

Fixture Congestion has Minimal Impact on External Workloads in Collegiate Soccer Players

Direct Original Research

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Abstract

Introduction: Advances in GPS technology have allowed for the measurement of soccer players' external workloads in competition. While short collegiate seasons with fixture congestion may pose challenges for sustained performance, no study has determined if objective measures of performance are impacted by game congestion in college soccer players.

Methods: External workload variables were measured using the Polar Team Pro™ GPS device (n=19 players). Data were normalized by minutes played to account for discrepancies in playing time. Paired samples T-test was used to determine if workloads were different between the first and second games of "double-header" weekends (n=14 games).

Results: In second games, sprints were significantly reduced compared to first games (0.49 ± 0.2 vs. 0.41 ± 0.1 , $p = 0.005$), with decelerations tending to be lower (1.58 ± 0.4 vs. 1.43 ± 0.4 , $p = 0.06$). However, there were no differences in total distance (133.3 ± 38.8 m vs. 129 ± 32.2 m, $p = 0.54$), high speed running (45.1 ± 13.1 vs. 47.7 ± 13.9 m, $p = 0.26$) and accelerations (1.5 ± 0.4 vs. 1.6 ± 0.4 , $p = 0.13$) respectively.

Conclusions: We note a small but significant difference in sprint distance with fixture congestion, despite no reduction in total distance run, high-speed running, or accelerations. These findings are unexpected due to the high demands of match play and limited recovery time between games.

Key Words: Football, GPS, Performance

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Introduction

Soccer is a demanding sport that requires athletes to be well trained in speed, strength, aerobic endurance, and power to meet the demands of competition ^{1,2}. While great strides have been made in understanding the physical requirements of elite level soccer in recent decades, there is a lack of inquiry surrounding match play in collegiate soccer in the US. Preliminary work has revealed the physical demand of men's ^{3,4} and women's ^{5,6} collegiate soccer, with both practice and competition contributing to high accumulated workloads over the course of a competitive season. Interestingly, it has been suggested the format of collegiate soccer in the US may also present distinct challenges not seen in other competition levels. For

example, the rules of NCAA soccer are unique and can involve extended game times due to clock stoppages and "overtime" periods. Crucially however, collegiate soccer players compete in an extremely protracted season, often playing >25 games in an approximately 3-month period. This can result in significant fixture congestion, previously described as games played less than four days apart ⁷ and/or more than two games per seven day period ⁸. Indeed, the tendency for collegiate soccer players to play two games less than 48 h apart would seem to represent fixture congestion



greater than that seen in professional soccer. The high volume of games poses potential problems for athletes and coaches alike, with both attempting to adequately manage rest, recovery, injury risk and performance. While this issue has been addressed in the professional game ⁷ no study has considered the effect of fixture congestion on performance in college soccer players.

The various positional demands and complex tactical nature of soccer can make it challenging to define individual match play performance; however, recent technological advances have made it possible to accurately measure the workload of players in competition. Traditionally, workloads have been described as internal or external, representing the physiological stress on athletes (e.g. heart rate) or movement profiles (e.g. distance covered, accelerations, sprints) respectively ⁹. The analysis of these workloads could potentially be used to help players and coaches navigate the challenges of fixture congestion in the collegiate setting. Therefore, we sought to characterize the external workloads of collegiate soccer players in games played <48 h apart. Due to both the demands of competition and limited recovery time between games, it is hypothesized that external workloads will be reduced in the second games of these “double-header” fixtures.

Scientific Methods

Participants

Data were collected from male NCAA Division II soccer players (n=19, age 19.9 ± 0.9 years, height 1.81 ± 0.1 m, weight 74.16 ± 8 kg) across the 2021 competitive season. All participants completed a medical history and informed consent prior to data collection and analysis, with the study evaluated and approved by the University of Indianapolis Human Research Protections Program and Institutional Review Board (IRB). Analysis was carried out on 14 games, comprising of seven “double-headers” in both non-conference and conference play. Double-headers were defined as two fixtures played <48 h apart, with first games taking place on Friday evenings and second games on Sunday afternoons. Participants were included in the analysis when they played >10 minutes in *both* first and second games and excluded if they were unable to play because of team selection, injury/illness, or if the GPS device did not record data for the entirety of minutes played. Goalkeepers were not included due to their unique movement patterns during games ¹⁰.

Protocol

GPS-derived external loads measures (Table 1) were collected using the Polar Team Pro™ athlete monitoring system (Polar™, Finland). This tool has been shown to be valid and reliable ¹¹ and has been extensively used in team-sport analyses, including soccer. Approximately 30 minutes prior to games, the device was powered on and placed between the scapulae in a custom vest (Polar Team Pro Shirt™, Polar, Finland). Players used the same device in each game. Within 24 hours of game completion, data was uploaded to proprietary software (Polar Team Pro Web Service™, Polar, Finland), reviewed, and exported for further analyses.

Table 1: GPS Measures

Measure	Description
Total Distance (TD)	The total accumulated moving distance at any speed (m)
High Speed Running (HSR)	Distance covered running at >11km/h (m)
Sprints (SP)	Number of explosive movements >2.8m/s ² of any distance
Accelerations (AC)	Number of explosive movements of increasing speed > 2m/s ²
Decelerations (DC)	Number of explosive movements of decreasing speed > 2m/s ²

Statistical Analysis

To account for discrepancies in playing time, data were normalized by minutes played in each game. For example, if a player competed in 30 minutes in game one, and 50 minutes in game two, we did not compare absolute external loads across these differing timeframes. Data was divided by minutes played and presented as such (e.g., distance covered/minute) to allow for meaningful comparisons. Analysis was carried out using GraphPad Prism Version 9 for Mac (GraphPad Software, California, USA) and presented as mean $\pm$ standard deviation. Paired samples T-test was used to determine if external loads measures (TD, HSR, SP, AC, DC) were different across 14 double-header fixtures (7 x 1st games vs. 7 x 2nd games). Statistical significance was set at $p = <0.05$.

Results

19 players competed in >10 min game time across the double header fixtures. Of those, average game time per player was 56.2 min (first game) and 56.3 min (second game), with eight instances of a single player completing all minutes

on both days. GPS analysis revealed SP per minute were significantly reduced in second games when compared to first, with DC tending to be lower (Fig 1). No significant differences were seen in TD, HSR or AC (Table 2).

Figure 1. SP and DC in First and Second Games. Bars Represent Individual Players.

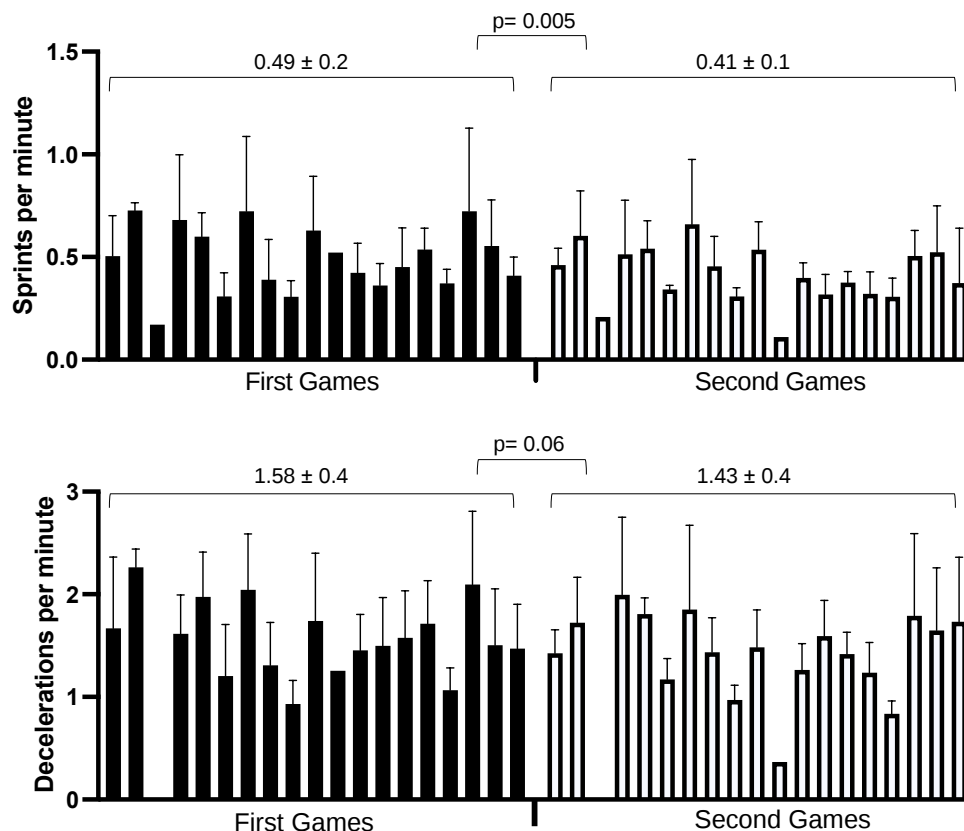


Table 2. External Load Measures in First and Second Games.

	First Games (n = 7)	Second Games (n = 7)	p
TD	129.7 ± 32.2	133.3 ± 38.8	0.54
HSR	47.7 ± 13.9	45.1 ± 13.1	0.26
AC	1.6 ± 0.4	1.5 ± 0.4	0.13

Discussion

The primary finding is that fixture congestion has a limited impact on external workloads in collegiate soccer players. To the best of our knowledge, this is the first data to explore this phenomenon at this level of competition. Specifically, small but significant decrements in sprinting (~ 0.08 SP per min) and a tendency for reduced decelerations (~ 0.15 DC per min) are identified when games are played <48 h apart, however, no differences are seen in total distance run, high-speed running distance, and accelerations. This is surprising, as minimal rest and recovery time between matches played might suggest a propensity for workload reductions with fixture congestion. While data presented is normalized by playing time, raw data allows for comparison of external loads to reported previously in male college soccer players³. Athletes that completed at least 90 minutes covered an average of 8892 m per game, approximately 475 m less than earlier described. Moreover, HSD running distance was also lower in this cohort of athletes (1700 m vs. 1348 m)³. This is intriguing, as it has been suggested that running distances, particularly at higher intensity, may be a differentiating factor between standards of play². Although it may be tempting to draw similar conclusions here, there is compelling



evidence that tactical preferences and opposition characteristics may influence external loads in competition ¹². As such, future work should aim to compare demands of college soccer players to determine if differences exist across competition levels.

While this is the first study to consider the implication of fixture congestion on workloads in the college game, the phenomenon has been analyzed in professional players, with equivocal findings. The preponderance of evidence would suggest that performance (as assessed via both external workloads and skill-based movements) is minimally impacted by fixture congestion at the elite-level ⁷. This is intriguing, as it has been posited that adequate recovery from competition can take anywhere from 48-120 hours ¹³. Data herein would seem to support sustained performance, as it has been shown that recovery of <48 hours does not appreciably diminish the activity profiles in collegiate players. However, differences were identified in sprinting, which has been shown to be metabolically taxing to athletes ¹. As such, it may be the case that the impacts of fixture congestion are isolated to the higher-intensity actions performed during gameplay. To this end, further work that may elucidate any relationship between sustained performance and high intensity work is recommended. Moreover, the data would suggest that coaches and strength and conditioning practitioners should consider the development of higher intensity actions as an integral component of player preparation.

There are several plausible explanations for the sustained running distances seen across double-header fixtures. First, despite 266 individual observations, only 16 (~6%) involved a single player competing all minutes in both games. As such, the effective use of squad rotation may be central to maintaining physical performance. This would be further supported by the fact that individual players saw an average of 56 mins (~62%) of available minutes over the course of 14 games analyzed. While this may provide a potential avenue to manage workloads, this strategy is limited only to those teams that have adequate numbers of players with skill levels at the required standard. In addition, it has been shown that soccer players may intentionally “regulate” their exertion during game play ¹⁴, and as such, it cannot be assumed that workloads presented herein demonstrate maximal efforts. Finally, it may be that the various recovery modalities suggested for soccer players ¹⁵ are well implemented in this group. Therefore, future studies should assess the effect of recovery techniques and performance, particularly at the collegiate level.

Conclusions

Fixture congestion has minimal impact on GPS-derived external workloads in male collegiate soccer players.

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