Investigation of readiness and perceived workload in junior female basketball players during a congested match schedule

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ABSTRACT: This study aimed to: a) investigate the differences in workload and readiness between two junior female national basketball teams competing at different European Championships (EC); b) compare workload, readiness and match performance for players with longer and shorter playing times, and; c) examine the relationship between workload, readiness and match performance variables. Under-18 (U18) (n = 10, height = 179.9 ± 6.6 cm, body mass = 70.2 ± 5.1 kg) and under-20 (U20) female national basketball teams (n = 11, height = 178.4 ± 8.8 cm, body mass = 73.0 ± 9.7 kg) were monitored during congested match schedules encompassing 7 matches within 9 days. Daily workload was determined via the session rating of perceived exertion (sRPE workload); readiness was measured by heart-rate variability (HRV) and well-being (WB); and match performance was assessed using the efficiency statistic and playing time. Analysis of workload and readiness during the EC showed no statistically significant between-team differences in any variables except WB for the U18 team, which was lower on Day 8 compared to the U20 team (p = 0.03; effect size [ES] = large). Players accumulating longer playing time showed a higher sRPE workload (p = 0.01, ES = moderate) and efficiency statistic (p = 0.04, ES = moderate) while no readiness variable differed significantly (p > 0.05) compared to players with shorter playing time. Trivial-to-small correlations were observed between workload, readiness and match performance variables. The study shows that junior female basketball players were able to cope with a congested schedule of 7 matches in 9 days irrespective of the competition context or individual differences in workload. Finally, combining objective and subjective methods to assess workload and readiness is recommended due to the weak relationships observed between these methods.

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INTRODUCTION

Basketball is one of the most popular team sports worldwide, with high participation rates for both men and women [1]. Basketball is characterized by repeated high-intensity sprinting, jumping, and changes of direction and thus requires significant effort by players [2, 3]. In fact, basketball players are exposed to periods of high physical loads, during which it is particularly important to manage stress and balance recovery in competitive athletes to avoid negative effects such as injuries and nonfunctional overreaching [4–6]. An example of a high physical loading period is the European Championship (EC), which is one of the most prestigious competitions organized by the International Basketball Association (FIBA), including youth and senior national teams [7].

Readiness to perform is fundamental during congested match schedules [8, 9]. Specifically, in above-mentioned EC tournaments conducted by the FIBA Europe, junior female basketball players are exposed to a congested game schedule that involves playing between 7 and 8 matches within a 9- to 10-day period [7, 10, 11]. In addition to the demands of a congested match schedule, junior national teams start their preparation and compete in EC during summer, which in basketball traditionally represents a period of transition and rest after the regular club season [12]. Therefore, national team players may increase their risk of injuries and nonfunctional overreaching because of the demanding preparations for upcoming tournaments [13] followed by the congested match schedule of the tournament [7]. Monitoring player workload, readiness and evaluating match performance during the EC might help to understand the demands of a congested match schedule, improve workload management and optimize player performances.

Competition demands can depend on several different aspects such as the athlete's skills, the skills of the opposing teams, and the tournament environment [8, 14]. Moreover, competition stress also depends on the social environment and athlete's role within the team [15]. Altogether, these possible differences support the need for comparison between teams playing in two separate ECs at a similar level (e.g. U18 and U20 EC) for greater understanding of the effects of a congested match schedule. Comparisons between teams might also enable identification as to whether playing level (i.e. U18 vs. U20) impacts demands in young athletes, and this may provide data to aid the transition of players from lower to higher levels of competition with advancing age in young adulthood. Furthermore, individual players are exposed to different workloads during a match [16, 17], and thus, it is essential to monitor each athlete individually in order to manage their loading and recovery strategies appropriately.

During international tournaments, it is important to implement monitoring tools that are minimally invasive and not time consuming [18]. Indeed, subjective well-being (WB) questionnaires and objective heart-rate variability (HRV) measures of athlete's readiness are easy-to-use and widely applied tools to understand whether athletes are effectively coping with external demands [13, 18]. Previous studies have assessed the relationship between objective and subjective methods to assess athlete readiness with the aim to evaluate whether they could provide similar information [19–21]. These studies indicated limited commonality between these two methodologies and the need to include both objective and subjective approaches to assess player readiness status [19–21]. However, no previous study has assessed the relationship between objective and subjective measure of readiness in basketball during a congested match schedule when players are under significant stress from increased match demands, calling for further investigations. Additionally, the assessment of match performance can provide information about the performance fluctuations of basketball players during congested match periods [22]. It seems essential to monitor players' performances and assess the relationships with workload and readiness variables as previously suggested [23]. Indeed, identifying these relationships in basketball is important in developing a fundamental understanding of what workload can be most effectively tolerated to sustain a high level of match performance.

Therefore, this study aimed to: a) investigate the differences in workload and readiness between two junior female national basketball teams competing at two different ECs (i.e., Under 18 [U18] and Under 20 [U20]); b) compare workload, readiness and match performance for players with longer and shorter playing times, and; c) assess the relationship between workload, readiness and match performance variables. We hypothesized that congested EC schedules would lead to significant impairment in readiness variables independently of the tournament environment, mainly in players exposed to extended playing times, and that a player's match performance would correlate strongly with readiness variables.

MATERIALS AND METHODS

Participants

Twenty-four female basketball players from Lithuanian national female U18 and U20 teams were recruited for this study. From the initial sample, 21 players (U18 [first place in EC], n = 10, age = 18.0 ± 0.4 years, height = 179.9 ± 6.6 cm, body mass = 70.2 ± 5.1 kg and training experience = 9.1 ± 1.8 years; U20 [third place in EC], n = 11, age = 20.5 ± 2.9 years, height = 178.4 ± 8.8 cm, body mass = 73.0 ± 9.7 kg and training experience = 9.6 ± 2.4 years) were investigated. Three players were excluded: one player competed in both teams and thus was analysed only as a member of the U20 team; and two players (one from each team) failed to complete full data collection. Players were informed about the study aims and procedures and provided personal written informed consent (and that of their guardian if less than 18 years old). Ethics approval was granted from the Kaunas Regional Ethical Committee Review Board in accordance with the ethical standards of the Helsinki Declaration, approval number BE-2–97.

Design

Workload, readiness and match performance of the two national teams were monitored for 10 days (U18, Austria, 3–12 August and

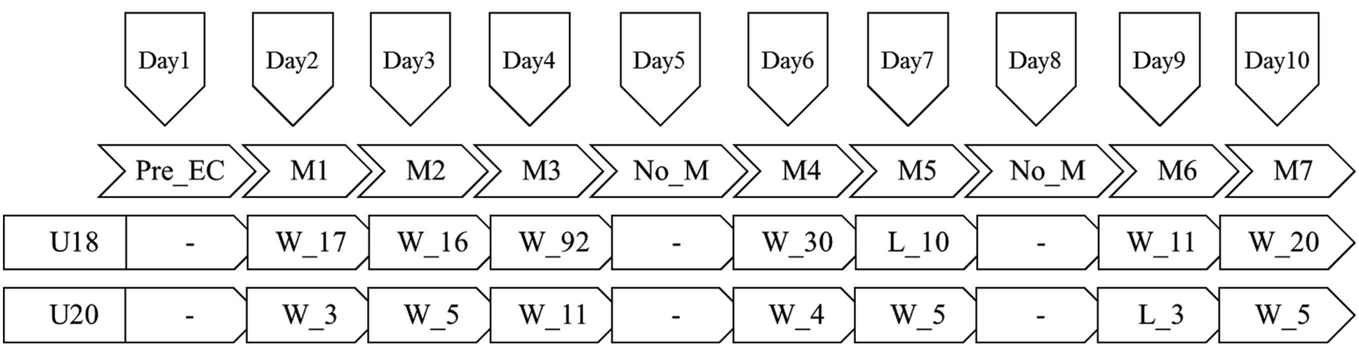

FIG. 1. Structure and match outcomes of the 10 days studied during the European Championship. Abbreviations: M, match (1-first; 2-second; 3-third; 4-fourth; 5-fifth; 6-sixth; 7-seventh matches); No_M, no-match day during which teams were training or resting; W, win match (indicating by how many points); L, lost match (indicating by how many points).

U20, Romania, 7–15 July). The U18 team was exposed to 1 day more of competition because of the greater number of teams in this EC age category. However, both Championships had a pre-EC day (Day 1) and the same distribution of matches (7) within the first 9 days of the tournament, with no matches on two days. Therefore, we used a 10-day time frame for a better comparison between the teams, although the U18 team later played one additional game which was not considered in this study. The structure and match outcomes of the 10-day study period are presented in Figure 1. On the days on which there was no match, teams had court-based training sessions or complete rest.

Procedures

Players were monitored during a 3-week preparation period prior to the commencement of the EC [13]. Therefore they were fully familiarized with all procedures to monitor workload and readiness.

Workload

Internal workload was subjectively assessed using the sRPE method, which is extensively used in basketball [13, 21, 22]. Each player was required to provide a global intensity score using the category ratio scale (Borg's CR-10) approximately 30 min after each match or training session in answer to the question, "How intense was your match/training session?" [23]. To determine sRPE workload, the duration of match or training session in minutes was multiplied by the sRPE score [23]. The match duration was recorded from the beginning to the end of the match including all stoppages (i.e., fouls, out of bounds, timeouts and inter-quarter breaks) but excluding the pre-match warmup [22]. Each training session duration was recorded individually including warmup and recovery periods but excluding the cooldown [21, 22]. The sRPE scores were collected and stored using cloud-based online survey software (Google Forms, Google, Mountainview, CA, USA) [22].

HRV

Every morning upon waking, players were required to measure their HRV for 90 s while seated and breathing spontaneously [24]. Heart-rate monitoring straps (H10 Bluetooth, Polar Electro, Kempele, Finland) were paired with a freely available smartphone application (Elite HRV, Ashville, North Carolina, USA), which has been previously used in basketball [13] to take daily measurements of players' HRV. The log-transformed square root of the mean sum of the squared differences between R-R intervals (Ln-rMSSD) was calculated using the Elite HRV app. The validity of the Elite HRV application for computing Ln rMSSD has been shown previously with nearly perfect correlations with the electrocardiogram ($r = 0.99$, $p < 0.05$) [24].

Well-being

Based on past recommendations, questionnaires were used to assess the daily WB status of each player [13, 22]. The questionnaire assessed fatigue, sleep quality, general muscle soreness, stress levels and mood on a five-point Likert scale (scores of 1 to 5 with 0.5-point increments) [21]. Each item of the WB score was assessed independently and the total WB score was calculated summing each item score [21]. Questionnaire data were collected every morning using the previously described online survey software (Google Forms) [22].

Match performance

Individual playing times and player efficiency statistical values for each match were collected from the official box scores on the websites of the FIBA EuroBasket Women 2018 U18 division B [11] and U20 division B [10]. The efficiency statistic value collected from the official box scores was used as a match performance variable in this study. The efficiency statistic formula used by FIBA organizers is as follows: PT+RT+AS+ST+BS–TO–(P3A–P3M)–(P2A–P2M)–(P1A–P1M) [25], where PT refers to points scored, RT to total rebounds, AS to assists, ST to steals, BS to blocked shots, TO to turnovers, P3A to 3-point shots attempted, P3M to 3-point shots made, P2A to 2-point shots attempted, P2M to 2-point shots made, P1A to free throws (1 point) attempted, and P1M to free throws (1 point) made [25].

Statistical analysis

Descriptive statistics (mean ± SD) were calculated for each variable. Data distribution was assessed using the Shapiro–Wilk test, which demonstrated a normal distribution for the HRV data and a non-normal distribution for the sRPE workload and WB data. Therefore, a 2×10 repeated-measures analysis of variance (ANOVA) was used to test differences in HRV between U18 and U20 teams (between-team) and changes in daily values (within-team). If significant differences were found, the independent t-test using the Bonferroni correction was used for post hoc analysis of daily differences. Because sRPE workload and WB were not normally distributed, Friedman and Mann–Whitney U tests were used to assess within-day changes and between-team differences, respectively. When the Friedman test showed a significant difference, Conover's post hoc non-parametric analysis with Bonferroni correction was used. In addition, the same analysis to check the daily changes in each dependent variable was carried out for the entire sample of 21 basketball players (U18 and U20 teams combined) together.

For the second aim, players from both teams were grouped based on their average playing time during the tournament via hierarchical cluster analysis using Ward's method and the squared Euclidian distance as the interval [7]. In this analysis, the efficiency statistic was also included in the cluster comparison. Data distribution was assessed using the Shapiro–Wilk test, which revealed normal distribution for all variables except for sRPE workload and sleep and mood from the WB questionnaire. Following the cluster analysis, the independent t-test or Mann–Whitney U test (sRPE workload, sleep, mood) was used for pairwise comparisons. The magnitude of differences for pairwise comparisons was assessed using Cohen's d effect size (ES) with 95% confidence intervals for parametric statistics. ES were interpreted as < 0.20 = trivial, 0.20–0.59 = small, 0.60–1.19 = moderate, 1.2–1.99 = large, and ≥ 2.0 = very large [26]. For nonparametric pairwise comparisons, ES was calculated as r and interpreted as 0.1 = small; 0.3 = moderate; 0.5 = large [27].

Finally, Spearman's rank test was used to correlate values of sRPE workload, playing time, efficiency statistic and HRV with values for WB (overall and each variable separately) and HRV. The magnitude of correlation (rho) between variables was interpreted according to the following benchmarks: < 0.1 = trivial; 0.1–0.29 = small; 0.3–0.49 = moderate; 0.5–0.69 = large; 0.7–0.89 = very large; and ≥ 0.9 = nearly perfect (29).

Statistical analyses were performed using SPSS v25.0 for Windows (IBM, Armonk, NY, USA) and JASP (Version 0.11.1). The level of significance was set at 0.05.

RESULTS

Between-team and within-team analysis

Analysis of workload during the EC showed no between-team differences for any day except Day 6 (no match), where the U18 team was exposed to significantly higher sRPE workload ($p = 0.04$; ES = 0.56, large, 95% CI = –0.82, –0.11) compared to the U20 team. HRV changes across the 10 days of the EC within and between groups (U18 and U20) are displayed in Figure 2. No significant differences were observed across EC days (within-team analysis [$p = 0.09$, ES = 0.48, small]) and no interaction ($p = 0.45$) was found with Ln_rMSSD, although a significant difference was observed between teams ($p = 0.04$, ES = 0.48, small). However, post hoc analysis revealed no daily differences between teams ($p > 0.05$) (Figure 2). The total within- and between-group (U18 and U20) changes in WB during the EC are presented in Figure 3. Significant differences between days were found for the U18 team (within-team analysis $p < 0.001$); post hoc analysis showed a significantly lower WB total score on Day 7 ($p = 0.004$; $p = 0.03$; $p = 0.006$) and Day 8 ($p = 0.002$; $p = 0.02$; $p = 0.003$) compared with Day 1, Day 4 and Day 5, respectively and for Day 9 ($p = 0.04$) compared with Day 1. No significant differences between days were found for the U20 team ($p = 0.30$). Between-team analysis found that the U18 team compared to the U20 team demonstrated significantly lower total WB on Day 8 after 2 consecutive match days (M4 and M5) ($p = 0.03$; ES = 0.56, large).

Combined team analysis

When considering both teams (U18 and U20) together as one sample, we found significant between-day differences. Post hoc analysis revealed significantly lower ($p < 0.05$) sRPE workload on no-match days (Day 1, Day 5, Day 8) compared with match days (Day 2, Day 3, Day 4, Day 7, Day 9 and Day 10). Conversely, in response to this loading schedule, no significant changes in Ln_rMSSD ($p = 0.12$) for players from the combined U18 and U20 teams were detected during the whole EC (Figure 4). However, total WB was significantly higher on Day 1 compared with Day 7 ($p = 0.03$) and Day 10 ($p = 0.04$) (Figure 5).

Longer vs. shorter playing time analysis

Players from both teams were grouped based on their average playing time during the tournament into Cluster 1 (n = 16) with an average playing time of 9.29 min and Cluster 2 (n = 5) with an

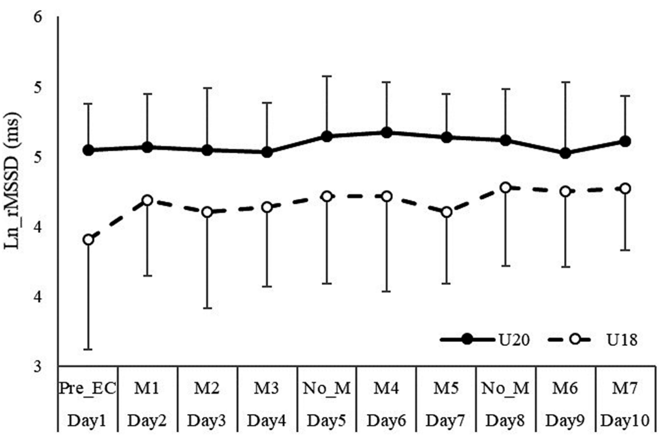

FIG. 2. Heart rate variability changes in U18 and U20 teams during the European Championships. Abbreviations: Ln_rMSSD, log-transformed data of root mean square of the successive differences; M, match.

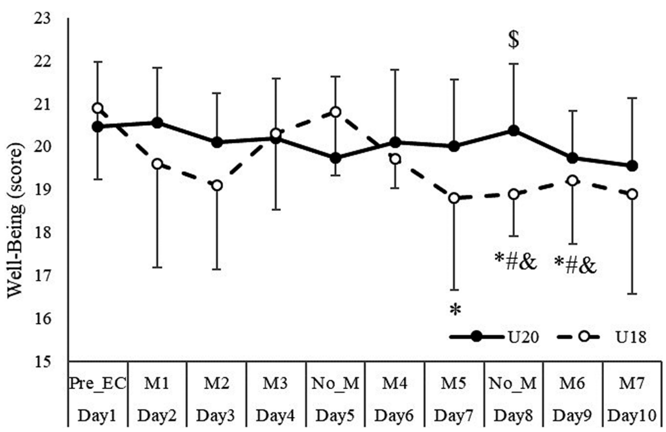

FIG. 3. Well-being changes in U18 and U20 teams during the European Championships. Note: * Significant ($p < 0.05$) difference compared with Day 1; # Significant ($p < 0.05$) difference compared with Day 4; & Significant ($p < 0.05$) difference compared with Day 5; $ Significant ($p < 0.05$) difference compared with U18. Abbreviations: M, match.

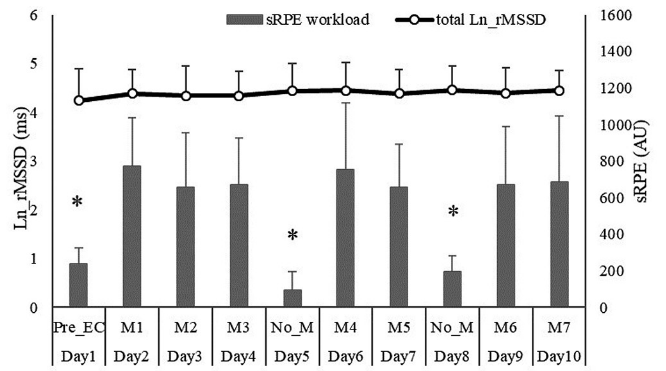

FIG. 4. Heart rate variability and workload changes for players from U18 and U20 teams combined, during the European Championships. Note: * Significant ($p < 0.05$) difference compared with match days (Day 2, Day 3, Day 4, Day 6, Day 7, Day 9, Day 10). Abbreviations: Ln_rMSSD, log-transformed data of root mean square of the successive differences; M, match; sRPE, workload calculated from session rating of perceived exertion.

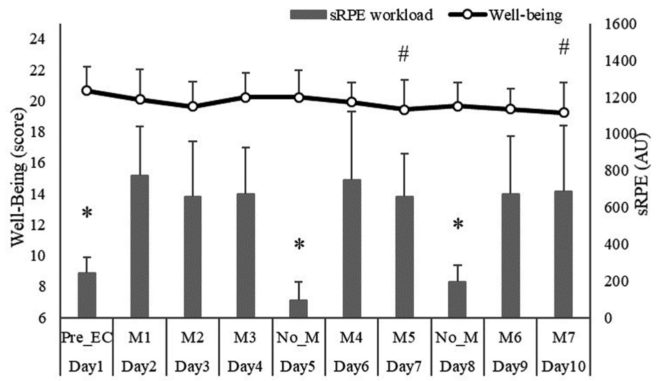

FIG. 5. Well-being and workload changes for players from U18 and U20 teams combined during the European Championships Note: * Significant ($p < 0.05$) difference compared with match days (Day 2, Day 3, Day 4, Day 6, Day 7, Day 9, Day 10); # Significant ($p < 0.05$) difference compared with Day 1. Abbreviations: M, match.

TABLE I. Comparison of workload and readiness variables between players with greater and lower playing time during the European Championships.

Variable	Cluster1 (n = 16)	Cluster2 (n = 5)	P value	LP	95% CI for LP		ES	95% CI for ES		Interpretation
					Lower	Upper		Lower	Upper	
Workload										
sRPE_WL (AU)*	497.62 ± 182.19; 568.10	685.10 ± 102.97; 645.30	**0.01**	-131.70	-377.00	-13.70	-0.78	-0.92	-0.41	Moderate
Playing time (s)	557.66 ± 297.36	1280.30 ± 136.96	**< .001**	-722.64	1013.80	431.42	-2.66	-3.95	-1.33	Very Large
Playing quality										
Efficiency (AU)	6.64 ± 5.48	12.48 ± 3.47	**0.04**	-5.85	-11.34	-0.36	-1.14	-2.20	-0.06	Moderate
Stress Response										
Ln_rMSSD (ms)	4.34 ± 0.51	4.54 ± 0.41	0.42	-0.204	-0.73	0.32	-0.42	-1.43	0.60	Moderate
WB total	20.00 ± 1.03	19.40 ± 1.45	0.31	0.60	-0.61	1.81	0.53	-0.49	1.54	Small
Fatigue	3.86 ± 0.23	3.80 ± 0.35	0.68	0.056	-0.22	0.33	0.22	-0.80	1.22	Moderate
Sleep	3.89 ± 0.43	3.72 ± 0.22	0.41	0.174	-0.25	0.60	0.44	-0.58	1.45	Small
Soreness	3.98 ± 0.16	3.70 ± 0.59	0.09	0.281	-0.05	0.61	0.92	-0.14	1.95	Moderate
Stress*	4.03 ± 0.32; 4.00	3.96 ± 0.17; 4.00	0.41	0.01	-0.20	0.20	0.25	-0.33	0.70	Small
Mood*	4.24 ± 0.34; 4.05	4.22 ± 0.44; 4.00	0.93	0.01	-0.20	0.40	0.03	-0.514	1.55	Trivial

Note: data are presented as mean ± standard deviation; bolded values indicate significant differences ($p < 0.05$); *nonparametric data are presented as mean ± standard deviation and median. Abbreviations: sRPE_WL, workload calculated from session-rating of perceived exertion; Ln_rMSSD, log-transformed data of root mean square of the successive differences; WB, well-being; LP, location parameter (mean difference for parametric variables and Hodges–Lehmann estimate for nonparametric variables); CI, confidence interval; ES, effect size (Cohen's d for parametric variables and r for nonparametric variables).

TABLE II. Spearman's rank coefficients for correlations between heart rate variability, well-being and workload variables.

	sRPE workload (AU)			Playing Time(s)			Efficiency (AU)			Ln_rMSSD (ms)		
	P-value	Rho	Interpretation	P-value	Rho	Interpretation	P-value	Rho	Interpretation	P-value	Rho	Interpretation
Ln_rMSSD	0.349	-0.070	Trivial	0.386	-0.063	Trivial	0.300	0.090	Trivial	—	—	—
Fatigue	0.151	-0.107	Small	0.315	-0.073	Trivial	0.732	0.030	Trivial	0.647	0.033	Trivial
Sleep	0.792	-0.020	Trivial	0.848	0.014	Trivial	0.460	0.064	Trivial	0.628	-0.035	Trivial
Soreness	**0.019**	-0.175	Small	**0.011**	-0.184	Small	0.516	0.057	Trivial	0.068	-0.133	Small
Stress	0.552	-0.045	Trivial	0.564	-0.042	Trivial	0.369	0.078	Trivial	0.280	0.079	Trivial
Mood	0.162	-0.104	Small	0.352	-0.068	Trivial	0.875	0.014	Trivial	**0.045**	0.146	Small
WB total	**0.044**	-0.150	Small	0.184	-0.097	Trivial	0.630	0.042	Trivial	0.824	0.016	Trivial

Note: bolded values indicate significant correlations ($p < 0.05$). Abbreviations: sRPE workload, previous day workload calculated from session-rating of perceived exertion; Ln_rMSSD, log-transformed data of root mean square of the successive differences; WB, well-being; Rho, Spearman's rank coefficient.

average playing time of 21.34 min. Between-cluster differences in workload and readiness variables during the EC are displayed in Table I. Cluster 2 showed a higher sRPE workload (p = 0.01, ES = –0.78 (moderate), CI = –0.92; –0.41), efficiency statistic (p = 0.04, ES = –1.14 (moderate), CI = –2.20; –0.06) and playing time (p < 0.001, ES = –2.66 (very large), CI = –3.95; –1.33), while no readiness variables differed significantly (p > 0.05).

Relationships

Spearman's rank coefficients of the relationships for sRPE workload, playing time, efficiency statistic and HRV with values of WB (overall and each variable separately) are presented in Table II, indicating trivial-to-small correlation coefficients.

DISCUSSION

The present study provides information on perceptual workload and readiness of junior female basketball players during a tournament with a congested match schedule. Our main findings did not confirm the expectation that a congested match schedule would lead to significant impairments in objective HRV, but on a few days (i.e. Day 7 and Day 10) lower subjective WB was evident when EC progressed towards the end of the monitoring period. There were no differences in readiness between players exposed to long and short playing times. These findings suggest that young female basketball players coped well with the workload, and generally endorse the feasibility of the FIBA EC format. Moreover, correlations between objective and subjective variables of a player's workload, match performance and readiness proved to be trivial to small, indicating the need for using both objective and subjective methods in combination.

It was found that the tournament demands were similar for the U18 and U20 teams as there were no differences in sRPE workloads on match days. Both teams had lower sRPE workloads on the days with no matches, indicating rest or very easy training sessions. In addition, both teams monitored in this study were medallists at their respective championships (i.e. 1st place for U18 and 3rd place for U20), although their accomplishments were achieved differently. Indeed, the U18 team played more unbalanced matches with score differences ranging from 10 to 92 points compared to the U20 team, which played close matches with score differences ranging from 3 to 11 points (Figure 1). This result could allow U18 team coaches to substitute main players more frequently, thereby ensuring that they were always ready to play, while the U20 team might have relied more on their main players. Despite this potential tactic, similar monitoring variables were observed regardless.

When considering the objective measures of HRV, it was previously demonstrated that low HRV values, which indicate the predominance of the sympathetic nervous system, are expected in athletes who are not tolerating their workload [13, 28]. It was reported that an Ln_rMSSD value of 4.5 ms indicates optimal performance in sprinters [29] and in female basketball players [13]. In our study, we found that both U18 and U20 female teams demonstrated no statistically significant changes in daily HRV across the EC compared to pre-match day. Moreover, as the U18 team tended to advance during the tournament these values became closer to the proposed optimal values (Ln_rMSSD 4.27 ms on Day 10) [13, 29]. The lack of a decrease in HRV indicates sufficient recovery of the players during the EC in both U18 and U20 teams. In agreement with these findings, no changes were observed in lacrosse athletes during a congested match tournament scenario of 7 matches in 8 days [30]. It should be noted that, to the best of our knowledge, this is the first study in basketball to compare players' HRV changes during a congested match schedule in youth female basketball, making our findings difficult to compare.

Consistently with the HRV results, no changes in WB were observed in the U20 team during the tournament, but the U18 team had lower total WB in the second half of the tournament compared with the beginning. Lower total WB for U18 compared with the U20 team was observed on Day 8 after two consecutive match days with the first lost game for U18 on Day 7. The observed decrease in WB values might have been influenced by psychological stress felt by U18 players since they lost their first match after four consecutive wins with unbalanced scores (≥ 16 point score difference). In contrast, U20 players had a similar level of opponents from the beginning of the EC considering the close match scores (Figure 1). Additionally, this result might be explained by the influence of contextual variables such as team skills, opponent ability, social environment, and competition environment [15] during the two different tournaments.

The combined team analysis including the entire sample of players from both teams allowed us to better understand the effect of a congested match schedule of 7 matches in 9 days. A lack of difference in HRV but a lowered WB at the end of the tournament shows the greater sensitivity of subjective WB over objective HRV [30]. These findings are consistent with those of Hauer et al. [30], who found no changes for male lacrosse athletes in HRV, although the scores from WB questionnaires were lower at the end of the tournament. This notion might suggest that although the rest days during the tournament are sufficient for physiological recovery, the players' well-being might be affected towards the end of the tournament, with the most important matches still ahead.

Match demands and playing times for each individual player depend on their playing position, tactical decisions and player rotation [7, 31, 32]. Therefore, we expanded our analysis by clustering players based on their average playing time during the whole tournament. The cluster of players who played more demonstrated a very large difference in average playing time (1280 s vs 558 s) and moderately better efficiency (12.5 AU vs 6.6 AU) than the players in the cluster with less playing time. Naturally, the daily sRPE workload of the clusters also differed, with averages of 685 AU and 498 AU for the higher and shorter playing-time clusters, respectively. Despite this dissimilarity, the workload seemed to be optimal for players in both clusters because no difference was detected in any readiness variable. This finding might indicate that players with longer playing time could have better fitness and recovery capacities and ability to cope with higher workloads compared with players experiencing shorter playing time.

Consistent with the findings of previous studies [30, 31, 32], we found no relationships between the monitored variables of workload, readiness and match performance, except the relationships between soreness and sRPE workload from the previous day and playing time. This is understandable because players whose playing time is longer execute more actions, thus possibly inducing greater muscle damage [35]. Similar results were observed by Clemente et al. [36] during a study of a congested period of training for male futsal players in which it was found that muscle soreness and fatigue were moderately correlated with sRPE reported from the previous day [36]. Moreover, Sansone et al. [6] demonstrated negative relationships between training load and perceptual recovery in female basketball players throughout the competitive season at daily, weekly and mesocycle levels. In addition, the objective measurement of Ln_rMSSD showed a small correlation with subjective mood, but did not correlate with the workload, playing time and efficiency statistic. It has been shown that HRV is affected by both physiological and psychological stimuli [37]; therefore changes in mood might affect the values of HRV.

The present study had some limitations. Although several monitoring methods were employed, future studies might provide more insightful information if objective external load measurement using microsensors and internal biochemical markers were included [38, 39]. In addition, the use of objective measures for sleep quality and duration, diet, fluid, and food supplementation could expand the interpretation of changes in WB observed during the study.

CONCLUSIONS

This study showed that junior female basketball players of international level were able to cope with a congested schedule of 7 matches in 9 days irrespective of the competition context or individual differences in workload. This finding might reflect a high level of player preparedness to cope with congested schedules, and optimal player rotation by coaching staff, which appropriately managed training and match workloads. Therefore, the use of tools to monitor workload and readiness should be adopted to avoid performance deterioration during tournaments with congested match schedules. Specifically, the combination of objective and subjective methods to assess workload and readiness is recommended due to weak relationships observed between these methods, suggesting they provide different insight.

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Conflict of interest declaration

The authors declare that they have no conflict of interest.

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