# Cardiac-Autonomic Responses to In-Season Training Among Division-1 College Football Players

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## Abstract

Flatt, AA, Esco, MR, Allen, JR, Robinson, JB, Bragg, A, Keith, CM, Fedewa, MV, and Earley, RL. Cardiac-autonomic responses to in-season training among Division-1 college football players. *J Strength Cond Res* 34(6): 1649–1656, 2020—Despite having to endure a rigorous in-season training schedule, research evaluating daily physiological recovery status markers among American football players is limited. The purpose of this study was to determine whether recovery of cardiac-autonomic activity to resting values occurs between consecutive-day, in-season training sessions among college football players. Subjects ($n$ = 29) were divided into groups based on position: receivers and defensive backs (SKILL, $n$ = 10); running backs, linebackers, and tight-ends (MID-SKILL, $n$ = 11) and linemen (LINEMEN, $n = 8$). Resting heart rate (RHR) and the natural logarithm of the root mean square of successive differences multiplied by 20 (LnRMSSD) were acquired at rest in the seated position before Tuesday and Wednesday training sessions and repeated over 3 weeks during the first month of the competitive season. A position × time interaction was observed for LnRMSSD ($p = 0.04$), but not for the RHR ($p$ = 0.33). No differences in LnRMSSD between days was observed for SKILL (Tuesday = 82.8 ± 9.3, Wednesday = 81.9 ± 8.7, $p > 0.05$). *Small* reductions in LnRMSSD were observed for MID-SKILL (Tuesday = 79.2 ± 9.4, Wednesday = 76.2 ± 9.5, $p \le 0.05$) and LINEMEN (Tuesday = 79.4 ± 10.5, Wednesday = 74.5 ± 11.5, $p \le 0.05$). The individually averaged changes in LnRMSSD from Tuesday to Wednesday were related to PlayerLoad ($r = 0.46$, $p = 0.02$) and body mass ($r = -0.39$, $p = 0.04$). Cardiac-parasympathetic activity did not return to resting values for LINEMEN or MID-SKILL before the next training session. Larger reductions in LnRMSSD tended to occur in players with greater body mass despite having performed lower workloads, although some individual variability was observed. These findings may have implications for how coaches and support staff address training and recovery interventions for players demonstrating inadequate cardiovascular recovery between sessions.

**Key Words** parasympathetic, cardiovascular, monitoring, sport science, recovery

## Introduction

In-season training sessions for American college football teams are typically 2 hours in duration and involve intermittent bouts of sprinting, rapid changes of direction, and physical contact such as blocking and tackling (36,37). The intensive running demands and frequent collisions associated with football play present a substantial physiological challenge to players (22,24,28). With football training sessions typically held on consecutive days during the competitive season, the potential for inadequate recovery between sessions may be heightened (20). Thus, investigation into recovery status monitoring protocols among football teams is warranted.

Previous studies have investigated the usefulness of biochemical (e.g., creatine kinase), endocrine (e.g., testosterone and cortisol), and psychometric (subjective ratings of well-being) markers for reflecting training responses in football players (20,21,23,24,27,28,37). These markers account for muscle damage, anabolic and catabolic influences, and perceptual responses, respectively. Although the current body of research has contributed to our understanding of various physiological and psychological effects of in-season football training, there is currently a gap in the literature concerning cardiovascular recovery among football players. This

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research is needed because recent quantification of heart rate responses from training indicate that football players achieve peak heart rate values >195 $b \cdot min^{-1}$ with an average heart rate of ~145 $b \cdot min^{-1}$ during positional drills (14). In addition, cardiovascular strain may be further exacerbated by heat stress from protective equipment requirements and environmental conditions (13). Thus, day-to-day cardiovascular recovery seems to be relevant for establishing recovery status in football players.

Physical exercise such as football training challenges the cardiovascular system with delivering oxygen to active peripheral muscle tissue, facilitating lactate and metabolite clearance, maintaining blood pH, and functioning in thermoregulation (11). However, the role of the cardiovascular system is not limited to acute training bouts, and it also plays a key role in re-establishing homeostasis during the post-training period (35). Cardiovascular adjustments made during and after exercise are mediated by the autonomic nervous system (3). Autonomic heart rate regulation can be assessed conveniently and noninvasively through heart rate variability (HRV). Vagally mediated HRV parameters reflect parasympathetic modulation and are often used to monitor cardiovascular recovery from training among athletes (7). The return of vagal-HRV to resting levels after a training bout is believed to reflect restoration of cardiovascular homeostasis (3,35).

The heterogeneity in physical and fitness characteristics among playing positions is a unique feature of American football. Positional groups comprising receivers and defensive backs (SKILL), running backs, linebackers and tight-ends (MID-SKILL), and linemen (LINEMEN) differ in body mass and composition, relative strength and power, aerobic fitness level, and physical demands during training and competition (2,14,34,36,38). LINEMEN are of particular interest because their size and body composition may exacerbate physiological responses during training. For example, despite lower running loads, LINEMEN demonstrate a similar mean exercise heart rate along with greater increases in core temperature and fluid loss during training relative to nonlinemen (13,14). Moreover, it has been shown that the ~20-hour recovery time between consecutive-day training sessions during spring camp (i.e., off-season) may be inadequate for LINEMEN because they exhibited substantially reduced vagally mediated HRV relative to baseline (19). In contrast, SKILL and MID-SKILL values returned to within or near baseline levels. Both body mass and external training load were significantly associated with individual HRV responses indicating that despite performing lower workloads, recovery time requirements for LINEMEN may be greater than nonlinemen (19).

It is currently unknown whether the responses observed during spring camp would be similar during in-season training. This research is needed because factors such as fitness level and training loads may differ between phases. Furthermore, monitoring player recovery status is of greater importance during the competitive season so that coaching personnel can intervene to minimize fatigue-induced decrements in performance and risk of illness or injury. Therefore, the purpose of this study was to determine whether cardiac-autonomic activity returns to resting values between consecutive-day in-season training sessions among college football players. A secondary aim was to quantify relationships between changes in cardiac-autonomic activity with body mass and external training load. We hypothesize that cardiac-autonomic responses will be position-dependent, with larger players (e.g., LINEMEN) displaying greater decrements in recovery than smaller players, despite lower training load as demonstrated during off-season training (19).

## Methods

### Experimental Approach to the Problem

This was a prospective observational cohort study featuring data collected during the first month of the 2016 competitive football season (i.e., September). Standardized for time and location, resting heart rate (RHR) and vagally mediated HRV were acquired at rest before Tuesday and Wednesday training sessions. Data collection procedures were repeated over 3 weeks resulting in 3 separate Tuesday and Wednesday measures for each subject. Cardiac-autonomic parameters were compared between positional groups across days. Relationships between body mass, PlayerLoad, and changes in cardiovascular parameters were subsequently quantified.

### Subjects

Subjects were recruited from a National Collegiate Athletic Association Division-1 football team ($n$ = 29) who were national champions from the previous season. All subjects were athletic-scholarship players and received regular competition playing time as a starter or starting back-up during the observation period. The subjects were grouped based on the playing position as previously described (31): mean ± *SD* SKILL: $n$ = 10; age = 20.2 ± 1.3 years; height = 188.0 ± 4.1 cm; body mass = 90.3 ± 6.0 kg, MID-SKILL: $n$ = 11; age = 19.7 ± 1.5 years; height = 187.5 ± 7.0 cm; body mass = 103.1 ± 7.1 kg and LINEMEN: $n$ = 8; age = 20.4 ± 1.5 years; height = 191.6 ± 5.3 cm; body mass = 135.0 ± 8.0 kg. All subjects were >18 years of age. Ethical approval for this study was granted by the University of Alabama institutional review board for human subject's research. All subjects and their parents/gaurdians provided written informed consent after details of the study and potential risks were communicated verbally and in written form before data collection.

### Procedures

*Training Schedule.* Weekly competition occurred each Saturday with passive rest or light training on Sunday and Monday. Football training sessions occurred on Tuesday through Friday with intensity and duration peaking on Tuesday and tapering progressively thereafter (36). Tuesday

**Table 1.** Model effects and mean and *SD* for the natural logarithm of the root mean square of successive differences multiplied by 20 (LnRMSSD) and resting heart rate (RHR).*

| Model effect | *F* | df | *p* | Mean ± *SD* LnRMSSD | | |
|---|---|---|---|---|---|---|
| a. LnRMSSD | | | | | | |
| Position | 1.08 | 2, 26 | 0.353 | SKILL: 82.4 ± 8.9 | MID-SKILL: 77.7 ± 9.5 | LINEMAN: 76.9 ± 11.2 |
| Day | 24.88 | 1, 26 | <0.0001 | Tues: 80.5 ± 9.7 | Wed: 77.7 ± 10.2* | |
| Position × day | 3.69 | 2, 26 | 0.039 | SKILL Tues: 82.8 ± 9.3 | MID-SKILL Tues: 79.2 ± 9.4 | LINEMAN Tues: 79.4 ± 10.5 |
| | | | | SKILL Wed: 81.9 ± 8.7 | MID-SKILL Wed: 76.2 ± 9.5* | LINEMAN Wed: 74.5 ± 11.5* |
| **Model effect** | ***F*** | **df** | ***p*** | **Mean ± *SD* RHR** | | |
| b. RHR | | | | | | |
| Position | 4.75 | 2, 26 | 0.017 | SKILL: 64.8 ± 8.1 | MID-SKILL: 71.0 ± 7.9 | LINEMAN: 74.2 ± 8.4† |
| Day | 7.62 | 1, 26 | 0.010 | Tues: 68.8 ± 8.8 | Wed: 70.6 ± 9.0* | |
| Position × day | 1.16 | 2, 26 | 0.329 | SKILL Tues: 64.2 ± 8.6 | MID-SKILL Tues: 70.4 ± 8.3 | LINEMAN Tues: 72.4 ± 7.3 |
| | | | | SKILL Wed: 65.3 ± 7.7 | MID-SKILL Wed: 71.6 ± 7.4 | LINEMAN Wed: 76.0 ± 9.2 |

*Significantly different from Tuesday ($p \le 0.05$).
†Significantly different from SKILL ($p \le 0.05$).

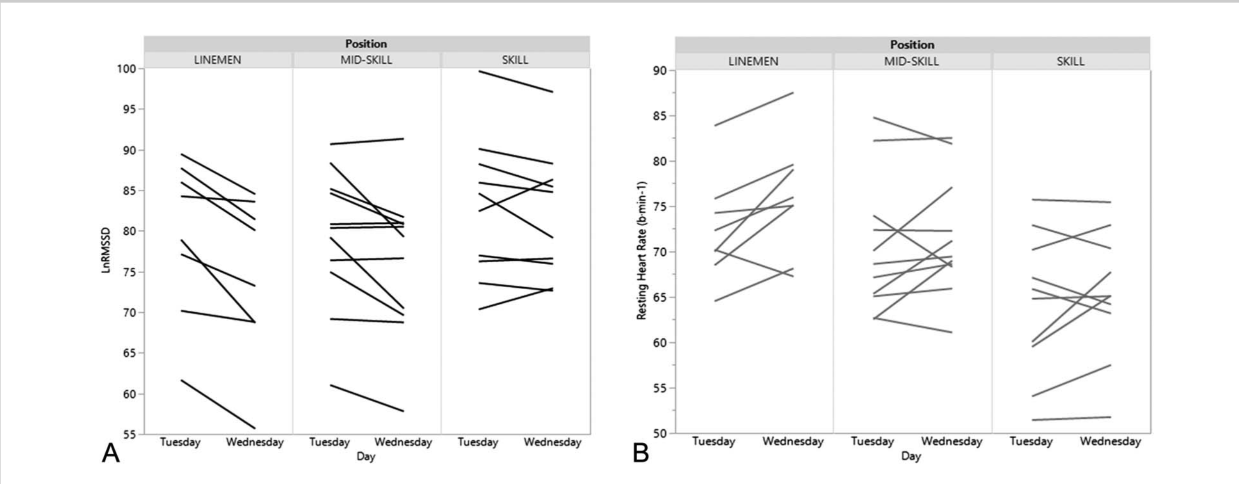


**Figure 1.** Individually averaged Tuesday and Wednesday values of (A) natural logarithm of the root mean square of successive R-R interval differences multiplied by 20 (LnRMSSD) and (B) resting heart rate (RHR) among positional groups.

therefore represented the optimal day to acquire the RHR and HRV that was least affected by previous high-intensity training (e.g., ~72 hours after competition) (35). The RHR and HRV data were acquired at the same time and location on Tuesday and Wednesday, 90–120 minutes before training. Football practices were approximately 2 hours in duration and included position-specific drills, technical and tactical training, and scrimmaging. Full protective equipment was worn by the subjects for each Tuesday session allowing for live tackling and blocking.

*Physiological Assessments.* During the week preceding regular season play, body mass was measured to the nearest 0.10 kg for each subject on a calibrated digital scale (Tanita Corporation, Arlington Heights, IL, USA). Weigh-in occurred before breakfast at the football training facility in team-issued t-shirt and shorts. To facilitate consistent data acquisition and minimize noncompliance issues (e.g., players forgetting to record data at home), RHR and HRV data were acquired at the football facility in the athletic training room in accordance with methods used during off-season training (19). Briefly, the RHR was obtained from a 1-minute sample through a tablet (iPad2; Apple, Inc., Cupertino, CA, USA) and finger-pulse plethysmography (HRV Fit LTD., Southampton, United Kingdom) (15) while players were seated comfortably on an athletic training table. The LnRMSSD derived from 1-minute recordings in collision-sport athletes obtained at the training facility under similar conditions has demonstrated acceptable relative (ICC = 0.90) and absolute interday reliability (CV = 7.65%) (29). The mobile application (ithlete; HRV Fit LTD., Southampton, United Kingdom) automatically provides the RHR and the natural logarithm of the root mean square of successive differences (LnRMSSD), which is the preferred vagally mediated HRV parameter for use in field settings (7). The LnRMSSD value is multiplied by 20 to fit an approximate 100-point scale for simplified interpretation. The application is equipped with an irregular pulse-rate detection algorithm, which excludes interpulse intervals <500 and >2,000 ms. Additionally, adjacent normal pulse–pulse (PPn) interval differences are automatically examined using the following formula: $(PPn - PPn - 1)2 < (40 \times \exp[120/PRave])2$, where PRave is the average pulse-rate calculated since the start of the recording. All LnRMSSD measures were supervised by an investigator. Heart rate variability data were automatically uploaded to a Web-based platform for analysis by the researcher.

*Training Load.* External training load was quantified using a 100-Hz triaxial accelerometer (Catapult Innovations, Melbourne, Australia). This device measures full-body acceleration in the sagittal, frontal, and vertical planes. Subjects wore the same device for each training session. Devices were fixed in place on their shoulder pads in a custom-built cartridge positioned between the scapulae. The training load parameter used for this study was total PlayerLoad. This parameter reflects total external workload including running, jumping, changes of direction, and body contacts (6). Moreover, PlayerLoad has been used previously to quantify injury-risk in college football players (39). After each practice session, training load data were downloaded to a laptop for analysis using accompanying software.

### Statistical Analyses

Data normality was confirmed using Shapiro-Wilks tests (all $p \geq 0.05$). A 1-way analysis of variance with Tukey honest significant difference post hoc analysis was used to compare Tuesday PlayerLoad values among positions. General linear mixed models were used to examine variation in the RHR

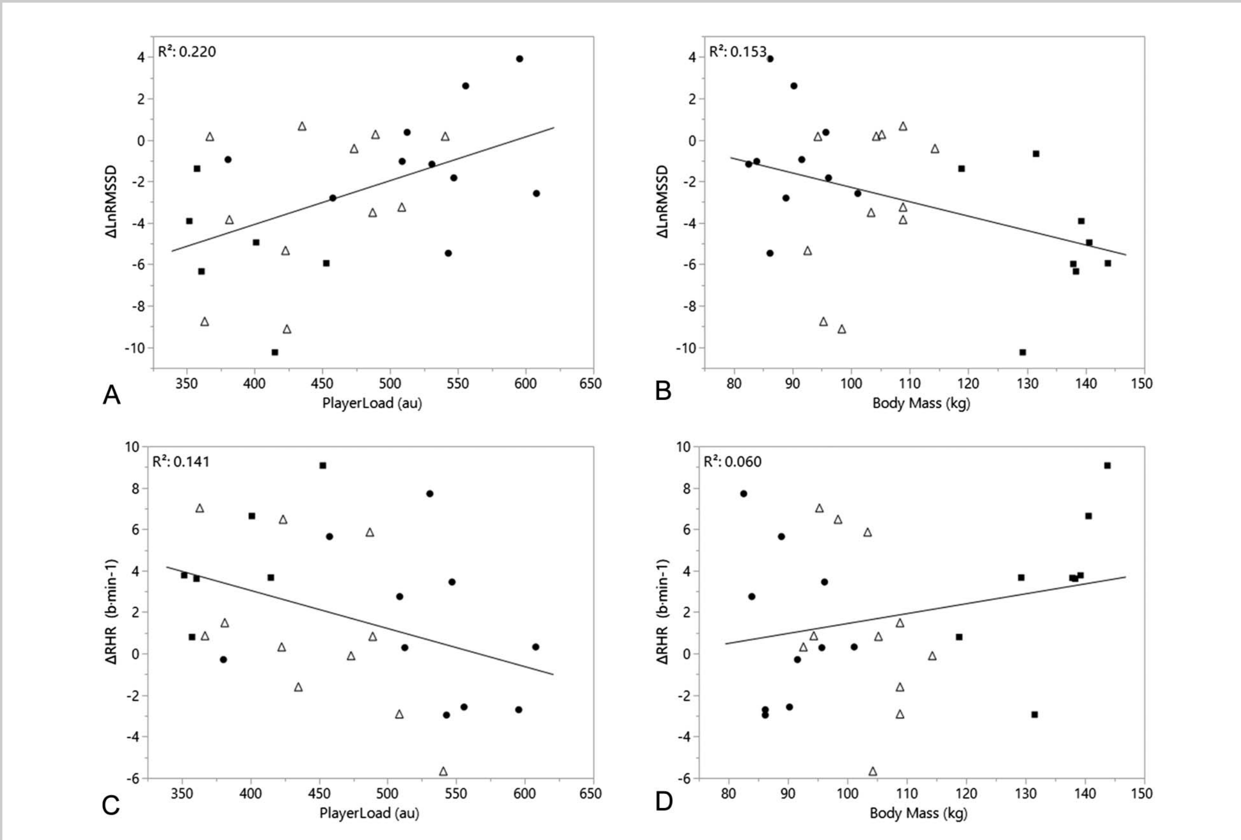


**Figure 2.** Scatter plots featuring relationships between the individually averaged daily change in the natural logarithm of the root mean square of successive differences multiplied by 20 (ΔLnRMSSD) and (A) PlayerLoad and (B) body mass and the relationship between the individually averaged daily change in resting the heart rate (ΔRHR) and (C) PlayerLoad and (D) body mass; Circles = SKILL; Triangles = MID-SKILL; Squares = LINEMEN.

and LnRMSSD among positions (i.e., SKILL, MID-SKILL, and LINEMEN) and between days. Position was included as a fixed main effect, time (Tuesday vs. Wednesday) as a fixed within-subjects repeated measure, the position × time interaction as a fixed main effect, and athlete identification as a random effect. Post hoc analyses were performed using Tukey honest significant difference comparisons. Cohen's *d* effect sizes (ES) (12) ± 90% confidence limits (CL) were calculated to explore the magnitude of the differences for cardiac-autonomic and PlayerLoad values. Effect sizes were interpreted qualitatively as follows: <0.2, trivial; 0.2–0.59, small; 0.6–1.19, moderate; 1.2–1.9, large; and >2.0, very large (25). The effect was deemed unclear if the CL crossed the threshold for both substantially positive (0.20) and negative (−0.20) values (1).

Change variables were calculated for the RHR (ΔRHR) and LnRMSSD (ΔLnRMSSD) by subtracting Tuesday values from Wednesday values and averaging changes intraindividually across the 3 time points. Relationships between ΔRHR and ΔLnRMSSD with body mass and PlayerLoad were quantified with Pearson correlations. The thresholds used for qualitative assessment of the correlations were: <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 (25). Statistical procedures were performed using JMP Pro 13 (SAS Institute, Inc., Cary, NC, USA) and Excel 2016 (Microsoft Corp., Redmond, WA, USA). Data are reported as mean ± *SD* unless noted otherwise. *p* values ≤0.05 were considered statistically significant.

## Results

PlayerLoad could not be obtained for 2 LINEMEN and thus $n = 27$ for PlayerLoad-related analyses. A significant effect was found for PlayerLoad among positions ($F_{2, 78} = 21.97$; $p < 0.0001$). PlayerLoad values for SKILL, MID-SKILL, and LINEMEN were 523.9 ± 76.9 arbitrary units, 444.7 ± 74.8 arbitrary units and 389.8 ± 47.0 arbitrary units, respectively. Post hoc analysis revealed that PlayerLoad for SKILL was significantly greater than MID-SKILL ($p < 0.0001$; ES ± 90% CL = 1.49 ± 0.44, *large*) and LINEMEN ($p < 0.0001$; ES ± 90% CL = 1.99 ± 0.47, *large*). Additionally, PlayerLoad for MID-SKILL was significantly greater than LINEMEN ($p = 0.026$; ES ± 90% CL = 0.83 ± 0.49, *moderate*).

A significant position × time interaction was observed for LnRMSSD (Table 1). Post hoc analysis revealed that

LnRMSSD on Tuesday was not significantly different from Wednesday for SKILL ($p = 0.346$; ES ± 90% CL = −0.10 ± 0.42, *unclear*). For MID-SKILL ($p \leq 0.05$; ES ± 90% CL = −0.32 ± 0.40, *small*) and LINEMEN ($p \leq 0.05$; ES ± 90% CL = −0.44 ± 48, *small*), LnRMSSD on Wednesday was significantly lower than Tuesday. Individually averaged LnRMSSD and RHR values (i.e., average of all Tuesday values and average of all Wednesday values for each subject) between groups and across days are displayed in Figure 1A, B, respectively. A significant main effect for LnRMSSD by day was also observed (Table 1a). Evaluated as all groups combined ($n = 29$), LnRMSSD on Tuesday was significantly greater than on Wednesday ($p \leq 0.05$; ES ± 90% CL = −0.28 ± 0.26, *small*).

There was no position × time interaction observed for the RHR (Table 1b). A significant main effect for the RHR by position was observed (Table 1b). The RHR for LINEMEN was significantly greater than SKILL ($p \leq 0.05$; ES ± 90% CL = 1.10 ± 0.49, *moderate*). A significant main effect for the RHR by day also was observed (Table 1b). Evaluated as all groups combined ($n = 29$), the RHR on Tuesday was significantly lower than on Wednesday ($p \leq 0.05$; ES ± 90% CL = 0.21 ± 0.25, *small*).

A significant positive relationship between ΔLnRMSSD and PlayerLoad ($n = 27$; $r = 0.464$, $p = 0.015$, *moderate*) was found, indicating that larger reductions in LnRMSSD occurred among those with lower PlayerLoad (Figure 2). A significant negative relationship between ΔLnRMSSD and body mass ($n = 29$; $r = -0.391$, $p = 0.036$, *moderate*) was found, indicating that larger reductions in LnRMSSD occurred among those with greater body mass (Figure 2). Relationships between ΔRHR and PlayerLoad ($n = 27$; $r = -0.351$, $p = 0.073$, *moderate*) and between ΔRHR and body mass ($n = 29$; $r = 0.244$, $p = 0.202$, *small*) were not statistically significant (Figure 2).

## Discussion

The purpose of this study was to determine whether cardiac-autonomic activity returns to resting values between consecutive-day in-season training sessions among college football players. A secondary aim was to quantify relationships between changes in cardiac-autonomic activity with body mass and external training load. The primary finding was that LnRMSSD on Tuesday was not meaningfully different from Wednesday for SKILL, but was significantly reduced for MID-SKILL and LINEMEN. Players with greater body mass and lower PlayerLoad tended to demonstrate greater reductions in LnRMSSD, although some individual variation was observed (Figure 1).

The position × time interaction observed in this study is consistent with a previous investigation in college football players that evaluated changes in LnRMSSD between consecutive-day training sessions during an off-season spring camp (19). However, the magnitudes of LnRMSSD changes for MID-SKILL and LINEMEN were smaller in the current study (ES = −0.32 and −0.44 for MID-SKILL and LINEMEN, respectively) relative to the spring camp (ES = −0.50 and −1.24 for MID-SKILL and LINEMEN, respectively) (19). The discrepancy in magnitude between off-season and in-season LnRMSSD responses may be partly explained by differences in training load values administered during spring camp versus the in-season. PlayerLoad values during the spring camp (623.7 ± 60.6 arbitrary units, 556.8 ± 53.6 arbitrary units and 450.0 ± 29.2 for SKILL, MID-SKILL, and LINEMEN, respectively) (19) were 15–22% higher (all *large* ES) than the current in-season PlayerLoad values (523.9 ± 76.9 arbitrary units, 444.7 ± 74.8 arbitrary units, and 389.8 ± 47.0 arbitrary units for SKILL, MID-SKILL, and LINEMEN, respectively). Increased load and intensity of training have been shown to cause greater reductions in vagally mediated HRV among a variety of athletes (35). Moreover, we speculate that adaptations from intensive preseason training in the heat (>30° C) and humidity (>50%) during the preceding weeks conditioned the athletes to better tolerate training sessions. For example, Yeargin et al. (40) reported that despite progressing from daily practices with no pads to practicing fully equipped twice per day during preseason camp in the heat, football players did not show progressive decrements in markers of hydration status (e.g., urine-specific gravity and osmolality), core temperature, or exercise heart rate, indicating heat acclimation. Additionally, preseason training in the heat has been shown to significantly increase plasma volume, vagally mediated HRV, and intermittent-running performance while decreasing the exercise heart rate (8,32) and reducing the magnitude of fluctuation in LnRMSSD in elite team-sport athletes (30). Increases in plasma volume support improved thermoregulation and stroke volume during exercise, reducing physiological strain (33). It has also been shown that intense preseason training facilitates "contact adaptation" in which football players display reduced creatine kinase concentrations during the competitive season relative to preseason (23). Thus, it is possible that lower PlayerLoad values and physiological adaptations (e.g., plasma volume expansion, improved thermoregulation, reduced cardiac strain, increased fitness, and contact adaptation) from intense preseason training in the heat facilitated improved cardiac-autonomic recovery between training sessions relative to responses observed during the off-season. However, further investigation is required to support these hypotheses.

In agreement with results from the spring camp (19), ΔLnRMSSD was significantly inversely associated with body mass, indicating that larger players tended to experience greater reductions in LnRMSSD despite having lower PlayerLoad values. A previous study in healthy adult men demonstrated significant relationships between skinfold thickness and acute (i.e., up to 30 minutes) cardiac-autonomic recovery after a graded maximal exercise test, independent of maximal oxygen uptake (16). Thus, excess fat mass characteristic of LINEMEN (4) may explain the observed relationship between ΔLnRMSSD and body mass. However, greater interindividual variation in LnRMSSD responses was observed in the current study relative to spring camp, weakening the strength of the correlation between ΔLnRMSSD and body mass from *large* to *moderate* (19). This may reflect the sensitivity of LnRMSSD to various factors and reinforces the need to monitor players individually. An important next step for future research would be to determine the association of LnRMSSD responses with specific markers of body composition (e.g., fat mass and fat-free mass) in football players.

The *moderate* relationship observed between ΔLnRMSSD and PlayerLoad is in agreement with results from the spring camp (19). We speculate that the aerobic fitness level may be the underlying variable influencing this association. This is based on the position-based differences in relative aerobic fitness among football players (34) coupled with results from a recent study demonstrating that collision-sport athletes who are more aerobically fit recover faster than less fit players, despite accumulating greater match-loads (26). In addition, it is well documented that individuals with higher aerobic fitness demonstrate accelerated parasympathetic reactivation after exercise (35) in addition to less overall fluctuation in their LnRMSSD trend (5,9,17).

Compared with the RHR, LnRMSSD demonstrated greater sensitivity to interposition training responses based on the nonsignificant position × time interaction observed for the RHR (Table 1). Moreover, compared with the RHR, LnRMSSD demonstrated stronger relationships with body mass and PlayerLoad. A previous study in collegiate team-sport athletes has also reported greater sensitivity of LnRMSSD compared with the RHR for reflecting responses and adaptation to training (18). This may be explained by the fact that LnRMSSD is reflective of cardiac-parasympathetic modulation, whereas the RHR is under both sympathetic and parasympathetic influence (10).

Collection of LnRMSSD data at the training facility is a limitation of the current study because of the heightened potential for "noise" that may confound resting measures. However, a series of repeated measures (i.e., 3 separate weeks) under standardized conditions were included in an attempt to account for this. In addition, more specific measures of body composition, hydration status, body temperature changes, and aerobic fitness level are needed to support our interpretations of the current findings. Furthermore, data were collected from the first month of the competitive season, which may not reflect responses that take place in later weeks, when a greater potential for accumulated stress and fatigue may exist. Thus, future research is needed to determine how LnRMSSD responses to training evolve over the course of the season. Because of the short-term nature of the current study (i.e., Tuesday vs. Wednesday LnRMSSD), it remains to be determined whether incomplete cardiac-parasympathetic recovery has any meaningful performance or health implications for football players. This requires investigation to assess whether LnRMSSD changes can be used to support training or recovery interventions.

## Practical Applications

Between-day recovery of cardiovascular homeostasis among football players during the first month of the competitive season is position-dependent and *moderately* related to both body mass and PlayerLoad. The LnRMSSD was more sensitive than the RHR for reflecting positional differences in response to football training. Despite greater workloads, SKILL exhibited no meaningful difference in LnRMSSD before the subsequent daily training session while LINEMEN and, to a slightly lesser extent, MID-SKILL displayed reduced LnRMSSD relative to resting values. This suggests that larger players may require greater recovery durations from training than smaller, more-fit players (e.g., SKILL). Therefore, it may be worthwhile for coaches and sports medicine practitioners to consider implementation of posttraining strategies that enhance cardiac-parasympathetic reactivation among larger players. Effective strategies may include prompt rehydration practices, efforts to reduce body temperature, and promoting adequate sleep quality and duration. Additionally, coaches should be mindful of the recovery differences among positional groups when planning training as larger players may not tolerate consecutive-day intensive training sessions and smaller players.

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