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ABSTRACT

Purpose: To investigate the recovery time course of customized wellness markers (sleep, soreness, energy and overall wellness) in response to match play in Division 1-A American Collegiate Football players.

Methods: A retrospective research design was used in this study. Wellness data was collected and analysed for two collegiate American football seasons. Perceptions of soreness, sleep, energy and overall wellness were obtained daily for the day preceding each game (GD-1) and the days following each game (GD+2, GD+3 and GD+4). Standardised effect size (ES) analyses±90% confidence intervals were used to interpret the magnitude of the mean differences between all time-points for the START, MIDDLE and FINISH of the season, using the following qualitative descriptors: 0–0.19 trivial; 0.2–0.59 small; 0.6–1.19 moderate; 1.2–1.99 large; <2.0 very large.

Results: Overall wellness showed small ES reductions on GD+2 (*d*=0.22±0.09, *likely* [94.8%]), GD+3 (*d*=0.37±0.15, *very likely*) and GD+4 (*d*=0.29±0.12, *very likely*) compared to GD-1. There were small ES reductions for soreness between GD-1, and GD+2, GD+3 and GD +4 (*d*=0.21±0.09, *likely*, *d*=0.29±0.12, *very likely*, and 0.30±0.12, *very likely*, respectively). Small ES reductions were also evident between GD-1 and GD+3 (*d*=0.21±0.09, *likely* for sleep. Feelings of energy showed small ES on GD+3 (*d*=0.27±0.11, *very likely*) and GD+4 (*d*=0.22±0.09, *likely*) when compared to GD-1.

Conclusion: All wellness markers were likely-very likely worse on GD+3 and GD+4 compared to GD-1. These findings show that perceptual wellness takes longer than 4 d to return to pre-game levels and thus should be considered when prescribing training and/or recovery.

Introduction

American Collegiate football (ACF) is a sport characterised by unique physical and psychological demands, mainly due to the large variety in positions, anthropometry and season length compared to other team sports[1]. Players need to have a combination of physical qualities to be able to cope with intense collisions and high-intensity bouts of exercise that are short in duration but repeated over the period of 3-4 hours in a game[2-4]. For instance, Wellman and colleagues reported that players can run total distances ranging from 3 to 5.5 km, with up to 650m of high intensity distance (4.48–6.4 $m.s^{-1}$) and between 15 and 38 high acceleration efforts (2.6–3.5 m/s^2) during an average game[1]. As such, given the demands imposed on players by ACF match play, it is pertinent to monitor the recovery timeline of physiological and psychological parameters to manage fatigue[5]. Failure to do so may impair positive training adaptations, thus leaving players at risk of non-functional overreaching and/or injury[5].

Perceptual ratings of wellness are commonly used to detect fatigue, monitor recovery, assist the individualized response to training and prescribe potential training modifications within athletic settings[5]. Indeed, many studies suggest that perceptual responses may reveal early signs of fatigue more readily than physiological markers of fatigue[6]. The advantage of psychometric tools over physiological fatigue markers is that they are non-invasive and cost effective; but many are considered too lengthy and impractical for daily use. As such, shorter customised questionnaires represent a viable alternative to monitor athletes response load[7]. In a survey of those who use self-reported perceptual wellness measures in high performance sport 80% of respondents stated they used a customized questionnaire[8]. The majority of recent research has focussed on the relationship between these perceptual wellness scores in response to training and matches; however, to the authors' knowledge, no researchers have yet examined the recovery of perceptual wellness markers in ACF players in response to match play.

The aim of the present case-study was to monitor the recovery time course of perceptual wellness markers (sleep, soreness, energy and overall wellness) in response to match play in ACF. Specifically, we studied the perceptual responses of ACF players from baseline (the day before game day; GD-1) to two, three and four days' post-game (GD+2, GD+3 and GD+4) over a two-year period.

Methods

Subjects

52 college level American footballers participated in this study (mean±SD age: 20.6±1.4 y, mass: 104.78±20.1 kg, height: 188.0±7.4 cm). All subjects were members of the same

Division I-A football team. All players gave informed consent by signing a form that states that de-identified injury, wellness or performance data (no release of individual information) may be used for research purposes. All players were fully familiarised with all procedures prior to the commencement of the study. All experimental procedures were approved by the University's Research Compliance Services.

Design

This study was a retrospective research design, where wellness data were collected for training sessions and competitive events during the 2014 and 2015 collegiate NCAA Division I-A American football regular seasons (two x twelve week seasons). Each training week included five training sessions. Perceptions of wellness were obtained at the same time daily (2 h prior to the commencement of training) for the day preceding each game (baseline: GD-1) and the days following each game (GD+2, GD+3 and GD+4). Data were then divided into three conditions (First 1/3 of the season; START, middle 1/3 of the season; MIDDLE, final 1/3 of the season; FINISH). Training for each day commenced at times ranging from 08:30-10:00, with university classes attended from approximately 12:00-16:00 in the MIDDLE and FINISH (not at START). In general, players travelled every second week to play (average flight time 1.5 h). Wellness measures for the day following the game (GD+1) were not obtainable as this was designated as a players' recovery/day off. To be included for final analysis, players were required to participate for at least one season and retain 80% or greater completed data sets. Thus, a total of 3532 observations were analysed, with 68±21 measures per player.

Methodology

Players completed the customized wellness questionnaire each day ~ 2 h before their main field training session. The information collected comprised of three 5-point Likert scale questions: soreness: How SORE were you when you woke up this morning? (1 = Terribly sore; 2 = Fairly Sore; 3 = Feeling OK; 4 = Slightly Sore 5 = No Soreness at all); sleep: How did you SLEEP last night? (1 = Slept Terrible; 2 = Slept Bad; 3 = Slept OK; 4 = Good Sleep; 5 = Excellent Sleep); and energy: How energized do you feel today? 1 = No energy at all; 2 = Hardly any energy; 3 = some energy; 4 = Well energized; 5 = totally energized). In addition, wellness responses were averaged to provide an overall wellness score for each player (1=poor wellness, 5=excellent wellness).

Statistical Analysis

Data are presented as means±SD. All procedures were performed using the statistical package Minitab 17.

Standardised effect size (ES) analyses±90% confidence intervals (CI) were used to interpret the magnitude of the mean differences between all time-points (GD-1, GD+2, GD+3, GD+4) for each of the three season conditions (START, MIDDLE, FINISH) for soreness, sleep, energy and overall wellness using the following qualitative descriptors: 0–0.19 trivial; 0.2–0.59 small; 0.6–1.19 moderate; 1.2–1.99 large; <2.0 very large)[9]. In addition, qualitative probabilistic terms were assigned using the following scale: <0.5%, most unlikely, almost certainly not; 0.5-5%, very unlikely; 5-25%, unlikely; 25-75%, possibly; 75-95%, likely; 95-99.5%, very likely; >99.5%, most likely, almost certainly[9]. The smallest worthwhile change (SWC) in each variable was calculated as 0.2 of the between-athlete standard deviation[10].

Results

All results are present in Table 1. Overall wellness showed small ES reductions on GD+2 (*d*=0.22±0.09, *likely* [94.8%]), GD+3 (*d*=0.37±0.15, *very likely* [99.5%]) and GD+4 (*d*=0.29±0.12, *very likely* [98.5%]) than GD-1. There were small ES reductions for soreness between GD-1, and GD+2, GD+3 and GD +4 (*d*=0.21±0.09, *likely* [90.8%], *d*=0.29±0.12, *very likely* [97.2%], and 0.30±0.12, *very likely* [97.6%], respectively). Small ES reductions were also evident between GD-1 and GD+3 (*d*=0.21±0.09, *likely* [93.5%]) for sleep. Feelings of energy showed small ES on GD+3 (*d*=0.27±0.11, *very likely* [97.2%]) and GD+4 (*d*=0.22±0.09, *likely* [92.6%]) when compared to GD-1. There were no differences between wellness markers at different stages of the season (START, MIDDLE and END, range: *d*=0.05-0.13; *trivial*).

Discussion

The present study analysed the recovery time course of perceptual wellness markers in response to match play in ACF at different stages of the season, over a two-year period. The main finding was a smaller reduction in the majority of wellness markers on GD+3 and GD+4 compared with GD+1. Interestingly, these wellness markers did not differ between stages of the season (START, MIDDLE and END). These findings show that pre-game wellness markers may take longer than 4 d to return to baseline levels and should thus be considered when prescribing training and/or recovery. For instance, this may be especially pertinent in situations which disrupt the normal training week schedule (i.e. short turnaround between games (< 7 d), the commencement of school, and or weeks involving extensive travel).

Significant reductions in exercise performance, cognitive ability and perceptual recovery markers following match-play have been commonly reported in other sports[11]. These reductions generally return to baseline levels within 72-

96 h[12]. However, all wellness markers in our study were at their worst ~72 h or 96 h post-game, showing little sign of returning to pre-game values. The prolonging of this recovery timeline in our study may be due to the differing demands of ACF to other sports, with a high amount of g-forces and collisions for the majority of positions[4]. It is also possible that given this sample of athletes are college student-athletes, the additional requirements of university may inhibit the recovery process (i.e. additional mental fatigue imposed from class). However, this remains speculative and further research pertaining to the analysis of the additional requirements of student-athletes is required. In addition, interventions aimed at reversing this trend of reduced perceptual wellness for up to 96 h post-game would seem advisable for game preparation. Future research which assesses the objective recovery of exercise performance following football match play is also warranted.

There were no differences evident between stages of the season for all wellness markers. This is surprising since there are numerous instances which could have contributed to an altered recovery status between time points during the season. For instance, the commencement of university classes[13] in the first week of the MIDDLE section could pose a risk to sleep quality with earlier training starts. Since American collegiate students are possibly the most at risk (healthy) population for sleep disruption[14], players may have altered their own sleep schedule (i.e. bed time) to accommodate the expected reduction in sleep quantity/quality. In addition, the accumulation of elevated fatigue levels towards the end of the season could reduce the ability to recover[5]. However, it is likely that altered training loads at the end of the season may have reduced training stress and stabilised wellness recovery[12]. Alternatively, the lack of differences in post-game recovery wellness between stages of the season may be explained by variance (or lack thereof) in game loading/demands. Although outside the scope of this investigation, further investigations into the effect of individual and position-specific physiological demands of collegiate football on the recovery of exercise performance timeline would complement these findings.

The present study showed that ACF footballers incur poorer ratings and small effects of wellness markers up to 96 h post-game play. Collectively, these findings should be considered from a practical perspective when prescribing training and/or recovery during a typical ACF season. For instance, attenuating training loads or schedules in response to changes in school requirements (i.e. cognitive fatigue induced from classes), scheduling (i.e. shorter/extended training weeks) or wellness/recovery markers (i.e. during travel) may be beneficial.

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Table 1: Perceptual customized wellness recovery markers in response to NCAA Division I-A American football game play

	GD-1	GD+2	GD+3	GD+4	Overall
Soreness	***3.48±0.65***	***3.11±0.73^#***	***2.99±0.74^** ***	***2.93±0.71^** ***	
START	3.60±0.65	3.07±0.68	3.02±0.63	2.89±0.63	**3.15±0.69**
MIDDLE	3.42±0.61	3.17±0.76	3.03±0.72	2.97±0.73	**3.15±0.72**
END	3.41±0.68	3.10±0.77	2.92±0.85	2.93±0.77	**3.09±0.73**
Sleep	***3.56±0.63***	***3.25±0.63***	***3.18±0.66^#***	***3.23±0.62***	
START	3.78±0.64	3.35±0.61	3.32±0.57	3.25±0.56	**3.42±0.61**
MIDDLE	3.42±9.66	3.17±0.63	3.08±0.71	3.16±0.65	**3.20±0.67**
END	3.49±0.56	3.23±0.64	3.16±0.67	3.29±0.64	**3.29±0.66**
Energy	***3.63±0.66***	***3.26±0.66***	***3.14±0.69^** ***	***3.20±0.66^#***	
START	3.81±0.70	3.25±0.64	3.18±0.64	3.21±0.58	**3.37±0.67**
MIDDLE	3.50±0.62	3.25±0.64	3.10±0.71	3.11±0.71	**3.24±0.69**
END	3.57±0.63	3.29±0.71	3.16±0.73	3.28±0.70	**3.33±0.66**
OW	***3.45±0.65***	***3.10±0.63^#***	***2.97±0.65^** ***	***2.91±0.60^** ***	
START	3.53±0.64	3.03±0.64	2.91±0.58	2.99±0.54	**3.11±0.67**
MIDDLE	3.42±0.59	3.08±0.60	2.83±0.67	2.87±0.61	**3.05±0.66**
END	3.40±0.71	3.19±0.65	3.01±0.69	3.05±0.62	**3.16±0.67**

Abbreviations: OW; Overall wellness

^Small effect size present (*d*=0.20-0.59) [9,10]

#Likely, probably lower than GD-1 [9,10]

*Very likely lower than GD-1 [9,10]