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Position-Specific Physical Workload Intensities in American Collegiate Football Training

ABSTRACT

Quantifying player training loads allows football coaching staff to make informed adjustments to the volume and intensity of training. Physical workload intensity in American football practices have not been extensively quantified. The current study examined physical workload intensities across positions in American collegiate football during training. Data from player tracking technology (Catapult Vector) were collected from 72 American football players (NCAA D-I) during in-season practices. Players were involved in individualized skill (indy), team playbook (team), and special team (ST) drills during practice and analyzed for their specialist offensive or defensive role (e.g., linebacker or wide receiver). Player running (i.e., high-speed running and sprint) and accelerations (i.e., high-intensity PlayerLoad™ and high-intensity inertial movement analysis) per minute were of interest. Drill type and practice day had significant effects on all workload intensity metrics ($p < 0.01$), but not position. Greater running intensities were seen in ST drills compared to other drill types. Tuesday practice sessions had greater overall intensities compared to other days. Interaction effect of position and drill type was significant ($p < 0.001$) for all intensity metrics, indicating that position groups exhibited unique workload responses to the drill types. Drill type and practice day interaction effect was significant for all intensity metrics ($p < 0.01$). The findings may be informative for coaches to tailor physical workloads of practice drills for positional roles in preparation for games and practices. Player tracking technology can add value for strength and conditioning coaches to adjust training programs based on position-specific on-field demands of players.

Keywords: inter-collegiate; microtechnology; external load; team sports; GPS; biomechanical load; accelerations

INTRODUCTION

American football is a highly dynamic sport, where players execute various amounts of high-speed running, changes of direction, tackles, and collisions (10,22). Within football, positional roles are highly specific with distinct physical demands that influence individual and team performance (9). To illustrate, the running back (RB) and wide receiver (WR) typically perform more non-contact running and cutting actions and cover greater high-speed distance than other positions (22). Offensive linemen (OL) and defensive linemen (DL) are typically more engaged in movements such as blocking or tackling (8,22,25). Defensive backs (DB), linebackers (LB), and tight ends (TE) execute a combination of high-speed running as well as blocking and tackling movements (22). Those positions are also known for their hybrid nature. Those football activities are generally short in duration (~3-7 s) executing at, or close to, maximal intensity (9). To prepare for those high-intensity game demands, players typically participate in individual and team playbook drills to mimic the high-speed running and collision demands of American football during practice (10,11).

In American football coaches prescribe drills during practice sessions to focus either on skill development or coordinated team play (8,24). Skill development is facilitated through individualized (indy) drills where players progress in deconstructed, position-specific maneuvers thought to enhance the individual performance of players and position groups (10,22). Team playbook (team) drills and special team (ST) drills are anecdotally most representative of games, as they are devoted to situational and tactical planning of offensive, defensive, or special team gameplay (22–24). Due to National Collegiate Athletic Association (NCAA) regulations on training time that allow student-athletes a specifically prescribed time on the field (i.e., 20 hours/week during the in-season period) (16), the coaches and strength and conditioning staff must balance indy and team coordination drills based on the needs of the team. That involves a periodized approach of manipulating acute training demands to emphasize position-specific skills, team coordination, or recovery aimed to improve on-field performance of players during games (19).

Periodization refers to the logical sequencing of varying volume-intensity training workloads to achieve peak performance and minimize the deleterious effects of fatigue (12,24). Running-based team sports have shown either a submaximal training workload during all training days between games via linear periodization (2,24) or a gradual decrease in training load on days closest to competitive matches via nonlinear periodization (5,6). Periodization studies in American football specifically have observed lower workloads in training sessions compared to games in combination with further decreases in loads of training sessions closest to games (22,24). Ward and colleagues (22) suggested that a thorough evaluation of within-practice training drills may be useful to highlight unique position-specific training demands.

Quantifying and monitoring training loads allow American football coaching staff to make informed decisions to adjust the volume and intensity of training (14). Previous studies have revealed positional differences in practices and games; for instance, nonlinemen (e.g., WR, RB, DB, and quarterbacks (QB)) perform greater amounts of running movements compared to linemen (e.g., OL, DL, and TE) during the pre-season period (8). Moreover, WR, DB, and LB experience more light-intensity impacts (5.0–6.0 g force) compared to other offensive and defensive positions during collegiate American football games (25). An evaluation of practice demands of National Football League (NFL) players revealed that variations in training intensity between positional groups can also be influenced by the periodization of training (22). Similarly, Wellman and colleagues (24) observed submaximal workloads during practices compared to games, as well as a gradual decrease in training load in sessions prior to competition (22). Periodization in American football has revealed variations in physical workload volume and intensity during within-week training sessions.

Due to the nature of the game, American football positions are subject to variations in physical workloads, both on the collegiate and national level. However, it is unknown how positional physical workloads are exerted on a collegiate level within-practices across the different days of the week. Therefore, the purpose of this study was to examine the differences in physical workload intensity of positions during training sessions in an elite NCAA Division I American football team. The current study tested four hypotheses. The first hypothesis was that higher workload intensities would be seen during indy drills compared to team-based or special team drills regardless of position and practice day. Second, it was hypothesized that the training workload intensity would decrease in sessions closest to games. The third hypothesis was that running-based positions (i.e., RB, WR, DB) would produce higher running workload intensities compared to linemen (i.e., OL, DL) and hybrid (i.e., TE, LB) positions regardless of drill type. The fourth hypothesis was that linemen and hybrid positions would exhibit higher acceleration intensities regardless of drill type or practice day.

METHODS

Experimental Approach to the Problem

A retrospective observational design was used to compare the physical workload intensities of collegiate American football players. On-field practice sessions were included in the analysis with the exception of the practice one day prior to the game, which was typically a walk-through practice. A total of 36 practices and 330 drills during the in-season period were analyzed. Physical workload intensity data were captured using the Global Positioning System (GPS), Local Positioning System (LPS), and accelerometer data from player tracking technology (Catapult Vector) of 72 players.

Subjects

NCAA Division I American football players from a single team were included in the study. The team competed in a Power Five conference. All players selected by the university's American football program were eligible to play at the collegiate level (n=140). From that group, 72 players were included for further analysis of their physical workload intensities in consultation with the coaching staff based on the expectation of playing time. Players were classified by their player positions: LB (n = 11), DB (n = 17), RB (n = 7), WR (n = 11), TE (n = 5), OL (n = 9) and DL (n = 12) (Table 1). All participants in the study were monitored during the 2019 NCAA Division I American football season. Players provided informed consent prior to participation in data collection via the Department of Athletics at the University. Data from all players were compiled into a data repository, and the Institutional Review Board at the University approved secondary data analyses.

Procedures

Practice Sessions. Each of the 72 subjects' positional physical workload data were collected from each practice session and game during the 12 weeks of the in-season period. Physical workload data were collected during the duration of each phase of the training sessions: warm-up, indy drills, ST drills, water breaks, and team drills. The coach-directed warm-up typically consisted of light-intensity movements and stretching. Indy drills involved players dividing into distinct positional groups. The activities performed in indy drills determined by the coaching staff included position-specific movements with and without the ball and varied throughout the week (8,22,24). During an ST and team drill, players would perform position-specific movements based on designated planning from coaching staff.

Player tracking Units. During team practice sessions, each of the 72 players wore a player tracking device (Vector; Catapult Innovations, Melbourne, Australia) in a custom pouch provided by the manufacturer. The pouch was attached to the athlete's shoulder pads and positioned between the scapulae of each player. The tracking device contained a global positioning system (GPS) and local positioning system (LPS) sensors (10 Hz), accelerometer (100 Hz), gyroscope (100 Hz), and magnetometer (100 Hz). To ensure intra-unit reliability (1,4,7,17), each athlete was assigned his own individual device for the season. The reliability and validity of these devices to capture player's physical workloads have been reported previously (13,15). Data collection was closely monitored during all practice sessions where drills were labeled, and outliers were flagged. After each session, data were downloaded into the manufacturer's software for further data processing (Catapult Sports Open Field software) and analyzed in R Studio (version 4.0.4; R Foundation for Statistical Computing, Vienna, Austria).

Measurements. There were two running and two acceleration workload intensity metrics of interest in the current study. The running intensity measures - high-speed running per minute (HSR/min) and sprint distance per minute (SD/min) were captured with GPS/LPS. High-speed running and sprint thresholds were defined as the distance covered above 12 mph and 15 mph, respectively (18). Further, the acceleration intensity measures - high PlayerLoad™ per minute (High PL/min) and high inertial movement analysis per minute (High IMA/min) were derived from the devices' accelerometer. PlayerLoad™ has been used previously to quantify biomechanical workloads in American football players. PlayerLoad™ is calculated as the total amount of acceleration taking place across three axes of movement (i.e., x, y, and z planes) (4,21). In the present study, high PL was a subset of PlayerLoad™ and included accelerations above 2 m/s^2 in arbitrary units (AU). Inertial Movement Analysis (IMA) used the accelerometer, gyroscope, and magnetometer data to determine athlete's micro-movements and changes of direction registered as a frequency (22). IMA has been reported to quantify non-running movements of American football players (25), such as collisions, tackles, and changes in direction. High-intensity IMA was a subset of total IMA and included number accelerations or decelerations greater than 3.5 m/s^2. Physical workload data collected by the devices were converted to an intensity metric by dividing the accumulated workload of each drill by the total duration of the recorded drill (indy: 13.5 ± 3.4 mins (mean ± standard deviation); ST: 7.8 ± 1.7 mins; team: 9.4 ± 3.4 mins). That calculation was completed for each player in each position in the dataset.

Study Design. The week of a collegiate American football season typically runs from Sunday to Saturday, with the game being played on Saturday. Sunday was a recovery day, Monday's session took place in the weight room, and on-field practice sessions ran from Tuesday through Friday for a total of 20 hours (16). The analysis included player workload data recorded during practices Tuesday through Thursday. Data from Friday practices were not included as Friday sessions featured light-intensity walkthroughs of team plays prior to Saturday games. Data was not recorded on Sunday as these days were used for recovery. For the purposes of this study, only indy, team, and ST drills from practices were analyzed, as those drills were performed at a high intensity and were used in preparation for competitive games. To isolate players actively participating in each drill, only players with active loads greater than 0 were included in the final dataset. Players that were not participating in certain practice drills due to injury were removed from further data analysis.

Statistical Analysis

The data were analyzed using linear mixed-effects models. For each measurement variable, position, drill type, and practice day were modeled as fixed effects with interactions between position and practice day and drill type and practice day. Subjects were modeled as random effects. The hypotheses were tested using an analysis of variance on the fixed effects and their interactions. For the fixed effects within each measurement variable, 95% confidence intervals were calculated for descriptive comparisons. Significance was established with a threshold value of $p < 0.05$. Data are presented as a mean ± 95% confidence interval.

RESULTS

Mean physical workload intensities are provided for position, drill type and practice day (Figure 1, Figure 2, Supplemental Tables). Significant main effects for drill type and practice day were found for all physical workload intensity metrics ($p < 0.001$, Table 2) but not for position. In addition, significant interaction effects of position and drill type ($p < 0.001$, Table 2), as well as drill type and practice day, were found for all intensity metrics ($p < 0.01$, Table 2).

Running Intensities

Significant main effects for drill type and practice day were found for HSR/min and SD/min (Figure 1; Supp. Table 1). HSR/min and SD/min of ST drills were higher than other drill types (Supp. Table 1). HSR/min and SD/min were highest on Tuesdays compared to other practice days (Supp. Table 1).

Significant interaction effects were observed between position and drill type for HSR/min and SD/min (Figure 1; Table 2: Supp. Table 2). DB and LB had greater high-speed running and sprint intensity in ST and team drills than indy drills (Supp. Table 2). RB had greater high-speed running intensity in indy and ST drills than team drills (Supp. Table 2). WR and TE had greater HSR/min and SD/min in indy drills than ST and team drills (Supp. Table 2).

In addition, a significant interaction effect was observed between drill and practice day in HSR/min and SD/min (Figure 1; Table 2, Supp. Table 3). HSR/min in indy drills was lower on Tuesday compared to Wednesday and Thursdays (Supp. Table 1). HSR/min was greater in ST and team drills on Tuesday compared to Wednesday and Thursday (Supp. Table 3). Similarly, SD/min in indy and team drills was lower on Tuesday compared to Wednesday and Thursday but was higher in ST drills on Tuesday compared to Wednesday and Thursday (Supp. Table 3).

[Insert Figure 1]

Acceleration Intensities

Significant main effects for drill type and practice day were found for high PL/min and high IMA/min (Figure 2; Table 2; Supp. Table 1). High PL/min and high IMA/min were found to be highest during indy drills compared to other drill types. High PL/min of ST drills was lower than team drills (Supp. Table 1). High PL/min was higher on Tuesdays and Thursdays compared to Wednesdays, while high IMA/min was higher on Tuesdays and Wednesdays compared to Thursdays (Supp. Table 1).

Significant interaction effects were revealed between positions and drill type for high PL/min and high IMA/min (Figure 2; Supp. Table 2). All positions had greater high PL/min during indy drills compared to other drill types (Figure 2; Supp. Table 2). All positions except RB and TE had lower high PL during ST drills compared to team drills (Figure 2; Supp. Table 2). DB, LB, RB, TE, WR had higher high IMA/min during indy compared to other drill types (Figure 2; Supp. Table 2).

Significant interaction effects were also revealed between drill type and practice day for high PL/min and high IMA/min (Table 2, Supp. Table 3). High PL/min during all drill types were lower on Wednesdays compared to Thursdays (Figure 2; Supp. Table 3). High IMA/min during special team and team drills was lower on Thursdays compared to Wednesdays (Figure 2; Supp. Table 3).

[Insert Figure 2]

DISCUSSION

The current study investigated differences in physical workload intensity across positions, practice drills, and practice days in an elite NCAA Division I American football team. The study demonstrated that workload intensity metrics were influenced by the interaction between position and drill type, indicating that distinct position groups exhibited their own unique workload responses for the different drill types. Additionally, workload intensity differed both between drill types and practice days independently. Specifically, greater running intensities were seen in special team drills compared to other drill types and Tuesday practice sessions had greater overall intensities compared to other training sessions. Further, the intensity metrics were influenced by the interaction between drill type and practice day as well. Ostensibly, this is the first study to report periodized within-week practice drill data to examine physical workload intensity metrics of an elite NCAA Division I American football team. These findings may have practical implications for highlighting unique demands of drills during practice and shifts in focus from running to acceleration movements throughout practice week.

Drill Type

The three drill types elicited similar workload intensity trends among the players when examining running and acceleration metrics. Where higher intensities were observed for high-speed running and sprinting during ST drills, accelerometer-based workload intensities were higher during indy drills compared to special team or team drills. Those findings aligned with previous observations that workload varies between drill types (8,24). Demartini et al. (8) suggested that individualized skill training conducted in smaller spaces–similar to that of the indy drills analyzed in the current study–may have allowed for increased repetitions, more rapid movements, and therefore higher accelerometer-based outcomes from all positions compared to the demands and environments of the other drill types. Higher accelerometer workload intensities of indy drills compared to other drill types allowed for the development of position-specific skills during practices where time allocation was limited. The findings of the current study highlighted the value of indy drills in developing position-specific skills during the in-season period where training was more focused on team coordination.

Notably, higher running intensities in ST drills were observed compared to other drill types, and accelerometer-based metrics were lowest during these ST drills. The findings of the current study support qualitative observations of ST drills and plays in American football. During ST plays, a team will kick the ball long distances downfield to the opposing team. That initiates a running sequence where players must run towards the opposing team to stop the ball from returning the ball. During those plays players engage mostly in running movements with fewer changes in direction or collisions compared to indy drills or team drills. These data highlight novel workload intensity demands of ST drills compared to other drill types.

Positional Differences

Under influence of different drill types, different positions had distinct intensity patterns in practice. Notably, the high-speed running and sprint intensities of WR and TE were highest during indy drills compared to ST and team drills. Similar observations were reported by Demartini and colleagues (8), who found that nonlinemen positions covered significantly greater high-speed distance than linemen during those position-specific drills. Further, the running intensity of TE during indy drills exceeded that of ST and team drills. Additionally, the running intensity of TE during indy drills was not found to be significantly different from running-based positions (DB and WR) during ST drills. During ST drills, DB and WR acted as defenders and ball-receivers on kicking plays requiring long distance running sequences. Although the primary role of a TE was to engage with OL, TEs occasionally served as secondary receivers during passing plays, requiring them to run downfield at high speeds and resulting in higher running intensities. That finding presented an opportunity for the coaching staff to make use of the potential high-speed and sprinting capabilities of TE in team drills.

When examining drill workload intensity among other running and hybrid positions, DB and LB positions had lower high-speed and sprint intensity during indy drills compared to ST and team drills. Additionally, DB and LB had higher high IMA during indy drills compared to ST and team drills. Together, these findings of DB and LB suggested a larger emphasis on accelerations instead of high-speed running during indy drills. Observationally, whereas DBs competed against

WRs in passing plays during team drills in the backfield, the LB engaged mostly with the RB or QB to halt offensive efforts by the opposing team. That increased running demand of DB and LB during team coordinated play (ST and team drills) warranted a shift in priority towards the development of high-speed running capabilities over movements requiring frequent accelerations during indy drills.

Examination of the workload metrics of RBs during each drill type revealed lower high-speed running intensity during team drills compared to indy and ST drills. That finding, combined with greater high IMA intensity of RB positions during indy and team drills compared to ST, further illustrated how the RB position is developed and utilized during practices. During a team drill involving a RB, the QB will hand off the football to the RB to run the ball through openings between linemen. During those plays, a RB often collided with linemen near the line of scrimmage demanding higher IMA efforts from the RB, which was exerted by quick changes of direction, a change in speed, or collisions with other players. Similar results were seen from impact profiles of RBs, revealing that RBs were exposed to the greatest number of severe impacts during games compared to other position groups (25). Those findings suggested that during indy drills, RB must develop skills to cope with a high degree of contact as well as high-speed running demands. The results of this study support previous findings of RB physical workloads and provide quantitative insight into the development of training protocols for the RB position.

The lineman positions are typically more engaged in collisions than in running activities (3,22). Findings of the current study support those differences in movement activities. Running intensities were consistently lower across all drill types compared to other positions, although these differences were not significantly different as a main effect. Whereas DL typically look for opportunities to sack the QB or intercept the ball, the primary role of the OL was to block the opposing DL and LB. That results in low running intensities for both lineman positions, but higher acceleration intensities. Especially, these higher intensities are pronounced in indy and team playbook drills, where they practiced collision-based movements against each other in an isolated and team setting, respectively. It is therefore important to monitor the biomechanical movement demands of linemen more so than the running intensities during practice.

Periodization

Workload intensities varied throughout the week with typically higher demands at the beginning of the week. More specifically, running intensities during ST and team drills were higher on Tuesdays compared to other practice days. In contrast, those intensities were lowest during indy drills on Tuesdays compared to other practice days. Those results suggested a shift from higher running intensity in players from ST drills in the beginning of the training week towards the execution of higher intensity running during indy drills in days closest to games. This may be an indication for more specialist work towards the end of the week and can be seen as periodization.

The results of the current study found high PL intensity to be significantly higher on Tuesdays and Thursdays than Wednesdays. That finding was contrary to observations in professional American football training programs (22) as well as soccer training (6,20), which found decreased volume and intensity of PlayerLoad™ in days preceding game day. The results of the current study may reflect the unique structure and demands of the NCAA American collegiate football system. Potentially, Tuesdays may have had increased high PL intensity outcomes compared to other days due to Tuesdays being the first on-field practice day of the week. Furthermore, the observed decrease in players' high PL intensity from Tuesday to Wednesday sessions may be of consequence from an overloading of physical workload intensity on Tuesdays.

The increase in overall workload intensity on Thursdays may have been prescribed intentionally by the coaching staff in anticipation of Fridays, which served as light-intensity walkthrough of team coordination plays before game day.

Strengths and Limitations

To our knowledge, the current study was the first to investigate periodized player workload intensities within distinct practice drills in an elite-level American football team. The current study used both running and acceleration intensity metrics to describe the physical demands of the seven most active position types. Additionally, this is the first study to highlight workload intensities of ST drills during in season practice sessions. Due to absolute workloads during American football practices already being widely researched (8,22,24), the current study focused solely on workload intensity metrics. As workload volume and intensity were interdependent, the relation of these metrics can be complex, but each has separate utility in informing positional demands. Volume indicates total workload during a period, whereas intensity suggests the relative difficulty of such period. Measuring both volume and intensity provide a more comprehensive knowledge of practice workloads, and it may therefore be prudent to include in the monitoring of player performance in practice.

The current study had several limitations. First, the physical workload intensities of QBs could not be analyzed because they were not equipped with player tracking technology. Future studies may consider monitoring QB workloads during practices to further tailor practice programs based on their physical loads. Second, the workload intensity demands of players with the most play time (starting players) were prioritized. That limits the generalizability of the results in the current study. Workload intensity results that include non-starters may provide a more holistic perspective of physical demands during practices. Finally, as the current study was restricted to practice intensities within players, future research should extend those methods to examine game intensities. Considering the within-week periodization of drill intensities observed here, analysis of these metrics within competition may better inform training prescription throughout the week and season.

PRACTICAL APPLICATIONS

This was the first study to report periodized within-week practice drill data of physical workload intensity metrics in an elite NCAA Division I American football team. The study provides novel insights using multiple physical workload metrics to quantify position-specific physical demands of American football players. For example, we found RBs showed greater emphasis on accelerations instead of running during indy and team drills. Further, results of this study showed greater running and acceleration efforts in DL compared to OL, suggesting a more aggressive role of the DL position. Additionally, the results show that GPS/LPS and accelerometer data can be used to highlight drill-specific workloads—i.e., high acceleration-based intensities during indy drills versus high-running based intensities during ST drills. The results of this study support the use of player tracking technology to quantify physical workload intensity beyond observations in everyday practices. American football coaching staff may use these data to tailor physical workload goals to the demands of certain drill types. Future studies may further explore physical workload intensity data from games as a baseline and tailoring workload intensities of drills during practices or off-season camps could help establish player readiness for competitive play. Further, periodized training loads could be used to track intensity of player activities during practices and games. From this, rehabilitation specialists could have a record of sudden changes in physical workload intensity that has been stated to lead to increased injury risk (11). Lastly, strength and conditioning staff may use these findings to evaluate the intensities of position groups rather than as distinct entities (i.e., DB/LB/RB during ST drills) given their similar workload demands. Creating position groups using physical workload data would enable them to create training programs that account for these similarities and improve the efficiency of training prescription and monitoring.

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TABLES AND FIGURES

Table 1. Descriptive characteristics (mean ± standard deviation) for each position including the number of players in each positional group.

Position	Height (cm)	Weight (kg)	n
DB	184.2 ± 3.4	87.7 ± 6.0	17
DL	192.3 ± 3.6	124.5 ± 9.4	11
LB	184.7 ± 2.0	105.9 ± 8.8	11
OL	194.3 ± 2.7	143.2 ± 16.4	8
RB	182.2 ± 4.6	95.1 ± 8.7	7
TE	195.1 ± 2.1	111.9 ± 5.7	5
WR	184.5 ± 5.4	90.3 ± 6.4	11

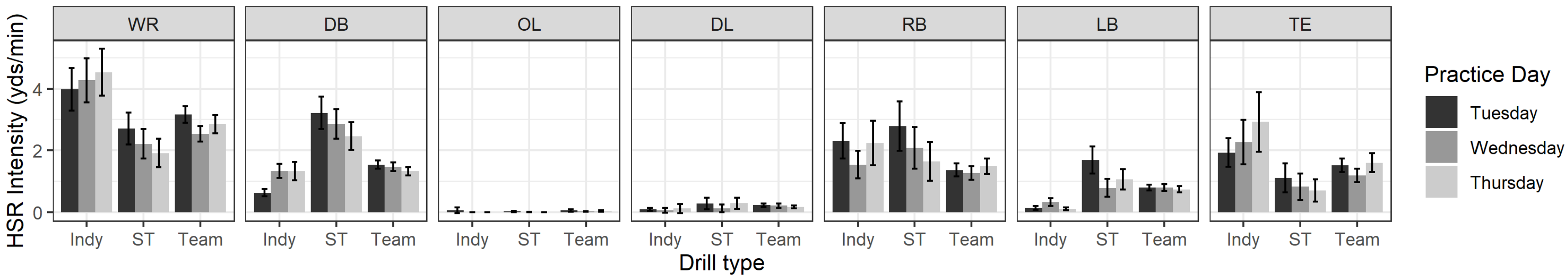
Table 2. Analysis of variance results for each measurement variable

Metric	Effect	N-DF	D-DF	F	p-value
HSR/min	Position	6	22628	0.334	0.919
	Drill	2	23674	18.147	**< 0.001**
	Day	2	23677	3	**< 0.05**
	Position*Drill	12	23674	42.293	**< 0.001**
	Drill*Day	4	23674	8.509	**< 0.001**
SD/min	Position	6	0	14.681	1
	Drill	2	23658	142.437	**< 0.001**
	Day	2	23624	7.494	**< 0.001**
	Position*Drill	12	23637	37.823	**< 0.001**
	Drill*Day	4	23630	13.992	**< 0.001**
High PL/min	Position	6	2	0.302	0.892
	Drill	2	23675	406.887	**< 0.001**
	Day	2	23676	37.676	**< 0.001**
	Position*Drill	12	23675	26.288	**< 0.001**
	Drill*Day	4	23675	16.034	**< 0.001**
High IMA/min	Position	6	2	0.946	0.595
	Drill	2	23677	154.555	**< 0.001**
	Day	2	23679	4.715	**< 0.01**
	Position*Drill	12	23677	11.235	**< 0.001**
	Drill*Day	4	23677	3.447	**< 0.01**

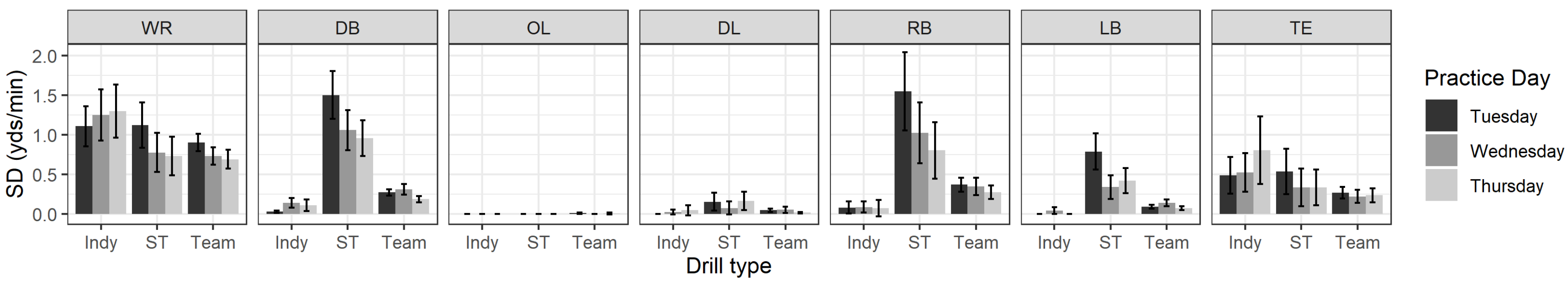
N-DF = Numerator degrees of freedom; D-DF = Denominator degrees of freedom; F = F-value; HSR/min = High-speed (>12 mph) running intensity; SD/min = sprint (>15 mph) intensity; High PL/min = high-intensity PlayerLoad™ intensity; High IMA/min = high-intensity inertial movement analysis intensity.

Figure 1. Mean (± 95% confidence interval) high-speed running intensity (A) and sprint intensity (B) of each position and drill type during each practice day

A)



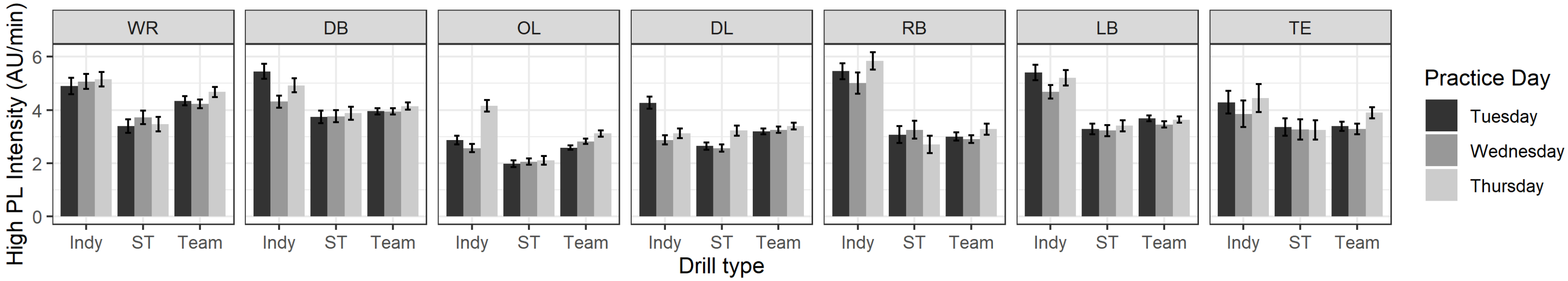
B)



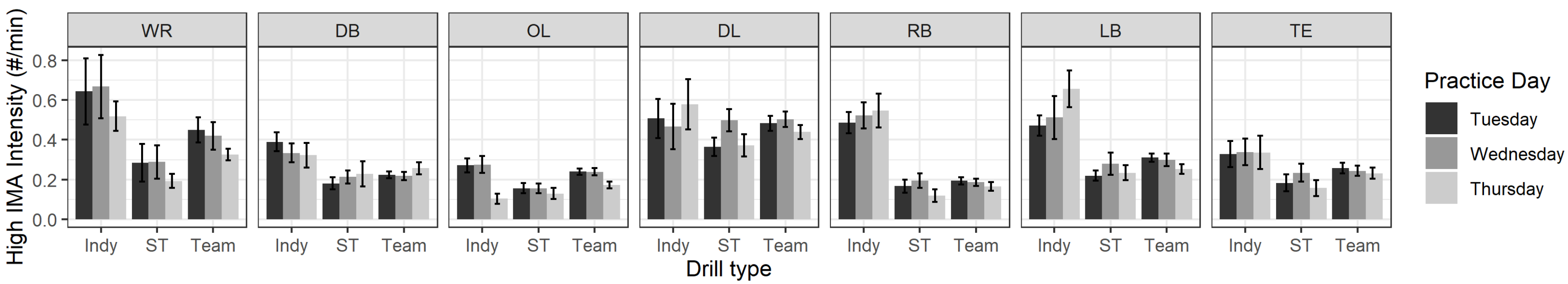
HSR/min = High-speed running intensity; SD/min = sprint intensity; Indy = Skill Development Drill; ST = Special Team; Team = Team play drill; DB = Defensive Back; DL = Defensive Linemen; LB = Linebacker; OL = Offensive Linemen; RB = Running Back; TE = Tight End; WR = Wide Receiver.

Figure 2. Average (±95% Confidence Interval) high-intensity PlayerLoad™ (A) and high intensity IMA intensity (B) of each position and drill type during each practice day.

A)



B)



High PL/min = High-intensity PlayerLoad™ intensity; High IMA/min = High-intensity inertial movement analysis intensity; Indy = Skill Development Drill; ST = Special Team; Team = Team play drill; DB = Defensive Back; DL = Defensive Linemen; LB = Linebacker; OL = Offensive Linemen; RB = Running Back; TE = Tight End; WR = Wide Receiver.

Supplemental Table 1. Average (± SD) workload intensity aggregated for drill type and day of the week (range of 95% CI below)

Main Effect Factor	High PL/min (AU/min)	High IMA/min (#/min)	HSR/min (yds/min)	SD/min (yds/min)
Indy	4.473 ± 1.734	0.447 ± 0.511	1.26 ± 2.389	0.253 ± 0.828
	4.401-4.545[b,c]	0.426-0.468[b,c]	1.161-1.359[b]	0.219-0.287[b]
ST	3.176 ± 2.185	0.245 ± 0.477	1.496 ± 4.086	0.644 ± 2.218
	3.123-3.229[a,c]	0.233-0.257[a,c]	1.396-1.596[a,c]	0.59-0.698[a,c]
Team	3.598 ± 2.000	0.303 ± 0.491	1.14 ± 2.34	0.244 ± 0.91
	3.566-3.63[a,b]	0.295-0.311[a,b]	1.103-1.177[b]	0.229-0.259[b]
Tuesday	3.541 ± 2.033	0.306 ± 0.487	1.374 ± 3.162	0.425 ± 1.575
	3.497-3.585[e,f]	0.296-0.316[f]	1.306-1.442[e,f]	0.391-0.459[e,f]
Wednesday	3.464 ± 2.075	0.315 ± 0.55	1.181 ± 2.905	0.337 ± 1.417
	3.42-3.508[d,f]	0.303-0.327[f]	1.12-1.242[d]	0.307-0.367[d]
Thursday	3.725 ± 2.033	0.277 ± 0.413	1.177 ± 2.636	0.287 ± 1.115
	3.677-3.773[d,e]	0.267-0.287[d,e]	1.114-1.24[d]	0.26-0.314[d]

Supp. Table 1: Superscripts indicate significance ($p < 0.05$), a = different from indy, b = different from ST, c = different from team; d = different from Tuesday; e = different from Wednesday; f = different from Thursday; Indy = skill development drill; ST = Special Team drill; team = Team playbook drill; High PL/min = high-intensity PlayerLoad™ intensity; High IMA/min = high-intensity inertial movement analysis intensity; HSR/min = high-speed running intensity; SD/min = sprint intensity; DB = defensive back; DL = defensive linemen; LB = linebacker; OL = offensive linemen; RB = running back; TE = tight end; WR = wide receiver.

Supplemental Table 2. Average (± SD) positional physical workload intensity for each position (range 95% CI below)

Position	Drill	High PL/min (AU/min)	High IMA/min (#/min)	HSR/min (yds/min)	SD/min (yds/min)
WR	Indy	5.027 ± 1.540	0.619 ± 0.794	4.230 ± 3.800	1.209 ± 1.601
		4.859-5.195[b,c]	0.533-0.705[b,c]	3.817-4.643[b,c]	1.035-1.383[b,c]
	ST	3.536 ± 2.358	0.262 ± 0.746	2.314 ± 4.514	0.891 ± 2.397
		3.386-3.686[a,c]	0.214-0.310[a,c]	2.026-2.602[a,c]	0.738-1.044[a,c]
	Team	4.397 ± 2.463	0.403 ± 0.832	2.842 ± 3.694	0.779 ± 1.560
		4.294-4.500[a,b]	0.368-0.438[a,b]	2.688-2.996[a,b]	0.714-0.844[a,b]
RB	Indy	5.389 ± 1.458	0.516 ± 0.271	1.994 ± 2.322	0.079 ± 0.329
		5.185-5.593[b,c]	0.478-0.554[b,c]	1.669-2.319[c]	0.033-0.125[b,c]
	ST	3.044 ± 2.291	0.165 ± 0.242	2.214 ± 5.064	1.154 ± 3.009
		2.856-3.232[a]	0.145-0.185[a]	1.797-2.631[c]	0.906-1.402[a,c]
	Team	3.043 ± 1.780	0.183 ± 0.206	1.361 ± 2.391	0.332 ± 1.063
		2.947-3.139[a]	0.172-0.194[a]	1.232-1.490[a,b]	0.275-0.389[a,b]
OL	Indy	3.115 ± 1.072	0.227 ± 0.023	0.019 ± 0.278	0 ± 0
		2.988-3.242[b,c]	0.204-0.250[b]	-0.014-0.052	0-0
	ST	2.042 ± 1.082	0.149 ± 0.213	0.006 ± 0.106	0 ± 0
		1.967-2.117[a,c]	0.134-0.164[a,c]	-0.001-0.013	0-0
	Team	2.822 ± 1.292	0.219 ± 0.218	0.031 ± 0.34	0.005 ± 0.109
		2.763-2.881[a,b]	0.209-0.229[b]	0.016-0.046	0-0.01
DL	Indy	3.452 ± 1.306	0.511 ± 0.634	0.082 ± 0.491	0.02 ± 0.199
		3.32-3.584[b,c]	0.447-0.575[b]	0.032-0.132[b,c]	0-0.04[b]
	ST	2.771 ± 1.513	0.416 ± 0.513	0.221 ± 1.572	0.125 ± 0.994
		2.681-2.861[a,c]	0.386-0.446[a,c]	0.128-0.314[a,c]	0.066-0.184[a,c]
	Team	3.275 ± 1.735	0.478 ± 0.561	0.201 ± 0.864	0.038 ± 0.424
		3.207-3.343[a,b]	0.456-0.500[b]	0.167-0.235[a,b]	0.022-0.054[b]

DB	Indy	4.894 ± 1.778	0.351 ± 0.338	1.072 ± 1.442	0.089 ± 0.34
		4.739-5.049[b,c]	0.322-0.380[a,c]	0.946-1.198[b,c]	0.059-0.119 [b,c]
	ST	3.783 ± 2.661	0.206 ± 0.460	2.875 ± 5.581	1.191 ± 3.065
		3.647-3.919[a,c]	0.182-0.230[a]	2.590-3.160[a,c]	1.034-1.348 [a,c]
	Team	4.005 ± 2.175	0.232 ± 0.400	1.448 ± 2.329	0.258 ± 0.925
		3.932-4.078[a,b]	0.219-0.245[a]	1.370-1.526[a,b]	0.227-0.289 [b,c]
LB	Indy	5.086 ± 1.632	0.536 ± 0.502	0.192 ± 0.514	0.015 ± 0.155
		4.922-5.250[b,c]	0.486-0.586[b,c]	0.140-0.244[b,c]	-0.001-0.031 [b,c]
	ST	3.296 ± 1.976	0.246 ± 0.418	1.183 ± 3.587	0.523 ± 1.83
		3.179-3.413[a,c]	0.221-0.271[a,c]	0.971-1.395[a,c]	0.415-0.631 [a,c]
	Team	3.583 ± 1.743	0.290 ± 0.391	0.772 ± 1.501	0.102 ± 0.492
		3.516-3.650[a,b]	0.275-0.305[a,b]	0.714-0.830[a,b]	0.083-0.121[a,b]
TE	Indy	4.172 ± 1.796	0.334 ± 0.264	2.316 ± 2.626	0.585 ± 1.087
		3.898-4.446[b,c]	0.294-0.374[b,c]	1.915-2.717[b,c]	0.419-0.751[c]
	ST	3.293 ± 2.304	0.195 ± 0.276	0.891 ± 2.810	0.408 ± 1.66
		3.087-3.499[a]	0.170-0.220[a,c]	0.639-1.143[a,c]	0.259-0.557
	Team	3.498 ± 1.924	0.245 ± 0.257	1.422 ± 2.434	0.241 ± 0.786
		3.385-3.611[a]	0.230-0.260[a,b]	1.279-1.565[a,b]	0.195-0.287 [a]

Supp Table 2: *Line 2: 95% confidence interval; Superscripts indicate significance ($p < 0.05$), a = different than Indy, b = different than ST, c = different than Team; Indy = Skill Development Drill; ST = Special Team; Team = Team play drill; High PL/min = high-intensity PlayerLoad™ intensity; high IMA/min = high-intensity inertial movement analysis intensity; HSR/min = high-speed running intensity; SD/min = sprint intensity; DB = Defensive Back; DL = Defensive Linemen; LB = Linebacker; OL = Offensive Linemen; RB = Running Back; TE = Tight End; WR = Wide Receiver.

Supplemental Table 3. Average (± SD) drill-dependent physical workload intensity for each practice day (±95% C.I. below)

Practice Day	Drill	High PL/min (AU/min)	High IMA/min (#/min)	HSR/min (yds/min)	SD/min (yds/min)
Tuesday	Indy	4.755 ± 1.797	0.450 ± 0.499	1.118 ± 2.239	0.213 ± 0.723
		4.632-4.878[e]	0.416-0.484	0.964-1.272	0.163-0.263
	ST	3.121 ± 2.206	0.230 ± 0.467	1.792 ± 4.634	0.842 ± 2.610
		3.032-3.210	0.211-0.249[e]	1.605-1.979[e,f]	0.736-0.948[e,f]
	Team	3.540 ± 1.943	0.317 ± 0.488	1.226 ± 2.347	0.270 ± 0.854
		3.487-3.593[f]	0.304-0.330[f]	1.162-1.29[e]	0.247-0.293[f]
Wednesday	Indy	4.057 ± 1.718	0.446 ± 0.564	1.299 ± 2.424	0.272 ± 0.882
		3.939-4.175[d,f]	0.407-0.485	1.133-1.465	0.211-0.333
	ST	3.170 ± 2.246	0.277 ± 0.518	1.372 ± 3.992	0.540 ± 2.109
		3.080-3.260	0.256-0.298[d,f]	1.211-1.533[d]	0.455-0.625[d]
	Team	3.503 ± 2.023	0.312 ± 0.559	1.080 ± 2.348	0.257 ± 1.049
		3.449-3.557[f]	0.297-0.327[f]	1.017-1.143[d]	0.229-0.285[f]
Thursday	Indy	4.655 ± 1.556	0.444 ± 0.448	1.399 ± 2.526	0.283 ± 0.882
		4.531-4.779[e]	0.408-0.480	1.197-1.601	0.212-0.354
	ST	3.257 ± 2.068	0.221 ± 0.426	1.265 ± 3.334	0.518 ± 1.714
		3.160-3.354	0.201-0.241[e]	1.108-1.422[d]	0.437-0.599[d]
	Team	3.783 ± 2.027	0.276 ± 0.397	1.113 ± 2.318	0.197 ± 0.783
		3.723-3.843[d,e]	0.264-0.288[d,e]	1.045-1.181	0.174-0.220[d,e]

Supp. Table 3: *Line 2: 95% confidence interval; Superscripts indicate significance ($p < 0.05$), d = different from Tuesday, e = different from Wednesday, f = different from Thursday; Indy = Skill Development Drill; ST = Special Team; Team = Team play drill; High PL/min = high-intensity PlayerLoad™ intensity; High IMA/min = high-intensity inertial movement analysis intensity; HSR/min = high-speed running intensity; SD/min = sprint intensity.