11; MD-2: 0.68; MD-3: 0.93; MD+1: 2.01; MD+2: 0.78). However, in this case VE does show small differences with other (ES: 0.37). Regarding to the rest of the day codes, they all present trivial to small differences.

****INSERT FIGURE 4 AROUND HERE****

Figure 5 presents the pairwise comparison with estimate effect size (95% CI) between periods for all three variables. In season practices show statistical values moderately lower with MD for all three variables (ES_{HR}: -1.04; ES_{RR}: -0.68; ES_{VE}: -0.92). Considering HR data, it is observable that match day presents values moderately higher than pre-season practices (0.86) and trivial differences are shown between in season practices and pre-season (-0.16). When comparing the other periods for RR, trivial and small differences appear (In season/Pre-season: -0.19, trivial; MD-In season: 0.46, small). Finally, VE presents small statistical differences when comparing pre-season with in-season (0.30) and match day (-0.53).

****INSERT FIGURE 5 AROUND HERE****

Discussion.

The aim of this study was to analyze the differences of internal PD experienced between training sessions and games in basketball. This study also aimed to compare (i) the internal PD between games and different types of sessions (based on day code) (ii) and the internal PD between games, pre-season practices and in-season practices. The main finding was that games presented higher mean internal PD (small-moderate effects) for all variables compared to the training sessions. Additionally, higher internal PD were reached during games comparing with the remaining day codes (other, MD, MD+1, MD+2, MD+3, MD-1, MD-2, MD-3) or sessions (games vs pre-season practices vs in-season practices). To our knowledge this is the first study that analyzes internal peak demands when comparing games and training practices.

Regarding to differences between games and training practices, internal PD during games were higher (small to moderate differences) during MD when comparing to the training for HR (ES = moderate), RR (ES = trivial) and VE (ES = moderate). These findings suggest that the game is the best scenario to expose the player to the internal PD. While higher internal PD were significantly reached during games, a lot of variability was evident, depending on the day code. HR (ES range = 0.70-3.74), RR (ES range = 0.32-1.46) and VE (ES range = 0.37-2.31) presented higher internal PD (small to very large differences) during MD when comparing to the rest of the day codes. This might be due to the specific training orientation differing between practices. In this regard, other, MD+2 and MD-2 were the day codes where internal peak demands were more similar (small to moderate differences) to the game for all parameters. However, during MD+1, where the aim of the practice session was to regenerate from the previous match, the internal PD for all parameters were moderate to very large, but still lower than the remaining day codes (other, MD, MD+2, MD+3, MD-1, MD-2, MD-3). These findings suggest that immediately after MD or during MD+1, players with more minutes played during the game should be focused on recovery; whereas players receiving little or no game exposure should carry out extra training to be exposed to the peak intensities (2) and to maintain their fitness and performance levels (17). Additionally, non-significant differences in internal PD were found between the rest of day codes practices (MD+2, MD+3, MD-1, MD-2, MD-3). These findings can be explained due to individual and specific team training orientation.

It should be considered that in some contexts, teams have congested schedules with 2–4 games per week. Therefore producing the PD during practices may not be necessary for most players (2). However, in a context where there are no congested schedules (e.g. 1 game per week), players who are not exposed to the PD during the microcycle, could be untrained to cope with the internal peak demands and successfully execute key technical-tactical skills during game-play. Depending on the games per week, objectives, individual necessities and stress tolerance, basketball practitioners should determine the best moment to expose players to the internal PD during practice sessions in order to prepare the athletes to withstand the PD of the game (2).

Regarding to differences between friendly games vs pre-season practices vs in-season practices, findings showed internal PD were significantly higher for HR, RR and VE (small to moderate effect size) during games than pre-season or in-season practices. Despite being friendly games, these findings revealed that the game is the scenario where higher internal PD are reached. Basketball practitioners should consider the fact that friendly games, may present higher internal PD compared to practice sessions depending on the day code or moment of the season (in-season practices or pre-season practices). Furthermore our results revealed higher internal PD during pre-season than in-season practices. This finding should be interpreted with caution because higher internal PD during pre-season practices could be due to players still not being adapted to cope with the peak intensities. This finding increases the importance of the pre-season training, because if the players do not attempt to do the pre-season practices for any cause such as travelling, injury, holidays or other possible reasons, they would not get exposed to pre-season practices demands, causing them to not be able to cope with games PD, resulting in an increase of future injury risk and possible performance reduction, etc.

There are some important considerations that should be mentioned. Firstly, a potential limitation of the current study is the sample size, due to data being collected during a short-incomplete period of the season (3 months). Nevertheless, the study results are unique to basketball players of this level, and this should be considered. Additionally, game data was only collected during friendly games due to league rules which ban wearable technology usage during official matches. Lastly, other factors such as tactical strategies, drills during practices or player experience that may also impact PD outcomes, were not able to be accounted for in the present investigation and should be considered in future investigations.

Our findings suggest useful practical applications in many ways for basketball practitioners. Firstly, players who do not play games during season are potentially at risk of not being exposed to the internal PD and might be untrained to withstand the PD. Secondly, higher internal PD for all parameters monitored were encountered during games rather than in practices. In order to ensure that players who are returning from an injury process are ready to cope with the internal PD (2), players should be exposed to PD before the return to play process in order to provide other valuable objective information to guarantee that the player is ready to cope with the higher demands of game-play (2,25). Finally, in a context where there is 1 game per week and players are not exposed to the internal PD during the microcycle, it would be necessary to include simulated contexts to get closer to withstand the peak intensities during the week (e.g. Friendly games or 5v5 game simulated conditions during practices). Providing objective feedback to staff about the EL and IL taken by players during practices and games might allow basketball practitioners to adjust their training prescriptions in order to prepare players to cope with the PD during game-play (12).

Conclusions.

Internal PD for all parameters monitored were higher during games than during practices. Additionally, internal PD were higher during friendly games and pre-season than in-season practices. Despite being friendly games, these findings revealed that the game is the scenario where higher internal PD are reached. It is crucial to quantify the peak demands to allow for optimal training of players to cope with these internal PD and successfully execute key technical-tactical skills during games.

REFERENCES.

1. Akenhead R, and Harley J, Tweddle S. Examining the External Training Load of and English Premier League Football Team with Special Reference to Acceleration. *J Strength Cond Res* 30: 2424–2432, 2016.

2. Alonso E, Miranda N, Zhang S, Sosa C, Trapero J, Lorenzo J, et al. Peak Match Demands in Young Basketball Players: Approach and Applications. *Int J Environ Res Public Health* 17: 2256, 2020.

3. Aoki MS, Ronda LT, Marcelino PR, Drago G, Carling C, Bradley PS, et al. Monitoring Training Loads in Professional Basketball Players Engaged in a Periodized Training Program. *J Strength Cond Res* 31: 348–358, 2017.

4. Bastida-Castillo A, Gómez-Carmona C, De la Cruz E, and Pino-Ortega J. Accuracy, intra-and inter-unit Reliability, and Comparison between GPS and UWB-based Position-tracking Systems Used for Time–Motion Analyses in Soccer. *Eur J Sport Sci* , 2018.

5. Bogdány, TM, Szilvia S, and Renáta K, F. Validation of the Firstbeat TeamBelt and BodyGuard2 Systems. *Magy Sport Szle* 5–12, 2004.

6. Brandão FM, Junior DBR, da Cunha VF, Meireles GB, and Filho MGB.

Differences between Training and Game Loads in Young Basketball Players. *Rev Bras Cineantropometria e Desempenho Hum* 21, 2019.

7. Casamichana D, Castellano J, Diaz AG, Gabbett TJ, and Martin-Garcia A. The Most Demanding Passages of Play in Football Competition: A Comparison Between Halves. *Biol Sport* 36: 233–240, 2019.

8. Fox JL, Green J, and 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* 1–43, 2020.

9. Fox JL, Salazar H, García F, and Scanlan, AT. Peak External Intensity Decreases across Quarters during Basketball Games. *Montenegrin J Sport Sci Med* 8: 5–12, 2020.

10. Fox JL, Conte D, Stanton R, McLean B, and Scanlan AT. The Application of Accelerometer-Derived Moving Averages to Quantify Peak Demands in Basketball. *J Strength Cond Res* 1, 2020.

11. Fox JL, Stanton R, and Scanlan AT. A Comparison of Training and Competition Demands in Semiprofessional Male Basketball Players. *Res Q Exerc Sport* 89: 103–111, 2018.

12. Harriss DJ, and Atkinson G. Ethical Standards in Sport and Exercise Science Research: 2014 Update. *Int J Sport Med* 34: 1025–1029, 2014.

13. Hellmann F, Verdi M, Schlemper BR, and Caponi S. 50th Anniversary of the Declaration of Helsinki: The Double Standard Was Introduced. *Arch Med Res* 45: 600–601, 2014.

14. Hopkins WG, Marshall SW, Batterham AM, and Hanin J. Progressive Statistics for Studies in Sports Medicine and Exercise Science. *Med Sci Sports Exerc* 41: 3–12, 2009.

15. Impellizzeri FM, Marcora SM, and Coutts AJ. Internal and External Training Load: 15 Years On. *Int J Sports Physiol Perform* 14: 270–273, 2018.

16. Jeong TS, Reilly T, Morton J, Bae SW, and Drust B. Quantification of the Physiological Loading of one Week of “Pre-season” and one Week of “In-season” Training in Professional Soccer Players. *J Sports Sci* 29: 1161–1166, 2011.

17. Mujika I, Halson S, Burke LM, Balagué G, and Farrow, D. An Integrated, Multifactorial Approach to Periodization for Optimal Performance in Individual and Team Sports. *Int J Sports Physiol Perform* 13: 538–561, 2018.

18. O’grady CJ, Dalbo VJ, Teramoto M, Fox, JL, and Scanlan AT. External Workload can be Anticipated During 5 vs. 5 Games-Based Drills in Basketball Players: An Exploratory Study. *Int J Environ Res Public Health* 17, 2020.

19. Reina M, García-Rubio J, Feu S, and Ibáñez SJ. Training and Competition Load Monitoring and Analysis of Women’s Amateur Basketball by Playing Position: Approach Study. *Front Psychol* 9, 2019.

20. Sampaio J, McGarry T, Calleja-González J, Jiménez Sáiz S, Schelling X, and Balciunas M. Exploring Game Performance in The National Basketball Association Using Player Tracking Data. *PLoS One* 10: e0132894, 2015.

21. Schelling X, and Torres-Ronda L. Conditioning for Basketball: Quality and Quantity of Training. *Natl Strength Cond Assoc* 35, 2013.

22. Staunton C, Wundersitz D, Gordon B, Custovic E, Stanger J, and Kingsley M. The Effect of Match Schedule on Accelerometry-Derived Exercise Dose during Training Sessions throughout a Competitive Basketball Season. *Sports* 6: 69, 2018.

23. Staunton C, Wundersitz D, Gordon B, and Kingsley M. Discrepancies Exist between Exercise Prescription and Dose in Elite Women's Basketball Pre-Season. *Sports* 8: 70, 2020.

24. Stojanović E, Stojiljković N, Scanlan AT and Dalbo VJ, Berkelmans, DM, and Milanović, Z. The Activity Demands and Physiological Responses Encountered During Basketball Match-Play: A Systematic Review. *Sport Med* 48: 111–135, 2018.

25. Taberner M, Allen T, and Cohen DD. Progressing rehabilitation after injury: Consider the "control-chaos continuum." *Br J Sports Med* 1–5, 2019.

26. Torres-Ronda L, Ric A, Llabres-Torres I, De las Heras Bernat, and Schelling X. Position-Dependent Cardiovascular Response and Time-Motion Analysis During Training Drills and Friendly Matches in Elite Male Basketball P Players. *J Strength Cond Res* 30: 60–70, 2016.

27. Vázquez-Guerrero J, Ayala F, Garcia F, and Sampaio J. The Most Demanding Scenarios of Play in Basketball Competition From Elite Under-18 Teams. *Front Psychol* 11, 2020.

28. Vázquez-Guerrero J, and Garcia F. Is it Enough to use the Traditional Approach Based on Average Values for Basketball Physical Performance Analysis? *Eur J Sport Sci* 0: 1–18, 2020.

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TABLES

Table 1. Description of day code types

Day code	Description
MD-3 (n = 4) MD-2 (n = 8)	MD-3 was the session 3 days before competition and MD-2 the session 2 days before competition. The sessions aimed to tactically prepare players for the next match using SSG (e.g. 2v2, 3v3, 4v4). The load was focused on metabolic demands where drills were centered in full court running based exercises.
MD-1 (n = 9)	The session the day before competition. The aim of this session was to prepare for the following game with particular focus on tactical aspects. The load was focused on technical-tactical elements where drills (mostly 5v5) were predominantly performed in half court without fastbreak/balance situations.
MD (n = 6)	Games against teams competing in the same category (first Spanish basketball division).
MD+1 (n = 1)	The session the day after competition. The aim of this practice was to regenerate from the previous match. The load was focused on low-impact activity (e.g. shooting drills) combined with regeneration exercises.
MD+2 (n = 5)	MD+2 was the session 2 days after competition. The aim of this practice was to regenerate from the previous match. The load was focused on low-impact activity (e.g. shooting drills) and technical skills.
MD+3 (n = 4)	MD+3 was the session 3 days after competition. The sessions were focused on metabolic adaptations where drills were centered on full court running-based exercises and SSG (e.g. 5v5, 2v2, 3v3).
Other (n = 13)	'Other' were sessions beyond ±3 days from competition, mostly during preseason. The sessions were focused on metabolic adaptations where drills were centered on full court running-based exercises (e.g. 2v2, 3v3, 4v4, 5v5), shooting and technical drills (e.g. 1v0, 1v1).

Table 2. Peak HR, RR and VE descriptive statistics for training sessions and games.

	Peak HR (bpm)		***Peak RR (times/min)***		***Peak VE (liter/min)***	
	Training (n = 45)	***MD (n = 6)***	***Training (n = 45)***	***MD (n = 6)***	***Training (n = 45)***	***MD (n = 6)***
Mean	175.91	187.26	43.96	46.69	126.46	144.59
± SD	12.55	8.75	4.86	4.66	26.07	22.55
% CV	7.14%	4.67%	11.05%	9.98%	20.62%	15.59%

Table 3. HR, RR and VE descriptive analysis between day codes and training sessions recorded (MD vs in season training vs preseason training).

	Peak HR (bpm)									
	Other (n = 12)	***MD (n = 6)***	***MD+1 (n = 1)***	***MD+2 (n = 5)***	***MD+3 (n = 4)***	***MD-1 (n = 9)***	***MD-2 (n = 8)***	***MD-3 (n = 4)***	***In Season (n = 22)***	***Pre-Season (n = 23)***
Mean	178.33	187.26	156.33	176.62	173.18	173.17	177.54	177.41	174.96	176.92
±SD	13.49	8.75	12.06	12.71	15.23	11.55	10.23	8.39	12.48	12.58
%CV	7.57%	4.67%	7.72%	7.19%	8.80%	6.67%	5.76%	4.73%	7.13%	7.11%
	Peak RR (times/min)									
	Other (n = 12)	***MD (n = 6)***	***MD+1 (n = 1)***	***MD+2 (n = 5)***	***MD+3 (n = 4)***	***MD-1 (n = 9)***	***MD-2 (n = 8)***	***MD-3 (n = 4)***	***In Season (n = 22)***	***Pre-Season (n = 23)***
Mean	45.09	46.69	39.89	44.58	42.92	42.74	44.34	43.68	43.52	44.42
±SD	5.16	4.66	4.26	4.92	5.47	4.17	4.85	3.75	4.70	5.00
%CV	11.44%	9.98%	10.67%	11.04%	12.75%	9.75%	10.93%	8.59%	10.79%	11.25%
	Peak VE (liter/min)									
	Other (n = 12)	***MD (n = 6)***	***MD+1 (n = 1)***	***MD+2 (n = 5)***	***MD+3 (n = 4)***	***MD-1 (n = 9)***	***MD-2 (n = 8)***	***MD-3 (n = 4)***	***In Season (n = 22)***	***Pre-Season (n = 23)***
Mean	134.50	144.59	99.33	125.91	118.97	120.42	128.51	125.20	122.70	130.45
±SD	29.35	22.55	19.62	25.41	29.32	21.43	24.55	17.89	23.94	27.66
%CV	21.82%	15.59%	19.75%	20.18%	24.65%	17.80%	19.11%	14.29%	19.51%	21.20%

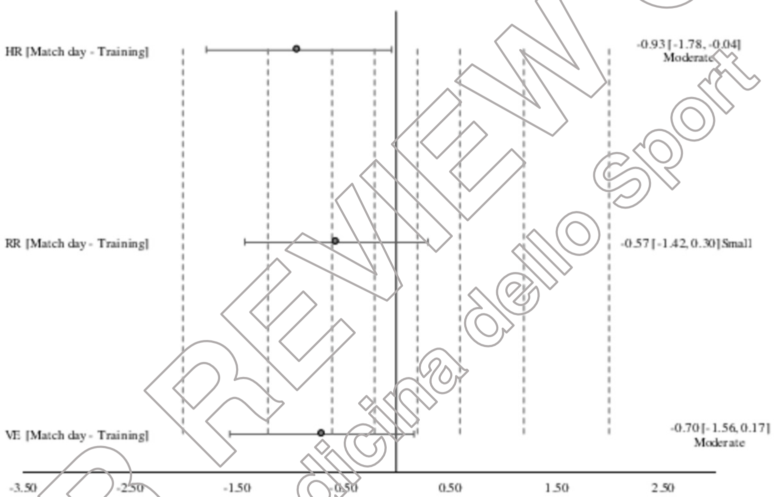

Figure 1. Peak HR, RR and VE standardized effect between game and training with 95% CI (Dash line represents magnitude effects from trivial to large).

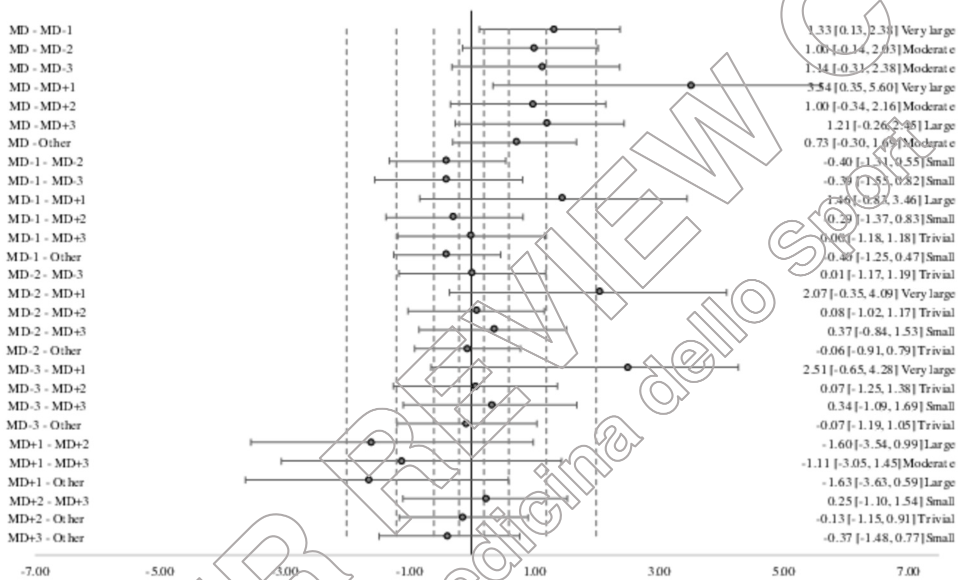

Figure 2. Peak HR standarized effect for each day code with 95% CI (Dash line represents magnitude effects from trivial to large).

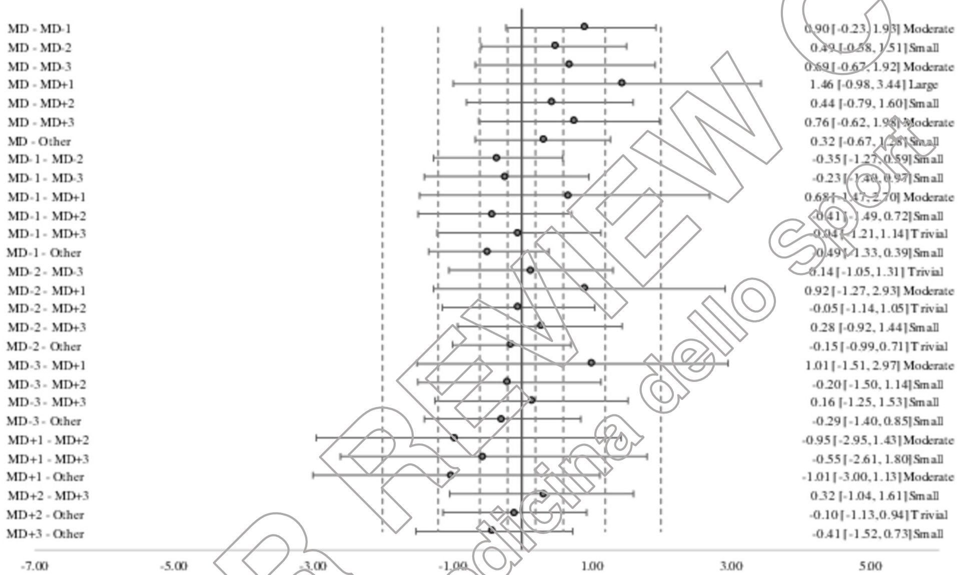

Figure 3. Peak RR standarized effect for each day code with 95% CI (Dash line represents magnitude effects from trivial to large).

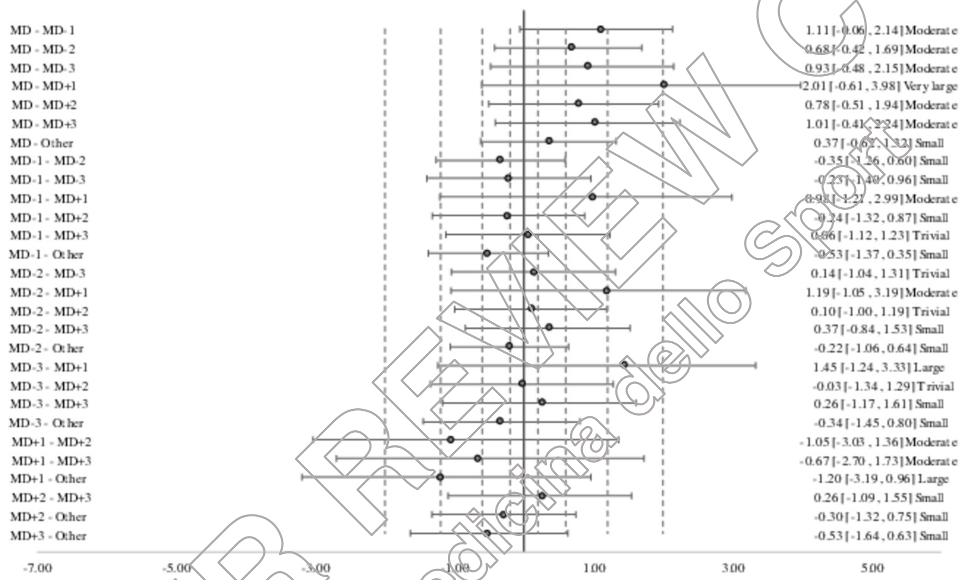

Figure 4. Peak VE standarized effect for each day code with 95% CI (Dash line represents magnitude effects from trivial to large).

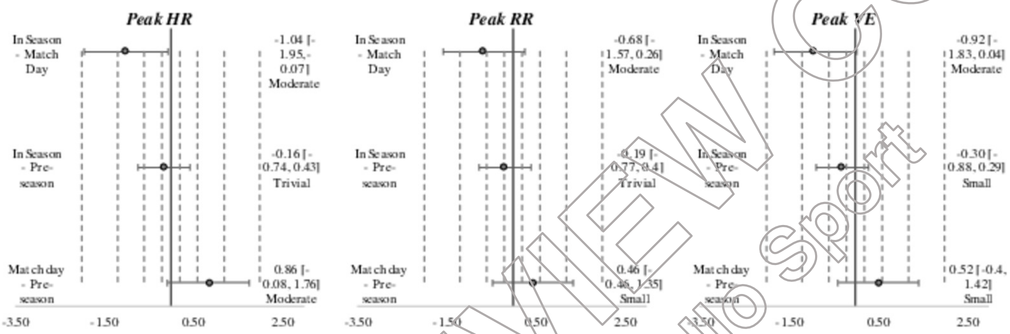

Figure 5. Peak HR, RR and VE standarized effect for period with 95% CI (Dash line represents magnitude effects from trivial to large).