Impact of Fixture Congestion on Indices of Performance & Recovery in Youth Soccer Players

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Headline

Elite soccer schedules often require players to undertake two competitive fixtures within seven days. Previous research has reported that around 72-96 hours are required after a single soccer match for measures of muscle function to return to pre-game levels (1,2). As players are regularly required to complete periods where games are separated by only 48 to 72 hours contemporary research has started to investigate the effects fixture congestion has on elite senior players activity profiles and markers of recovery (3,4,5). However, it is apparent that there is a paucity of literature regarding the impact of fixture congestion in elite youth players (20).

Aim. It is unclear how the exposure to two competitive fixtures within seven days affects physical performance and recovery status in elite youth soccer players. The current study sought to identify if a difference existed in indices of physical output and recovery during the second fixture in a double game week in comparison to a single game week.

Methods

Athletes. 9 elite male youth soccer players (mean age 17.6 ± 0.6 years, stature 177.1 ± 6.9 cm, body mass 71.48 ± 6.9 kg) participated in two single game weeks and two double game weeks. All matches analysed during the study were competitive home fixtures from the English Under-18 Professional Development League 2 Northern Division. Ethical approval was granted by St Mary's University. Organisational, parent and participant consent was also obtained.

Design. A within group repeated measures design was used to examine the physical output and markers of recovery. To be included in the study each participant had to meet the following criteria (i) the player completed the full duration of all games (ii) the player didn't suffer any type of injury during any of the games (iii) the player played in the same position during each game. In addition, to control contextual factors (3), the following criteria had to be met in order for data to be included in the study (i) the first and second half of the game had no more than 3 added minutes of playing time (ii) the winning score line did not differ by more than 2 goals (iii) all games were played on the same pitch. Single game week fixtures were defined as the only competitive fixture occurring during a normal training week, with the game played on a Saturday. A double game week fixture was defined as the second fixture occurring during a week with two competitive games played on a Saturday – Tuesday schedule. Single game week and double game week fixtures took place over alternate weeks during the second half of the season. Training load was kept consistent throughout and recovery practices were standardised.

Methodology. To measure physical performance during the game a 10Hz GPS system (OptimEye X4, Catapult Innovations, Canberra, ACT, Australia) was used to conduct time-motion analysis of the total distance (m), high intensity distance (≥5.5ms-1) and amount of high intensity accelerations (>3ms-2). Heart rate analysis (Polar Team2, Polar Electro Ltd, Warwick, England) was used to monitor cardiovascular exertion while an RPE load (RPE using the Borg CR10 scale x game time) was measured to quantify psycho-physiological fatigue (2,6). Indices of recovery were collected using a validated 0-100mm visual analogue scale (VAS) (7,8) for perceived recovery status, leg soreness, and sleep quality. In addition to this, a countermovement jump assessment was also completed on an integrated dual portable force plate set up with a sampling rate of 1000Hz (Pasco 2-axis force platform, Pasco, Roseville, CA, USA). Recovery measures were obtained at 1, 24, 48 and 72 hours post-game for all fixtures. Participants were familiarised with all data collection procedures during the 3 previous home fixtures that took place before the study.

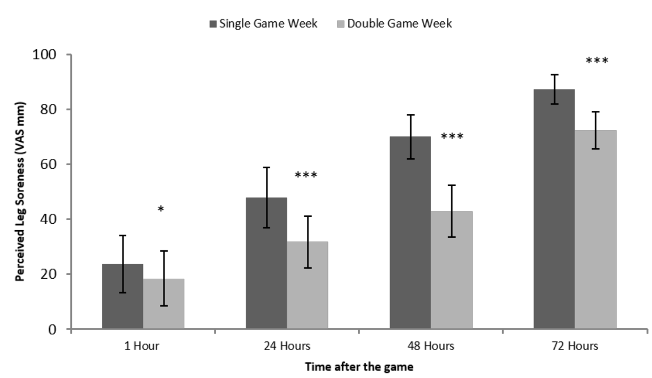

Fig. 1. Comparison of perceived leg soreness VAS scores (mean ± SD) after SGW and DGW fixtures at 1 hour, 24 hours, 48 hours and 72 hours post game. *Small effect size, **moderate effect size, ***large effect size.

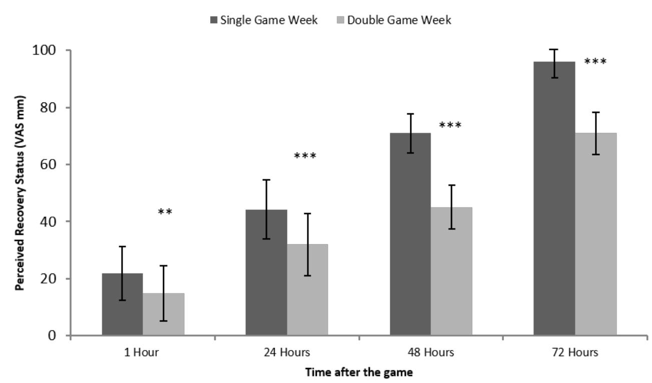

Fig. 2. Comparison of perceived recovery status VAS scores mean ± SD after SGW and DGW fixtures at 1 hour, 24 hours, 48 hours and 72 hours post game. *Small effect size, **moderate effect size, ***large effect size.

Table 1. Mean ± standard deviation of Visual Analogue Scale (VAS) measurements for perceived leg soreness and perceived recovery at 1, 2, 48 and 72 hours post-game.

Parameter	Time of Measurement Post - Game	Single Game Week	Double Game Week	Effect Size	95% CI Between Means	*Qualitative*
Perceived leg Soreness (VAS m)	1 hour	23.7 ± 10.4	18.5 ± 9.9	-0.51	-11, 1	*Likely moderate decrease*
	24 hours	47.9 ± 10.8	31.8 ± 9.3	-1.58	-22, -11	*Likely large decrease*
	48 hours	70.1 ± 8.0	43.0 ± 9.4	-3.08	-35, -19	*Most likely large decrease*
	72 hours	87.3 ± 5.4	72.3 ± 6.6	-2.46	-21, -8	*Very likely large decrease*
Perceived recovery Status (VAS mm)	1 hour	21.7 ± 9.4	14.8 ± 9.7	-0.71	-11, -2.5	*Possible moderate decrease*
	24 hours	44.2 ± 10.2	31.9 ± 10.8	-1.17	-17, -7.5	*Very likely large decrease*
	48 hours	70.8 ± 6.8	45.0 ± 7.7	-3.53	-31, -21	*Most likely large decrease*
	72 hours	96.0 ± 5.5	70.8 ± 7.4	-3.80	-24, -15	*Very likely large decrease*

Effect sizes (ES), 95% confidence intervals (CI) and magnitude based inferences (MBI) are provided between all measurements between single and double game weeks.

Table 2. Mean ± standard deviation of total distance (TD), high intensity distance (HID), high intensity accelerations (HIA), heart rate minutes over 85% maximum MHR (HR>85%) and rating of perceived exertion load (RPE Load).

Parameter	Game period	Single Game Week	Double Game Week	Effect Size	95% CI Between Means	*Qualitative*
Total Distance (m)	First Half	5734 ± 234	5592 ± 181	-0.67	-320, 38	*Possible moderate decrease*
	Second Half	5523 ± 226	5390 ± 223	-0.59	-290, 27	*Possible moderate decrease*
	Total	11257 ± 429	10982 ± 353	-0.69	-500, -46	*Possible moderate decrease*
High Intensity Distance (m) (≥5.5m.s-1)	First Half	401 ± 121	376 ± 100	-0.22	-63, 13	*Possible small decrease*
	Second Half	380 ± 133	297 ± 88	-0.73	-130, -35	*Likely moderate decrease*
	Total	781 ± 249	673 ± 186	-0.49	-180, -36	*Very likely small decrease*
High Intensity Accelerations (n) (>3m.s-2)	First Half	145 ± 24	134 ± 28	-0.42	-24, 0	*Likely small decrease*
	Second Half	135 ± 19	129 ± 23	-0.26	-118, -6	*Possible small decrease*
	Total	280 ± 42	263 ± 51	-0.36	-36, 5	*Likely small decrease*
Heart Rate >85% MHR (mins)	First Half	32 ± 3	31 ± 2	-0.43	-4, 0	*Likely small decrease*
	Second Half	31 ± 2	32 ± 3	0.35	-2, 3	*Unclear*
	Total	64 ± 4	63 ± 5	-0.07	-5, 3	*Unclear*

Effect sizes (ES), 95% confidence intervals (CI) and magnitude based inferences (MBI) are provided between first half, second half and total measures for all parameters between single and double game weeks.

Statistical analysis. 9 players met the eligibility criteria to be included in the study. All data are provided as means ± standard deviations. In line with the suggestions of Carling et al (3), Cohens d effect sizes (ES) and 95% confidence intervals (CI) were calculated to determine the magnitude of the differences between parameters from the single game and double game weeks. ES was classified as trivial (<0.2), small (0.2-0.6), moderate (0.6-1.2) and large (>1.2). A published spreadsheet (17) was used to make a qualitative probabilistic mechanistic inference about the true effect. Threshold values were calculated by dividing the between-subject standard deviation by 0.2 (small), 0.6 (moderate) or 1.2 (large) in order to determine the magnitude band that the effect falls into (18). The resulting values were translated into descriptors using the modified thresholds proposed by Batterham and Hopkins (19): 0-0.5% most unlikely; 0.5-5% very unlikely; 5-25% unlikely; 25-75% possibly; 75-95% likely; 95-99.5% very likely; and >99.5% most likely. If the probabilities of the effect being substantially positive and negative were both >5%, the effect was reported as unclear. Pearson correlations were used to investigate the relationship between physical performance and recovery data.

Results

The greatest difference between double game and single game weeks was highlighted by perceived measures of recovery status and muscle soreness which displayed large negative effect sizes after 24, 48 and 72 hours (Figure 1/2, Table 1). No meaningful differences were found for CMJ or perceived sleep quality between single game and double game weeks at any time point (Due to this, no data for these parameters are included in the report but all data is included in the accompanying spreadsheet).There was a consistent pattern of physical output being reduced during a double game week when compared to a single game week (Table 2). Total distance and high intensity distance displayed the largest reductions during double game weeks with moderate negative effect sizes observed for both of these parameters.

Discussion

These findings are similar to those reported by Buchheit et al (20) who found that the majority of match running parameters were reduced for adolescents who were post peak height velocity during a period of congestion. The decrease in high speed running by 22% during the second half of double game week fixtures may have the biggest impact on performance as high-intensity actions are often the decisive factor involved in the outcome of a game (9). Furthermore, correlational analysis identified the strongest association between physical performance and markers of fatigue occurred between high intensity distance and post-match leg soreness (r= -0.81) highlighting that this may be the most fatiguing action. Previous studies have shown that high intensity running depletes glycogen stores (10) as well as causing more structural damage to the muscle (11), and an accumulation of these effects may have caused the decline in match running performance. In addition, Bradley and Noakes (12) reported that senior players adopt a self-pacing strategy in order to sustain high intensity running performance during periods of fixture congestion and the younger players in this study may not have developed this ability yet.

As indices of recovery were accentuated following double game week fixtures (Figure 1, Table 2) this suggests a residual fatigue from the previous fixture in that week might have contributed to the increased perception of fatigue following the second fixture. The magnitude of difference in fatigue effects was observed further away from match day and this is consistent with previous research that has shown delayed onset muscle soreness (DOMS) peaks at 48-72 hours post-game (13). The findings are in agreement with the research carried out by Thorpe et al (14) that found subjective assessments are effective measurements of in-season fatigue in soccer players.

The overall findings of the study suggest that double game week fixtures may be more physically demanding than single game week fixtures for youth soccer players. The reduction in physical capacity and decline in indices of recovery were most likely caused by a transient state of fatigue characterised by muscular damage, glycogen depletion as well as an elevated amount of stress placed on the cardiovascular, endocrine, and nervous systems (11,15,16). This is likely attributable to the lower training age of youth players, meaning that they haven't yet developed the physical capacity and self-pacing strategies to consistently sustain match running performance levels. Additionally, the lower level of physical maturity may contribute to the fatigue effects experienced by young players being amplified.

Practical Applications

- An individual approach to player monitoring should be used, ensuring that a players physical exertion and markers of recovery from the previous game are used to inform training load and use of appropriate recovery strategies.
- Despite the heightened levels of fatigue after double game weeks, young players may need to periodically be exposed to periods of congestion in order to develop the self-pacing strategies utilised by senior players. However, further research is needed to determine the association between fixture congestion and injury risk for youth players.
- Elite youth players should follow a long term development plan in order to improve their physical capacity and make them more resistant to fatigue. This should include sufficient exposure to match specific actions such as high speed running, accelerations and decelerations.

Limitations

- As the study was carried out in the real world setting during competitive fixtures it is difficult to meet the necessary inclusion criteria across a greater amount of games. Due to this, further research is required pooling data from multiple teams across a larger number of games.
- Pre-game measures could have been included for the markers of recovery (CMJ & VAS) to quantify the pre / post game fatigue effect as well as the time course of recovery rates post game.
- Although the main purpose of this study was to identify the general effects of fixture congestion for youth players, further analysis could be carried out to monitor these effects for specific playing positions.

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