

**Variation in countermovement jump metrics following competitive soccer matches
throughout a season in professional players**

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Abstract

Purpose: This study aimed to analyze the variations in the countermovement jump (CMJ) derived metrics in professional soccer players due to match exposure; in addition, it was analyzed if these responses are dependent on the time played by the athlete.

Methods: Thirty professional soccer players performed a CMJ test one day before and in the second day after the match (i.e. MD-1 and MD+2), throughout a competitive season. The comparison of the CMJ performance in the situations MD-1 vs. MD+2 was made by a paired t test. The effect sizes were calculated using Cohen's d. We also compared MD-1 vs. MD+2 according to the different time played by athletes (G1, with > 69 minutes played; G2, 40 to 69 minutes played and G3, < 40 minutes played) by using an ANOVA. Level of significance was set at $p \leq 0.05$.

Results: The analyzed CMJ metrics presented decrements in MD+2 compared to MD-1 ($p < 0.05$). It was observed that the declines in jump height (JH; $p = 0.37$) and reactive strength index modified (RSI-mod; $p = 0.02$) on MD+2 were more pronounced in players with greater match exposure.

Conclusions: This study suggests that measures of CMJ are sensitive for monitoring post-match neuromuscular fatigue in professional soccer players and can distinguish fatigue levels among groups of players with different match exposures.

Key Words: countermovement jump, monitoring, neuromuscular fatigue, soccer

Introduction

Soccer is characterized by brief bouts of high-intensity activity interspersed with irregular recovery periods, with the interaction between different physical capacities [1]. It is getting more demanding over the years, especially in high-intensity running and sprinting distance, and with more matches played nowadays compared to the last decade [2,3]. Most high-intensity activities include accelerations, decelerations, changes of direction, and jumps, which involve eccentric muscle contractions, resulting in a wide variety of muscle damage [4]. It may result in delayed onset muscle soreness (DOMS) peaking in 24 hours post-match and being substantially elevated until 72 hours in conjunction with a decrement in strength capacity in the following days [5]. Also, eccentric fatigue modulates the stretch-shortening cycle (SSC) effectiveness [6], and responses of repeated SSC actions are very versatile and complex because the fatigue does not depend only on the metabolic loading, and the full recovery may take 4–8 days depending on the parameter and on the severity of exercise.

Understanding the fatigue response of soccer players after matches throughout the season is essential for physical trainers and coaches to make informed decisions, helping to assess players' readiness and full recovery to optimize performance in upcoming games [7]. The most traditional approach for evaluating fatigue and recovery is through field tests of neuromuscular function (e.g., strength or isokinetic torque, sprinting, changes of direction speed, jumping) [8,9]. While numerous tests exist to assess fatigue, the choice of the assessment method should consider aspects such as biological basis, sensitivity, and feasibility of the metrics [8,9]. It is important to emphasize that player recovery assessments should neither cause additional fatigue nor be time-consuming [4,8], which otherwise would make these markers impractical in a team-sport context.

In this sense, the countermovement jump (CMJ) has been widely used to assess recovery due to its relevance to performance, reliability and feasibility within the soccer routine [10–12]. The usefulness of jump tests seems enhanced by the convenient and detailed analysis of kinetic and kinematic variables provided by a force plate or similar systems, which may permit greater insight into the neuromuscular responses associated with neuromuscular fatigue [13, 14]. The metrics that describe overall performance like jump height is one of the most traditionally used (mainly due to the greater ease of obtaining) and it seems to be able to show fatigue until 48–72 hours post-match [12,15,16]. On the other hand, it is highlighted that the strategy metrics (e.g., duration prior to take-off) have been shown to be more sensitive to change compared with outcome measures [8]. Despite the widespread use of vertical jump as an assessment tool, the

choice for the jump metric with best sensitivity for monitoring game-induced fatigue is still not well established.

External load metrics, such as high-intensity running and the number of accelerations, have been linked to acute and residual post-match fatigue in soccer [17]. In this context, match exposure may influence fatigue and recovery markers; for example, more minutes played may lead to a greater decrement in CMJ performance [18, 19]. Therefore, it is important to assess whether CMJ metrics are sensitive enough to detect responses based on varying levels of game time exposure. Furthermore, most studies present data collected at a single time point, which may not accurately reflect athletes' physical status over the course of a season [20]. To obtain more representative results, fatigue responses should be analyzed across multiple matches throughout the season.

Based on the above contextualization, the aim of the current study was to analyze changes in CMJ-derived metrics following competitive soccer matches in professional players; in addition, we examined these responses according to the time played by the athletes. It was hypothesized that CMJ metrics (jump performance and strategy-based metrics) would decline in the second day after matches (MD+2), especially in the group of players with the most playing time.

Material and Methods

Participants

Thirty professional soccer players were evaluated in the current study (age: 27.1 year; body mass: 79.3 kg; height: 1.80m). The players were selected by convenience and belonged to the same club competing in the second division soccer league in Brazil. As selection criteria, all players needed to be involved in the same training and recovery routine. Only games scheduled once a week were analyzed (congested fixtures were excluded). Furthermore, players could not be injured or present any problem that took away from the scheduled training or recovery session and had to participate in the assessments. An informed written consent was obtained prior to participation in the study. The study was approved by a local Research Ethics Committee (CAAE 73685523.9.0000.5531).

Design and Procedures

Soccer players were evaluated a day before the match (MD-1) and in the second day after the match (MD+2) (Figure 1). The included players were analyzed over 10 non-

consecutive matches, between April 2023 and November 2023 (i.e., during the in-season period).

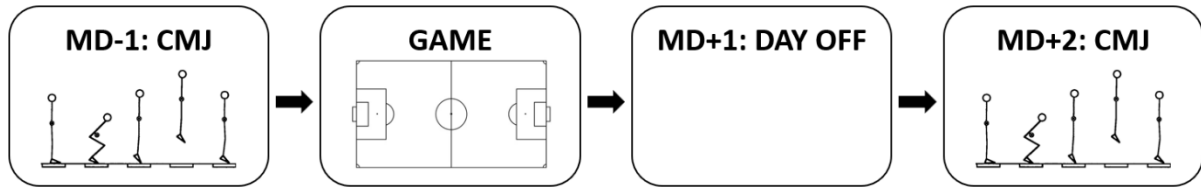


Figure 1 – Depiction of the study design

A typical week of the soccer players consisted of a free day on MD+1. On MD+2, players who played 60 minutes or more did a recovery session (exercises with low intensity). On MD+3, before the pitch training, there was a gym session, consisting of exercises for strength maintenance. MD-3 was the training session with the highest volume, while MD-2 and MD-1 were tapering sessions.

Countermovement jump assessment

One day before and in the second day after the match (i.e. MD-1 and MD+2) the soccer players performed a countermovement jump (CMJ) test. Before testing, players performed a warmup protocol consisting of isometric and dynamic squats, skipping, submaximal continuous CMJs and hopping, and one maximal CMJ. After 30 seconds, players were asked to perform four maximal CMJ interspersed with 20 seconds on dual force plates (EMG System™, São Paulo, Brazil). The mean of the 3 best attempts were retained for analysis. They started from a static standing position and were instructed to perform a countermovement (descent phase) followed by a rapid and vigorous extension of the lower limb joints (ascent phase). During the jump, the participants were asked to keep their trunks as vertical as possible and their hands remained on their hips. The athletes were then instructed to jump as high as possible. Players were familiarized with the CMJ for, at least, three months before starting the systematic evaluations.

From ground reaction force the following variables were obtained: jump height (JH), by impulse-momentum method; peak power output (PPO); jump duration (JD), i.e., duration between the initiation of the countermovement and take-off; peak force relative to body weight (PF%bw); eccentric and concentric work (W_{ECC} and W_{CON} , respectively); peak rate of force development (RFD); reactive strength index modified (RSI-mod), calculated as the ratio of JH and JD; and squat depth (SD) during propulsive phase of the jump, i.e., lowest value of displacement of the center of mass obtained by integration method.

Match External Load Data

The match external load was measured using a portable 10 Hz GPS system (Playertek, Catapult, Melbourne, Australia). The GPS unit was positioned between the player's scapulae through a vest. Each player used the same unit throughout the study period. After each match, data was downloaded using its respective software. The metrics utilized were total distance (TD), high-speed distance (HSD, >19.8km/h) and sprint distance (SD, >25.2 km/h).

Statistical Analysis

The data of baseline values of the first two weeks were confronted to verify reliability of the data. In this analysis were included a total of 20 players. Intraclass correlation coefficient (ICC; 2-way mixed effects with absolute agreement) with 95% confidence intervals (CI), coefficient of variation (CV) with 95% CI and typical error of measurement (TEM) were calculated for the between-session reliability. The ICC values were classified as follows: >0.90 classified as "excellent"; 0.75-0.90 as "good"; 0.5-0.74 as "moderate" and <0.50 as "poor" [21].

To compare the CMJ performance in the situations MD-1 vs. MD+2, 20 players (with a minimum of 60 minutes played) were included in the sample [19], composing 50 data pairs. The comparison of CMJ variables between the situations was made by a paired t test, with significant level set at $p < 0.05$. Normality of the data was assessed using a Shapiro-Wilk test. The effect sizes were calculated using Cohen's d, with the following classification: < 0.2 = trivial, $0.2 - 0.5$ = small effect, $0.5 - 0.8$ = moderate effect and > 0.8 = large effect [22].

We also compared MD-1 vs. MD+2 according to the different time played by athletes. In order to avoid the interference of training sessions, this analysis was conducted only when MD+1 was a free day. For this analysis it was possible to include four matches, with a total of 28 players, divided into three groups: Group 1 (G1, $n = 10$; data pairs = 17), with > 69 minutes played (mean value = 97 ± 11); Group 2 (G2, $n = 8$, data pairs = 13), with 40 to 69 minutes played (mean value = 53 ± 7); Group 3 (G3, $n = 17$, data pairs = 20), with < 40 minutes played (mean value = 5 ± 10). The players could be included in different groups at different matches (e.g., athlete "A" played 75 minutes in one match, being classified as G1, and in another match played 30 minutes, being classified as G3). To test differences among groups and between moments was used an ANOVA (with Wald test). We also tested differences among groups according to the match external load with an ANOVA. Level of significance was set at $p \leq 0.05$.

Results

Table 1 shows the reliability of the vertical jump variables. There were no significant differences between sessions ($p>0,05$). The ICC ranged from good to excellent (0.81- 0.94) for all variables, except for RFD (0.71 - moderate). Also, the CV was less than 5% for most variables. Only RFD presented CV above 5%.

Table 1 - CMJ derived-variables of MD-1 obtained in the first two sessions of season (i.e., between session analysis).

	1 ^a Session	2 ^a Session	p-value	ES (95%IC)	ICC (95%IC)	CV(%) (95%IC)	TEM
JH (cm)	33.5±2.9	33.9±3.9	0.39	0.2 (-0.64;0.25)	0.82 (0.65-0.91)	3.7 (2.7-4.7)	1.53
PPO (W/kg)	52.1±3.7	52.6±4.6	0.21	0.29 (-0.73;0.16)	0.90 (0.79-0.95)	2.4 (1.8-2.9)	1.37
JD (ms)	795±56.9	786±54.0	0.10	-0.39 (-0.07;0.84)	0.93 (0.85-0.97)	1.7 (1.2-2.2)	16
PF (%bw)	2.41±0.11	2.38±0.10	0.06	-0.46 (-0.01;0.91)	0.84 (0.69-0.92)	1.6 (1.0-2.1)	0.04
W _{ECC} (J/kg)	-0.37±0.05	-0.36±0.05	0.86	-0.04 (-0.48;0.4)	0.94 (0.88-0.97)	2.9 (-3.8 to -2.1)	0.01
W _{CON} (J/kg)	0.79±0.07	0.80±0.07	0.76	0.07 (-0.51;0.37)	0.86 (0.71-0.93)	2.8 (2.0-3.6)	0.03
RFD (N/s)	6.25±1.9	6.30±1.6	0.86	0.04 (-0.48;0.4)	0.71 (0.46-0.85)	12.1 (7.0-17.2)	0.98
RSI-mod	0.42±0.05	0.44±0.06	0.15	0.33 (-0.78;0.12)	0.82 (0.65-0.91)	4.8 (3.4-6.1)	0.02
SD (cm)	36.4±4.9	37.1±4.4	0.12	0.36 (-0.09;0.81)	0.92 (0.82-0.96)	3.2 (2.2-4.2)	1.4

Note: JH: jump height; PPO: peak power output; JD: jump duration; PF: peak force % body weight; W_{ECC}: eccentric work; W_{CON}: concentric work; RFD: rate of force development; RSI-mod: reactive strength index modified; SD: squat depth.

The players presented the following values of match external load: 104 meters/minute for total distance covered, 9.8 meters/minute for high-intensity running and 1.9 meters/minute for sprint.

Table 2 presents the CMJ variables comparing the moments MD-1 and MD+2. All variables presented significant decrements at MD+2 ($p>0.05$). JH presented large effect size while PPO, JD, W_{Con} and RSI-mod presented a moderate effect.

Table 2. CMJ derived-variables analyzed pre (MD-1) and post-match (MD+2) of players who played more than 60 minutes.

	MD-1	MD+2	p	Δ (%)	Cohen's d
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JH (cm)	33.4±4.0	31.7±3.8	< 0.001	-1.7 (-5.1)	-0.81 (-0.49 to 1.13)
PPO (W/kg)	52.4±5	50.6±5	< 0.001	-1.7 (-3.4)	-0.74 (-0.42 to 1.05)
JD (ms)	772±65	800±83	< 0.001	27.5 (3.6)	0.53 (0.82 to -0.23)
PF (%bw)	2.46±0.19	2.42±0.19	< 0.001	-0.04 (-1.6)	-0.40 (-0.10 to -0.67)
W _{ECC} (J/kg)	-0.36 ±0.06	-0.35±0.06	0.011	0.009 (-2.8)	-0.37 (-0.66 to -0.08)
W _{CON} (J/kg)	0.78±0.08	0.76±0.08	< 0.001	-0.02 (-2.6)	-0.61 (-0.30 to -0.91)
RFD [N/(kg*s)]	7.04±3.56	6.22±3.42	0.002	-0.8 (-11.7)	-0.47 (-0.17 to -0.76)
RSI-mod	0.43±0.06	0.40±0.06	< 0.001	-0.03 (-7.0)	-0.76 (-0.44 to 1.07)
SD (cm)	35.2±5.6	34.8±5.9	0.121	-0.4 (-1.1)	-0.25 (-0.56 to 0.07)

Note: JH: jump height; PPO: peak power output; JD: jump duration; PF: peak force % body weight; W_{ECC}: eccentric work; W_{CON}: concentric work; RFD: rate of force development; RSI-mod: reactive strength index modified; SD: squat depth.

Table 3 presents the CMJ variables divided into three groups (G1, G2 and G3), according to match exposure. There was an interaction group x time for jump height (F=6.6; p=0.04), in which G1 and G2 presented lower jump height in MD+2 compared to MD-1. RSI-mod also presented an interaction time x group (F=7.6; p=0.02) in which G1 and G2 presented lower RSI-mod in MD+2 compared to MD-1. The variables JD (F=3.7; p=0.15), PF (F=2.4; p=0.31), PPO (F=5.2; p=0.08), W_{ECC} (F=0.8; p=0.69), W_{CON} (F=4.7; p=0.10) and RFD (F=3.5; p=0.17) presented an effect only on time.

Table 3. CMJ derived-variables analyzed pre (MD-1) and post-match (MD+2) into three groups divided according to the time played.

G1 (>69min)		G2 (40-69min)		G3 (<40min)	
MD-1	MD+2	MD-1	MD+2	MD-1	MD+2

JH (cm)	33.2±3.3	31.3±3.1*	34.2±4.3	31.9±3.4*	34.5±3.5	34.5±3.9
PPO (W/kg)	52.4±5.2	50.9±5.4	53.7±5.3	52.3±3.9	53.4±3.9	53.7±4.2
JD (ms)	785±65	811±85	757±53	791±72	791±63	793±73
PF (%bw)	2.46±0.19	2.39±0.23	2.46±0.12	2.38±0.14	2.42±0.16	2.40±0.17
W _{ECC} (J/kg)	-0.36±0.1	-0.351±0.1	-0.356±0.1	-0.341±0.1	-0.366±0.1	-0.366±0.1
W _{CON} (J/kg)	0.78±0.07	0.77±0.06	0.79±0.08	0.75±0.07	0.80±0.07	0.80±0.07
RFD (N/s)	6.9±2.9	5.5±3.1	6.8±2.2	4.8±1.9	6.4±2.8	5.8±2.3
RSI-mod	0.43±0.05	0.40±0.06*	0.45±0.06	0.41±0.06*	0.44±0.06	0.44±0.07
SD (cm)	35.1±5.6	34.7±5.8	32.8±3.2	32.6±3.0	35.8±5.3	35.4±4.9

Note: JH: jump height; PPO: peak power output; JD: jump duration; V_{TO}: velocity at take-off; PF: peak force % body weight; W_{ECC}: eccentric work; W_{CON}: concentric work; RFD: rate of force development; RSI-mod: reactive strength index modified; SD: squat depth. * Shows the differences between MD-1 and MD+2 within groups (p<0,05).

JH and RSI-mod (the two variables that exhibited significant interaction) are also presented graphically in the Figure 2, where we can highlight the individual changes at MD-1 vs. MD+2, for the three groups (G1, G2 and G3).

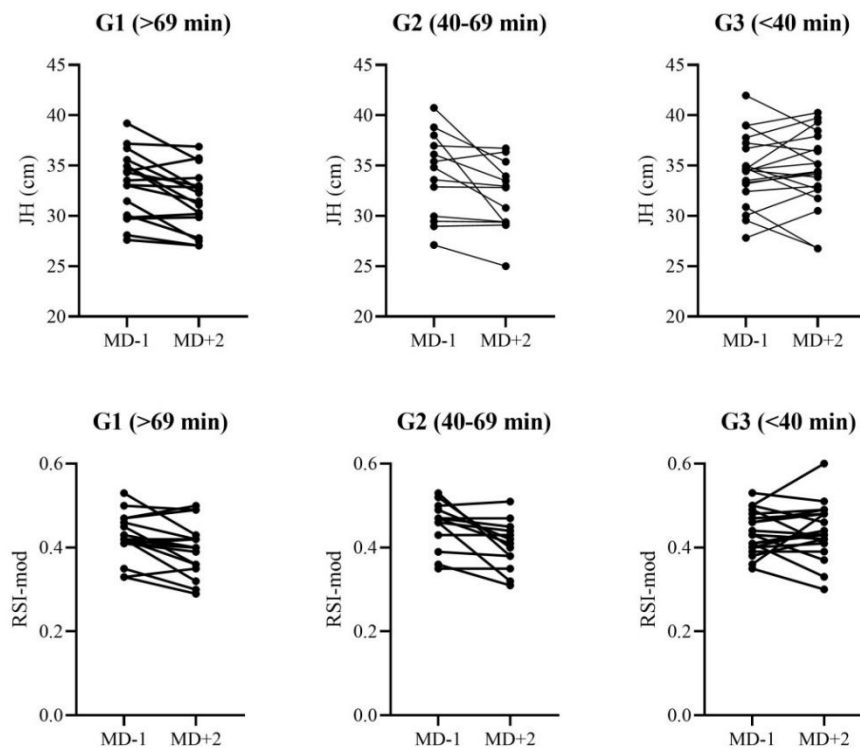


Figure 2. Individual changes of jump height (JH) and reactive strength index modified (RSI-mod) when comparing MD-1 vs. MD+2, for the three groups (G1, G2 and G3).

Table 4 presents the match external load (total distance covered, distance covered at high-intensity running and in sprints) for the three groups according to the time played (G1, G2 and G3). Anova showed differences among the three groups, for total distance ($F = 317.4$; $p < 0.05$), distance covered at high-intensity ($F = 61.05$; $p < 0.01$) and distance in sprints ($F = 38.14$; $p < 0.05$).

Table 4. External load into three groups divided according to the time played.

	G1 (>69min)	G2 (40-69min)	G3 (<40min)
Total Distance covered (km)	9.9 ± 1.1	6.0 ± 0.9	0.6 ± 1.2
High-Intensity running (m)	773 ± 267	582 ± 171	61 ± 131
Sprint (m)	178 ± 77	119 ± 56	14 ± 28

Note: All values are statistically different ($p < 0.05$)

Discussion

The aim of the present study was to analyze variations in CMJ-derived variables due to match-induced fatigue in professional soccer players. The main results indicated that on the second day after a match (MD+2), the analyzed metrics showed declines compared to one day before the match (MD-1). Additionally, it was observed that the declines in JH and RSI-mod on MD+2 were more pronounced in players with greater match exposure.

The majority of CMJ variables showed good to excellent relative reliability (ICC ranging from 0.81 to 0.94) and CV (absolute reliability) ranging from 1.7 to 4.8%. Researchers have suggested as acceptable reliability $CV < 5\%$ [9,23–26]. Only RFD presented a poor reliability ($CV = 12.1$). Previous studies have shown that RFD at CMJ presents just low-moderate reliability [27–30] and is not impaired 48-72 hours post intervention [30,31]. Therefore, caution should be given when utilizing RFD at CMJ for recovery analysis of athletes. Alternatively, it is suggested to analyze RFD peak at squat jump (SJ), which presents acceptable reliability [32].

When comparing MD+2 with MD-1, a significant reduction in the outcome variable “JH” was observed, with a large effect size and a percentage decrease (5.1%) exceeding its CV. A meta-analysis reported an ES of 0.59 when using JH to detect changes in neuromuscular status following a fatiguing intervention [33]. Consistent with our findings, it was documented a similar JH reduction of 6.5% at 48 hours post-match [34]. When analyzing repeated CMJ performance immediately after a soccer match, significant reductions in JH were also observed compared to baseline [35]. However, some studies did not report changes in JH; for instance, it

was found no decrements in JH in elite soccer players 42 hours post-match, and also a non-significant JH reduction immediately post-match in young soccer players [10,31]. Similarly, in collegiate team-sport athletes, neither JH nor PPO showed differences from baseline at 24 or 72 hours after a fatiguing protocol [9]. Consequently, there appears to be no definitive consensus on the response of CMJ outcome variables to game-induced fatigue.

Based on the impulse-momentum relationship, the mechanical impulse determines the velocity of the body's center of mass at the end of a push-off (i.e., take-off velocity) and, subsequently, the JH [34–37]. In terms of physical capacities, generating high impulse during lower-limb push-off—and thereby accelerating a mass as much as possible—is often assumed to depend on the ability to apply force rapidly and produce substantial mechanical work in a short time [40]. Therefore, a reduction in JH following match-induced fatigue is likely due to diminished capacities in these areas. Also, PPO, one of the variables related to JH [41], was impacted by match fatigue, as well as JD, indicating that players became slower during the propulsive phase of the jump.

In addition to CMJ outcome variables, the strategy used in the CMJ under fatigued conditions can be modified to maintain performance, which supports the use of time- and rate-based metrics [13,42]. It has been suggested that strategy metrics may be more sensitive to changes than outcome measures following intense exercise [8,13]. In the present study, RSI-mod was significantly reduced (moderate ES; percentage changes > CV%) two days after soccer matches. Comparing our results with the literature, it was found that the flight time (FT) to contraction time (CT) ratio (analogous to RSI-mod) was altered even 72 hours post-intervention [13]. In rugby players, the sensitivity of RSI-mod to detect neuromuscular fatigue was position-dependent [43]. In contrast, it was found no decrements in FT:CT two days after high-load soccer matches [12,15]. It's important to note that, as a ratio, any changes in RSI-mod should be interpreted in light of changes in its individual components (JH and/or JD). In our study, the negative changes in RSI-mod were due to a decrease in JH (ES = -0.81) and an increase in JD (ES = 0.53). Since no differences in squat depth were observed between conditions, the increased JD likely indicates that players became slower, exhibiting reduced ballistic characteristics such as rate of force development during the propulsive phase of the jump. This may reflect fatigue in the SSC, which can impair muscle function for up to 96 hours post-exercise [44]. We emphasize the importance of monitoring changes in squat depth during the CMJ, as jump height may remain unchanged, particularly in well-trained athletes, while compensatory strategies, such as increased squat depth, may still occur to preserve performance (Bishop et al., 2023).

Since 2020, it has been possible to make five substitutions during a soccer match, which can occur at halftime and/or in up to three additional stoppages. This change in the rule results in more players with widely varying playing times, increasing the complexity of individualizing training loads and recovery protocols post-game. In light of this, we analyzed CMJ responses among groups with different match exposures. We found that JH and RSI-mod were reduced two days after a match in G1 (>69 minutes) and G2 (40-69 minutes), but not in G3 (less than 40 minutes of exposure). This suggests that these variables are sensitive to recovery levels based on match exposure. While previous studies [15,45,46] have examined the influence of match exposure, they did not find within-group effects on JH when comparing different playing times. Unlike those studies, our findings indicate that players with greater match exposure (G1 and G2) had not fully recovered by MD+2 compared to players with fewer minutes (<40) on the field. It is important to note that these results are based on the analysis of four games, which strengthens the robustness of the findings. Nonetheless, we recommend further studies with a larger sample of games to provide more clarity on this topic.

In closing, we emphasize the importance of incorporating the CMJ test into clubs' routines for monitoring fatigue and recovery. First, the CMJ is a practical and feasible test that does not induce fatigue. Additionally, its muscle-specific nature is advantageous, as it relies on the SSC [40], which is also crucial in performance tasks observed during matches [8]. The frequent accelerations, decelerations, changes of direction, and sprints in soccer have a high potential to induce fatigue and muscle damage [4], which can be effectively tracked using neuromuscular function tests [9]. We therefore encourage practitioners to include the CMJ as part of recovery and match-readiness assessments, both at the group level and, more importantly, at the individual level. The first step is to establish the variability of the data (e.g., the coefficient of variation – CV) at baseline (i.e., MD-1) and then determine whether any subsequent change in test scores at MD+2 exceed the CV observed at MD-1. This approach allows practitioners to be confident that a real (i.e., meaningful) change has occurred [42]. For example, Table 1 shows an average CV of 3.7% for JH at baseline, while the average change from MD-1 to MD+2 was 5.1% (Table 2), indicating a likely real change that may warrant consideration by the coaching or physical performance staff. The same reasoning applies at the individual level: for instance, if a player shows a 3% change in JH between MD-1 and MD+2, it should only be interpreted as a real change if it exceeds that player's CV at MD-1. Therefore, it is essential to know both the athlete's baseline values and the measurement variability. Alternatively, effect sizes can be used to support decision-making, as they indicate the magnitude of change between two time points (e.g., MD-1 vs. MD+2) relative to measurement

variability. It has been suggested that effect sizes greater than 0.8 (representing a large effect – [22]) may serve as a reference threshold to flag potential signs of neuromuscular non-recovery. This method can be applied at both group and individual levels.

The main limitations of the current study include that players were selected by convenience from the same club, and it was not possible to balance the number of individuals in each group when comparing match exposure, nor was a control group included. Additionally, specific physical demands associated with playing positions [47,48] were not controlled in our analysis. Caution should also be exercised when comparing our findings with existing literature and applying them practically, considering specific factors such as assessment timing [31,35,46], individuals' performance levels [10,45], and the equipment used [15]. The strengths of this study lie in the players' skill level and the feasibility of implementing the current protocol in a real-world setting. Furthermore, the reported variations in MD+1 vs. MD+2 were analyzed across 10 matches in the season, providing more robust results and new insights on this topic. Given that the first 'high load' training session after a soccer match is typically scheduled for two to three days post-match, monitoring CMJ 48 hours post-game (before the next training session) enables the staff to individualize subsequent training loads if significant impairment is observed.

Conclusion

In conclusion, most CMJ-derived variables demonstrated acceptable reliability between sessions. A significant decline was observed in all CMJ metrics two days after soccer matches (MD+2) compared to MD-1 in professional soccer players, with JH being the only variable showing a large effect size. Additionally, changes in JH and RSI-mod effectively distinguished fatigue levels among groups of players with different match exposures.

Declarations

Conflict of interest:

The authors declare no conflict of interests.

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