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PERCEIVED WELLNESS ASSOCIATED WITH PRACTICE AND COMPETITION IN NCAA DIVISION I FOOTBALL PLAYERS

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ABSTRACT

The present study assessed the influence of movement demands resulting from weekly practice sessions and games, on perceived wellness measurements taken post-game (Sunday) and 48 hours pre-game (Thursday) throughout the in-season period in National Collegiate Athletic Association (NCAA) division I football players. Thirty players were monitored using GPS receivers (Catapult Innovations OptimEye S5, Melbourne, Australia) during 12 games and 24 in-season practices. Movement variables included low-intensity distance, medium-intensity distance, high-intensity distance, sprint distance, total distance, player load, and acceleration and deceleration

distance. Perceived wellness, including fatigue, soreness, sleep quality and quantity, stress, and mood, was examined using a questionnaire on a 1-5 Likert scale. Multi-level mixed linear regressions determined the differential effects of movement metrics on perceived wellness. Post-hoc tests were conducted to evaluate the pair-wise differentials of movement and significance for wellness ratings. Notable findings included significantly ($p < 0.05$) less player load, low-intensity distance, medium-intensity distance, high-intensity distance, total distance, and acceleration and deceleration distance at all intensities, in those reporting more favorable (4-5) ratings of perceived fatigue and soreness on Sunday. Conversely, individuals reporting more favorable Sunday perceived stress ratings demonstrated significantly ($p < 0.05$) higher player load, low-intensity and medium-intensity distance, total distance, low-intensity and medium-intensity deceleration distance, and acceleration distance at all intensities than individuals reporting less favorable (1-2) perceived stress ratings. Data from the present study provide a novel investigation of perceived wellness associated with college football practice and competition. Results support the use of wellness questionnaires for monitoring perceived wellness in NCAA division I college football players.

Key Words: GPS, Monitoring, Questionnaire, American football

1

2 INTRODUCTION

3

4 American football is a full-contact team sport associated with intense physical demands,
5 characterized by frequent collisions and blunt force trauma associated with repeated
6 contact with opponents and the ground during blocking, tackling, and ball-carrying
7 activities, in addition to high-speed running and frequent accelerations, decelerations,
8 and change of direction specific impacts (29,33,34). Global positioning systems (GPS)
9 technology with integrated triaxial accelerometers (IA) have provided a means of
10 quantifying the physical demands of training and competition in NCAA division I football
11 (33,34) and similar contact team sport (9,23). Recent studies (33,34) have provided
12 novel insight into the positional movement demands associated with NCAA division I
13 football, including the quantification of sprint distances and high-intensity accelerations
14 and decelerations, and the frequency and intensity of positional impacts and rapid
15 changes of direction associated with competition.

16

17 The intense nature of competition in NCAA division I football necessitates the prudent
18 programming of in-season practice loads that maintain position-specific physical
19 demands and minimize excessive fatigue that may be associated with maladaptation
20 and underperformance. Consequently, the judicious monitoring of the individual
21 physiological and psychological response, commonly referred to as internal load, to
22 exercise loads encountered in practice and competition is vital for maximizing

23 competitive performance (1,12). Investigations in contact team sport, including
24 American football, have examined potential measures of an athlete's internal load,
25 including subjective or perceived wellness, and biochemical and neuromuscular
26 responses to training and competition (8,20,32), however ambiguity exists as to which
27 methods are most pertinent (12).

28

29 Perceived measures of wellness are efficient, inexpensive and non-invasive to the
30 athlete (18). Additionally, wellness measures have demonstrated sensitivity to training
31 stress, exhibiting a dose-response relationship with exercise load (28), and may be
32 more efficacious than objective measures in identifying internal load (28). While
33 subjective measures have demonstrated accuracy in assessing athletes' internal
34 response to training and competition loads, the comprehensive nature of some forms
35 presents substantial logistical challenges in many applied settings (31). A survey of the
36 current trends in fatigue monitoring among high-performance sport revealed 84% of the
37 respondents used subjective questionnaires, 80% of which utilized custom designed
38 forms consisting of 4-12 items (30). Based upon current practices and previous
39 recommendations for athlete monitoring (14), the implementation of brief, customized
40 questionnaires to quantify the internal response of individuals participating in team-
41 sports is supported.

42

43

44

45 Previous research (8,33) has provided an increased understanding of the positional
46 movement demands and the time-course of perceived recovery resulting from practice
47 and competition NCAA division I football players. Currently, the impact of GPS-derived
48 movement variables associated with practice and game demands on perceived
49 wellness during the in-season competitive period remain ambiguous. A more
50 comprehensive understanding of the perceived psychological response to the
51 movement demands of practice and competition, will provide performance staff a model
52 from which to plan post-game recovery modalities and program subsequent training
53 sessions. Further, evaluating the impact of weekly in-season practice loads on
54 perceived wellness will provide novel insight for coaches seeking to manage the
55 deleterious effects of fatigue and optimize subsequent game-day performance.

56

57 The aims of the present study were to (a) assess post-game (Sunday) recovery to
58 determine which GPS-derived game day variables influence post-game perceived
59 wellness in NCAA division I football players (b) to determine which GPS-derived
60 movement variables accumulated during in-season weekly practice sessions influence
61 perceived wellness two days prior to NCAA division I football games (Thursday). We
62 hypothesized that there will be significant differences in GPS-derived movement
63 variables in NCAA division I football players who reported differential ratings of
64 perceived wellness on both Sunday and Thursday.

65

66

67 **METHODS**

68

69 **EXPERIMENTAL APPROACH TO THE PROBLEM**

70

71 Two statistical models were utilized to accomplish the aims of the present study. A
72 'Sunday' model examined GPS and IA derived workloads resulting from Saturday
73 games and the subsequent perceived wellness on Sunday. The 'Thursday model'
74 examined the impact of GPS and IA derived workloads accumulated Tuesday and
75 Wednesday, on Thursday perceived wellness. Researchers examined GPS and IA
76 technology data collected from players during 24 regular season practices and 12
77 competitions completed throughout the in-season period of an NCAA division I football
78 season. Data in the present study were grouped at the individual level and included the
79 following positional observations: Wide Receiver (WR): 100 (52 Sunday, 42 Thursday),
80 Offensive Linemen (OL): 98 (51 Sunday, 47 Thursday), Running Back (RB): 70 (36
81 Sunday, 34 Thursday), Quarterback (QB): 24 (12 Sunday, 12 Thursday), Tight End
82 (TE): 69 (36 Sunday, 33 Thursday), Defensive Tackle (DT): 48 (26 Sunday, 22
83 Thursday), Defensive End (DE): 50 (26 Sunday, 24 Thursday), Linebacker (LB): 85 (39
84 Sunday, 46 Thursday), and Defensive Back (DB): 112 (54 Sunday, 58 Thursday).

85

86 To assess perceived wellness associated with in-season practice and competition, a
87 custom-designed questionnaire (Figure 1) was completed by participants every day
88 following a game (Sunday), as well as Thursday morning prior to any physical activity.

89 A total of 656 observations (332 Sunday and 324 Thursday) were included in the
90 present examination. For the purposes of examining perceived wellness associated
91 with games, only GPS and IA data where a survey was completed the following day
92 were included in the analysis. To determine the impact of in-season weekly practice
93 sessions on subjective markers of perceived wellness on Thursday, only movement
94 data where an individual completed a survey on Thursday and participated in Tuesday
95 and Wednesday practice sessions, were included for analysis.

96

97 **SUBJECTS**

98

99 Thirty NCAA Division I Football Bowl Subdivision (FBS) football players (age 20.5 ± 1.1
100 years; age range 18.6 – 22.9; height 187.8 ± 6.2 cm; and mass 107.4 ± 18.6 kg)
101 participated in the present study. All subjects were collegiate athletes whom had been
102 selected to participate in the football program prior to the commencement of the study.
103 All participants in the present study completed an 8-week summer off-season physical
104 development training program that included a full-body strength and power training
105 program and specific skills and conditioning sessions designed to simulate the demands
106 of NCAA division I college football practice. The present study comprises the statistical
107 analysis of data collected as part of the day to day student athlete monitoring and
108 testing procedures within the university's football program. Ethical approval was
109 obtained from the university's Institutional Review Board and all subjects signed an
110 institutionally approved informed consent document prior to participating in the study.

111

112 **PROCEDURES**

113

114 *Global Positioning System Units.* Positional movement data were collected from 24 in-
115 season practice sessions and 12 games using commercially available microtechnology
116 units (OptimEye S5; Catapult Innovations, Melbourne, Australia) operating at a
117 frequency of 10 Hz . The units included a triaxial accelerometer (IA) which operated at
118 100 Hz and assessed the frequency and magnitude of full-body acceleration (m-second²)
119 ²) in three dimensions, namely, anterior-posterior, mediolateral, and vertical (16,22).
120 Prior to the commencement of each practice and game, GPS receivers were placed
121 outside for 15 minutes to acquire a satellite signal, after which, receivers were placed in
122 a custom designed pocket attached to the shoulder pads of the subjects. Shoulder
123 pads were custom-fit for each individual, thereby minimizing movement of the pads
124 during practice and competition. The GPS and IA receivers used in the present study
125 were positioned in the center of the upper back, slightly superior to the scapulae.
126 Subjects were outfitted with the same GPS receiver for each practice and game.
127 Following the completion of practices and games, GPS receivers were removed from
128 the shoulder pads, and subsequently downloaded to a computer for analysis utilizing
129 commercially available software (Catapult Sprint 5.1, Catapult Innovations, Melbourne,
130 Australia). Combined tri-axial accelerometer data were represented as PlayerLoadTM
131 (PL), which is a modified vector magnitude expressed as the square root of the sum of
132 the squared instantaneous rates of change in acceleration in each of the three planes
133 and divided by 100 (3). Boyd and colleagues (3) have demonstrated the laboratory

134 intra-unit (0.91-1.05 % coefficient of variation [CV]) and inter-unit (1.02-1.10 % CV)
135 reliability of PL and determined its inter-unit reliability in Australian Rules Football
136 matches (1.90% CV). Findings from other team sports including basketball, netball, and
137 Australian football have demonstrated the ability of accelerometer derived PL to
138 differentiate between competitive games, scrimmage games, practice drills, positional
139 demands, and levels of competition (2,5,24). Improvements in technology and sampling
140 methodologies have increased the accuracy of data recorded via portable GPS for
141 applied research purposes (15), and have provided a valid and reliable means of
142 assessing activity profiles in team sports (6). Previous research (6) has demonstrated
143 the validity of GPS, with GPS-derived distance measures within 5% of a criterion
144 distance, and intra-unit reliability of distance measures, within 4.5 m (90% CI: 3.5-6.6 m)
145 (6). Additionally, IA have demonstrated reliability (3) as a means of measuring physical
146 activity across multiple players in team sports, with strong inter-unit relationships
147 ($r=0.996-0.999$) demonstrated during high-intensity contact team sport activity.

148

149 *Movement Classification System.* Movement profile classifications have been described
150 for game analysis in American football (33) and similar contact team sports (21). The
151 classification profile utilized in the present study was selected by the researchers to
152 more accurately reflect the demands of American football (33). Each movement
153 classification was coded as one of four speeds of locomotion. Low-intensity
154 movements, such as standing, walking and jogging, were considered to be 0 – 12.9
155 $\text{km}\cdot\text{h}^{-1}$, medium-intensity movements, such as striding and running, were considered to
156 be 13.0 – 19.3 $\text{km}\cdot\text{h}^{-1}$, high-intensity movements, such as fast running for some

157 positional groups, and sprinting for others, were classified as $19.4 - 25.8 \text{ km}\cdot\text{h}^{-1}$, and
158 sprinting movements were classified as exceeding $25.8 \text{ km}\cdot\text{h}^{-1}$. Short duration high-
159 intensity movements, or measures of acceleration and deceleration, were classified as
160 four groups, specifically low-intensity ($0 - 1.0 \text{ m}\cdot\text{s}^{-2}$), medium-intensity ($1.1 - 2.0 \text{ m}\cdot\text{s}^{-2}$),
161 high-intensity ($2.1 - 3.0 \text{ m}\cdot\text{s}^{-2}$), and maximal-intensity ($> 3.0 \text{ m}\cdot\text{s}^{-2}$).

162

163 *Perceived Wellness.* Players were instructed to complete a customized self-report
164 wellness questionnaire utilizing a commercially available web-based application
165 (CoachMePlus, Buffalo, NY) on their smartphone device, every Sunday and Thursday
166 throughout the in-season period. No physical activity took place on Sundays, however
167 players were required to participate in medical evaluations, and were instructed to
168 complete the questionnaire prior to the commencement of the evaluations. On
169 Thursdays, players were instructed to complete questionnaires prior to the morning
170 training session. The custom designed wellness questionnaire, based upon earlier
171 recommendations by Hooper et. al. (14) and previous implementation in Rugby League
172 (20) evaluated six subscales, including fatigue, soreness, stress, sleep quality, sleep
173 quantity, and mood, on a 1-5 Likert scale (Figure 1). Players were instructed to respond
174 as to how they were currently feeling.

175

176

177

178

179 **STATISTICAL ANALYSES**

180

181 The perceived wellness ratings and movement metrics selected for categorization in the
182 present study, were used to perform two statistical models to achieve the two main
183 aims. All models were assessed using movement metrics as the outcome variable.

184

185 *Sunday Model:* A series of multi-level mixed linear regressions were used to determine
186 the differential effect of specific game day movement metrics on perceived wellness
187 ratings the following day (Sunday). Categorical outcomes were used to determine less
188 favorable responses (1 and 2), neutral responses (3), and more favorable (4 and 5)
189 responses to account for the possibility of non-linear relationships with varying
190 outcomes. Each movement metric was associated with wellness ratings in each of the
191 six subscales. Following the regression analyses, post-hoc tests were conducted to
192 evaluate the pair-wise differentials of movement and their significance for each wellness
193 rating (Tables 1-2). Significance in all tests was measured at three levels; $p < 0.001$,
194 $p < 0.01$, and $p < 0.05$. Adjusted predictions at the means were reported with their
195 respective 95% confidence intervals. All statistical analyses were performed using
196 Stata Statistical/Data Analysis Software (Stata 14 for Windows, version 14.1; StataCorp,
197 College Station, TX, USA).

198

199

200 *Thursday Model:* A series of multi-level mixed linear regressions were used to
201 determine the differential cumulative effects of specific movement metrics associated
202 with Tuesday and Wednesday practice sessions on Thursday perceived wellness.
203 Categorical outcomes were used to determine less favorable responses (1 and 2),
204 neutral responses (3), and more favorable (4 and 5) responses to account for the
205 possibility of non-linear relationships with varying outcomes. Each movement metric
206 was used to examine the relationship between an individual's Thursday perceived
207 wellness rating relative to their Sunday perceived wellness rating. Following the
208 regression analyses, post-hoc tests were conducted to evaluate the pair-wise
209 differentials of each movement metric and its significance for each individual's Thursday
210 wellness rating compared to Sunday (Tables 3-6). Significance in all tests was
211 measured at three levels; $p < 0.001$, $p < 0.01$, and $p < 0.05$. Adjusted predictions at the
212 means are reported with their respective 95% confidence intervals. All statistical
213 analyses were performed using Stata Statistical/Data Analysis Software (Stata 14 for
214 Windows, version 14.1; StataCorp, College Station, TX, USA).

215

216 **RESULTS**

217

218 *Sunday Perceived Wellness:* Significant ($p < 0.05$) differences in PL, low-, medium-, high-
219 intensity distance and total distance, including acceleration and deceleration distance at
220 all intensities resulting from competitive games on the preceding day, were
221 demonstrated in players who rated their level of fatigue and soreness a 1 or 2,

222 compared to those who rated it a 3, and those who rated it a 4 or 5. Significant ($p < 0.05$)
223 differences in sprint distance were also demonstrated in those who rated fatigue a 4 or
224 5 compared to those who rated fatigue a 1 or 2 (Table 1).

225
226 Individuals who reported a 3, 4, or 5 for perceived stress the day following competition
227 demonstrated significantly ($p < 0.05$) greater PL, low-, medium-intensity, and total
228 distance, low- and medium-intensity deceleration distance, and medium- and high-
229 intensity-acceleration distance than those who rated perceived stress a 1 or 2 (Table 2).

230
231 The only significant ($p < 0.05$) findings for the subscale of sleep quality were for maximal-
232 intensity deceleration distance between those whose ratings were a 1 or 2 vs a 3, and
233 those who rated sleep quality a 1 or 2 vs. a 4 or 5 (Table 2). No significant differences
234 in movement variables were demonstrated for subscales of mood and sleep quantity.

235
236 ***Insert Tables 1 and 2 here***

237
238 *Thursday Perceived Wellness:* Individuals who rated their perceived fatigue a 4 or 5 on
239 both Sunday and Thursday accumulated significantly ($p < 0.05$) less high-intensity
240 deceleration and maximal-intensity acceleration distance on Tuesday and Wednesday
241 practices than those who rated fatigue a 1 or 2 on Sunday and improved to a 3 on

242 Thursday, and those who reported a 1, 2, or 3 on Sunday and improved to 4 or 5 on
243 Thursday (Table 3).

244

245 When comparing players whose rating of perceived soreness improved from Sunday to
246 Thursday, those who rated soreness a 4 or 5 on Thursday, accumulated significantly
247 ($p<0.05$) more PL on Tuesday and Wednesday than those who rated soreness a 3 on
248 Thursday. Individuals whose perceived soreness was a 3 on Thursday and the same or
249 higher score on Sunday achieved significantly ($p<0.05$) less PL than those whose
250 perceived rating of soreness was a 3 on Thursday but lower (1 or 2) on Sunday.

251 Players who rated soreness a 4 or 5 on both Sunday and Thursday had significantly
252 ($p<0.05$) higher cumulative PL resulting from Tuesday and Wednesday practices than
253 those who rated soreness a 4 or 5 on Thursday and a 1, 2, or 3 on Sunday.

254 Significantly ($p<0.05$) more total-, maximal- and high-intensity acceleration and
255 deceleration distance was accumulated on Tuesday and Wednesday by those who
256 rated soreness a 4 or 5 on both Sunday and Thursday, compared to those whose rating
257 was a 3 on Thursday and the same or higher on Sunday (Table 4).

258

259 Players who rated perceived stress a 4 or 5 on both Sunday and Thursday accumulated
260 significantly ($p<0.05$) greater PL, total-, sprint- and maximal-acceleration and
261 deceleration distance on Tuesday and Wednesday than those who rated stress a 1, 2,
262 or 3 on Sunday and improved to a 4 or 5 on Thursday, and those who rated stress a 3,
263 4, or 5 on Sunday and increased to a 3 on Thursday. Individuals who rated perceived

264 stress a 4 or 5 on both Sunday and Thursday achieved significantly ($p<0.05$) less total
265 distance on Tuesday and Wednesday than those whose perceived stress was a 1 or 2
266 on Thursday and the same or higher on Sunday (Table 5). Players who rated sleep
267 quality a 4 or 5 on both Sunday and Thursday accrued significantly ($p<0.05$) more sprint
268 distance on Tuesday and Wednesday practice sessions than those who rated sleep
269 quality a 3 on Thursday and a 1 or 2 on Sunday (Table 6).

270

271 ***Insert Tables 3-6 here***

272

273 **DISCUSSION**

274

275 The aims of the present study were to assess recovery, utilizing a custom
276 questionnaire, to determine which GPS-derived game-day variables influenced
277 perceived wellness the following day, and to determine the impact of in-season weekly
278 practice sessions on subjective markers of perceived wellness two days prior to games.
279 The results of the present study contribute novel insight into the perceived wellness
280 associated with practice and competitive loads experienced by NCAA division I college
281 football players throughout in-season period and the implementation of wellness
282 questionnaires within an applied, high-performance setting. The results confirm our
283 hypothesis that differences in perceived wellness were associated with significant
284 differences in individual movement characteristics attributed to practice and competition.
285 The most notable findings were significantly ($p<0.05$) less PL, low-intensity, medium-

286 intensity, high-intensity, and total distance, and acceleration and deceleration distance
287 at all intensities, associated with competition, in those with more favorable ratings of
288 perceived fatigue and soreness the day following games. Additionally, individuals who
289 reported more favorable perceived stress the day following competition demonstrated
290 significantly ($p < 0.05$) greater PL, low-intensity, medium-intensity, and total distance,
291 low-intensity and medium-intensity deceleration distance, and acceleration distance at
292 all intensities than individuals who reported the least favorable ratings of perceived
293 stress. Data from the present study provide an increased understanding of the impact
294 of specific game-day movement variables on post-game perceptual wellness, and
295 support the implementation of a perceived wellness questionnaire to quantify perceptual
296 recovery following NCAA division I football games.

297
298 Individuals who accrued significantly ($p < 0.05$) less PL, running distance at all intensities,
299 and deceleration and acceleration distance at all intensities during NCAA division I
300 football games, reported more favorable ratings of perceived fatigue the day following
301 the game. Similar findings with respect to perceived soreness the day following games
302 were demonstrated by significantly ($p < 0.05$) less PL, running distance at all intensities,
303 except for sprint distance, and acceleration and deceleration at all intensities in
304 individuals who reported more favorable ratings. Individuals who reported more
305 favorable perceived stress responses the day following games demonstrated
306 significantly ($p < 0.05$) greater movement demands associated with competition than
307 those who rated perceived stress less favorably. The results of the present study
308 suggest that increased movement demands resulting from competition may be directly

309 associated with a less favorable perceived fatigue and soreness response the day
310 following games. The perceived stress response appears to differ from both the fatigue
311 and soreness response, resulting in more favorable perceived stress responses
312 associated with increased movement demands. These data illustrate that movement
313 characteristics associated with NCAA division I football games reflect individual
314 perceptions of fatigue, soreness, and stress, and support the integration of perceived
315 wellness measures as part of a comprehensive athlete monitoring program.

316

317 The high-intensity movement demands, and the frequency and intensity of positional
318 impacts and rapid changes of direction that characterize participation in NCAA division I
319 football games have been reported, are associated with substantial physical demands,
320 and may contribute to increased fatigue and soreness following games (33,34).

321 Comparing the results of the present study with previous examinations is problematic
322 due to the paucity of similar investigations in NCAA division I football. An examination
323 by Fullagar et.al. (8) of the time course of perceptual recovery following NCAA division I
324 football games demonstrated less favorable ratings of perceived soreness and overall
325 wellness that persisted for up to four days following competition. While the results of
326 Fullagar et. al. (8) shed new light on perceptions of wellness associated with NCAA
327 division I football seasons, it did not examine perceived wellness the day following
328 competition or quantify the game day movement demands associated with the wellness
329 response.

330

331 Similar findings of increased perceived soreness and fatigue one day following contact
332 team-sport competition have been demonstrated by researchers (20,32) who utilized a
333 questionnaire similar to the one in the present study, and reported significant ($p < 0.01$)
334 increases in fatigue and soreness ratings one day following Rugby League competition,
335 when compared to pre-competition values. The scope of these studies, however, did
336 not include the utilization of microtechnology to assess competitive movement demands
337 to determine which GPS-derived movement variables may influence the differential
338 ratings of perceived wellness the following day. While fatigue and soreness following
339 intense team-sport competition may be expected, the present study represents a novel
340 investigation into which GPS-derived gameday movement variables influence perceived
341 wellness the following day. As part of a judicious athlete monitoring program, the
342 objective quantification of external loads associated with practice and competition,
343 alongside a subjective quantification of the athlete's physiological and psychological
344 response to these loads, appears prudent (12). Clear guidelines on the modification of
345 training loads in response to unfavorable perceptual responses do not exist (17), and as
346 such performance coaches should judiciously monitor the perceptual responses of
347 athletes following competition and take appropriate measures including the
348 implementation of recovery protocols and the modification of subsequent practice
349 session when deemed prudent.

350

351 In the present study, several GPS-derived variables were able to differentiate
352 individuals whose rating of perceptual stress was a 4 or 5 vs. a 1 or 2, and those who
353 rated stress a 3 vs. a 1 or 2. Data indicated more favorable perceived stress responses

354 with increases in game-day exercise demands. These findings are in agreement with
355 the results reported by Hartwig et. al. (13) which demonstrated an inverse relationship
356 between training volumes and perceptual stress ratings in Rugby Union players during
357 the in-season period, but are in contrast with pre-season research (4) in Australian rules
358 football which demonstrated a negative effect of increased training loads on perceived
359 stress ratings the following day. These data may indicate a directional relationship
360 between the perceptual stress response and movement demands associated with
361 intensified pre-season training camps in contact team-sport athletes, and an inverse
362 relationship for competitive games, perhaps due to psychological factors unaccounted
363 for, including self-satisfaction (13). In division I college football players, both physical
364 and psychological stress have been associated with injury occurrence (19,25), and
365 consequently, the inclusion of the stress subscale as part of the athlete wellness
366 monitoring program may be advantageous in decreasing the likelihood of maladaptation
367 resulting from all sources of stress accompanying participation in division I college
368 football.

369

370 The present study also investigated perceptual wellness two days prior to games to
371 evaluate the time-course of perceived recovery and to assess the impact of in-season
372 weekly practice sessions on subjective markers of perceived wellness preceding
373 competition. While several significant unidirectional relationships were demonstrated
374 between GPS-derived movement demands of competition and perceived fatigue on
375 Sunday, similar significant unidirectional relationships were not established when
376 examining the impact of Tuesday and Wednesday practice sessions on Thursday

377 perceived fatigue. Individuals who accumulated significantly ($p<0.05$) greater medium-
378 intensity and high-intensity deceleration and medium-intensity and maximal-intensity
379 acceleration distance on Tuesday and Wednesday practice sessions experienced an
380 improvement, indicated by higher scores, in perceived fatigue on Thursday. These
381 improvements were seen in individuals who rated perceived fatigue a 1 or 2 on Sunday
382 and improved to a 3 on Thursday, and those who were a 1, 2 or 3 on Sunday and
383 improved to a 4 or 5 on Thursday, when compared to individuals who rated perceived
384 fatigue a 4 or 5 on both Sunday and Thursday. The results of Thursday assessments of
385 perceived fatigue in the present study are supported by previous research (13) in Rugby
386 Union players which demonstrated more favorable recovery scores in players who had
387 the highest training and physical activity volumes during the in-season period. Data
388 from the present study suggest that individuals with more unfavorable, or lower, ratings
389 of perceived fatigue on Sundays are not hindered by increased practice loads on
390 Tuesday and Wednesday, but may actually experience improvements in perceived
391 fatigue ratings on Thursday. It is also plausible to assume that individuals who
392 experienced increased perceived fatigue on Sundays following games may have
393 engaged in recovery modalities in conjunction with programmed physical activities,
394 resulting in more favorable perceived fatigue ratings on Thursday.

395

396 A lack of unidirectional findings of Thursday perceived wellness was demonstrated for
397 the subscales of perceived soreness and stress. Individuals who rated perceived
398 soreness a 4 or 5 on both Sunday and Thursday accumulated significantly ($p<0.05$)
399 greater PL, high-intensity deceleration distance and maximal-acceleration distance in

400 Tuesday and Wednesday practice sessions than those whose soreness rating improved
401 from Sunday to Thursday, and those whose rating was the same or became worse from
402 Sunday to Thursday. Similar to soreness, the subscale of stress demonstrated
403 significantly ($p < 0.05$) greater PL, total, high-intensity, and sprint distance, and maximal-
404 and high-intensity acceleration and deceleration distance for individuals rating perceived
405 stress a 4 or 5 on both Sunday and Thursday than those whose perceived stress
406 improved from Sunday to Thursday, and those whose rating was the same or became
407 worse from Sunday to Thursday. Limited research (8) in NCAA division I college
408 football players makes comparison of the present study with previous investigations
409 problematic. It is unclear whether differences in practice loads in the present study
410 were responsible for improvements demonstrated in some wellness subscales, or if
411 other factors including days until competition and under-reporting unfavorable
412 responses (7) in attempt to appear better or more well-adjusted, played a role. An
413 examination (10) of in-season perceptual wellness in Australian football players has
414 indicated that days-to-game was a significant coefficient for wellness. Similar results
415 have been demonstrated in Rugby League players (20) with shorter micro-cycles
416 between competition being associated with improved wellness, suggesting that players'
417 perception of wellness is related to days-to-game. Psychological factors, including
418 motivation and focus of an athlete on the impending game, may override negative
419 physiological symptoms, resulting in players perceiving themselves as recovered and
420 physically prepared for competition (11). The possibility of these results being
421 confounded via conscious bias associated with Thursday questionnaires cannot be
422 underestimated. This is often the result of an individual responding in a socially

423 desirable manner, typically over-reporting positive responses and under-reporting
424 negative or unfavorable responses (27). In a college football player, this may manifest
425 as overrating wellness on Thursday in attempt present their physical state more
426 favorably to the coaching staff, despite possible negative physical symptoms associated
427 with the cumulative loading of the Tuesday and Wednesday practice sessions. It is
428 plausible that these factors may have contributed to the lack of unidirectional findings
429 associated with the Thursday questionnaires, however similar investigations have not
430 been undertaken in NCAA division I college football players.

431
432 The results of the present study provide novel insight to the physical and psychological
433 responses associated with participation in NCAA division I football games and in-
434 season practice sessions. Significant differences in volumes and intensities of GPS and
435 IA movement variables were reported in athletes who responded more or less favorably
436 on perceived wellness measures. The use of a customized wellness questionnaire may
437 provide sport and performance coaches with an improved understanding of the
438 individual response to practice and competition, and contribute to the design of training
439 and recovery protocols to enhance subsequent competitive performance. The ease of
440 administration and cost effectiveness associated with individual athlete monitoring via
441 wellness questionnaires, permits football teams, at every level, to implement these
442 strategies throughout the in-season period.

443

444 Future studies should examine how coaches seeking to enhance competitive
445 performance, can manipulate individual and position-specific practice volumes and
446 intensities to mitigate fatigue, enhance recovery, and optimize subsequent competitive
447 performance. Although it was beyond the scope of the present study, future
448 investigations should also examine the impact of perceived wellness ratings on
449 competitive performance and injury risk in NCAA division I football players.

450

451 **PRACTICAL APPLICATIONS**

452

453 The present study provided a novel analysis of the physiological and psychological
454 response to competitive movement demands and training loads associated with in-
455 season weekly practice sessions. Results support the implementation of a
456 questionnaire consisting of 4 subscales, including fatigue, soreness, stress, and sleep
457 quality. A Likert scale with five response choices, or alternatively, having individuals
458 compare their current well-being to normal (worse than normal, normal, better than
459 normal) offering three response choices, similar to the DALDA (26) may be employed.
460 Consideration as to the number of questions and potential responses which ease the
461 time burden on the athlete, while simultaneously obtaining valuable data, is critically
462 important.

463

464

465 Due to weekly competition associated with an NCAA football season, performance
466 coaches should monitor individual perceived wellness on a weekly basis. Recovery
467 modalities should be implemented for individuals reporting less than favorable ratings of
468 fatigue and soreness one day following games. Additionally, an assessment of
469 perceived wellness should be undertaken within 48 hours prior to subsequent
470 competition, to examine the impact of weekly practice sessions on the well-being of
471 college football players. Results of the present study do not support practice load
472 reductions on Tuesday and Wednesday in attempts to improve well-being on Thursday,
473 even for players who reported less than favorable ratings of wellness on Sunday.
474 However, coaches should evaluate individual wellness scores prior to games, and
475 initiate communication with athletes who report unfavorable wellness scores on
476 Thursdays. Interpersonal communication conveys a sense of concern for the player,
477 ensuring the athlete that wellness scores are being monitored and their input is
478 meaningful, and provides coaches increased information from which to program training
479 loads and recovery modalities for individuals who report less than favorable wellness
480 ratings on Thursdays. Minimizing the deleterious effects of fatigue while simultaneously
481 improving the position-specific technical, tactical, and physical demands associated with
482 athlete preparation in division I college football players requires a collaborative effort
483 between members of the coaching staff, medical staff, performance staff, and most
484 importantly, the athletes themselves. The ease of administration, cost-effectiveness,
485 and the minimal time investment required to collect perceived wellness data, makes it a
486 practical tool for monitoring team sport athletes.

487

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489

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494

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589 division I college football players. *J Strength Cond Res* 31: 330-338, 2017.

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Table 1. Sunday Ratings of Perceived Fatigue and Soreness: Line 1: Adjusted Predictions at the Means

Line 2: Lower and Upper limits of 95% Confidence Interval

^A Significantly different ($p < 0.05$) for 1 or 2. ^B Significantly different ($p < 0.05$) for 3.

All distance measures are represented as meters.

| Movement Variables | Perceived Fatigue | | | Perceived Soreness | | |
|---|----------------------------|---|--|----------------------------|---|--|
| | 1 or 2 | 3 | 4 or 5 | 1 or 2 | 3 | 4 or 5 |
| Total Distance | 3839.6 (3686.1, 3993.1) | 3554.9 ^A (3426.2, 3683.5) | 3114.1 ^{AB} (2816.2, 3412.0) | 3817.9 (3694.1, 3941.8) | 3441.1 ^A (3426.2, 3683.5) | 3064.7 ^{AB} (2816.2, 3412.0) |
| Low-Intensity Distance | 3221.4 (3103.5, 3339.3) | 2988.8 ^A (2890.0, 3087.6) | 2665.2 ^{AB} (2436.4, 2894.0) | 3201.6 (3106.7, 3296.6) | 2908.5 ^A (2789.1, 3027.8) | 2594.2 ^{AB} (2333.1, 2855.4) |
| Medium-Intensity Distance | 391.7 (364.8, 418.6) | 361.4 (338.9, 383.9) | 293.0 ^{AB} (240.8, 345.2) | 387.2 (365.4, 409.1) | 347.4 ^A (319.9, 374.9) | 304.3 ^A (244.1, 364.4) |
| High-Intensity Distance | 162.7 (146.5, 178.9) | 149.8 (136.2, 163.4) | 114.0 ^{AB} (82.5, 145.5) | 167.2 (154.1, 180.3) | 134.2 ^A (117.7, 150.6) | 115.3 ^A (79.3, 151.3) |
| Sprinting Distance | 60.2 (50.9, 69.5) | 50.8 (42.9, 58.6) | 34.5 ^A (16.4, 52.6) | 58.1 (50.5, 65.6) | 46.5 (37.0, 56.1) | 44.1 (23.3, 65.0) |
| Player Load | 441.3 (425.7, 456.9) | 411.8 ^A (398.8, 424.9) | 365.5 ^{AB} (335.2, 395.7) | 441.0 (428.5, 453.5) | 398.2 ^A (382.5, 414.0) | 355.2 ^{AB} (320.8, 389.6) |
| Low-Intensity Accel. Distance | 1740.5 (1668.3, 1812.7) | 1610.7 ^A (1550.2, 1671.2) | 1395.3 ^{AB} (1255.1, 1535.4) | 1727.4 (1669.2, 1785.7) | 1567.7 ^A (1494.4, 1640.9) | 1351.7 ^{AB} (1191.4, 1511.9) |
| Medium-Intensity Accel. Distance | 101.7 (96.1, 107.3) | 91.8 ^A (87.1, 96.5) | 73.8 ^{AB} (63.0, 84.6) | 100.8 (96.3, 105.3) | 87.4 ^A (81.7, 93.1) | 73.9 ^{AB} (61.5, 86.4) |
| High-Intensity Accel. Distance | 52.4 (49.4, 55.3) | 48.2 (45.8, 50.7) | 39.5 ^{AB} (33.8, 45.2) | 52.5 (50.1, 54.9) | 45.3 ^A (42.3, 48.3) | 40.7 ^A (34.2, 47.3) |
| Max-Intensity Accel. Distance | 74.8 (70.6, 78.9) | 69.2 (65.7, 72.7) | 59.3 ^{AB} (51.2, 67.3) | 75.2 (71.8, 78.5) | 65.0 ^A (60.8, 69.2) | 61.0 ^A (51.8, 70.2) |
| Low-Intensity Decel. Distance | 1102.6 (1054.8, 1150.5) | 1014.5 ^A (974.3, 1054.6) | 879.6 ^{AB} (786.7, 972.6) | 1093.2 (1054.5, 1131.9) | 984.9 ^A (936.2, 1033.5) | 859.2 ^{AB} (752.8, 965.6) |
| Medium-Intensity Decel. Distance | 72.5 (67.9, 77.0) | 65.6 ^A (61.8, 69.4) | 52.2 ^{AB} (43.4, 61.0) | 72.3 (68.6, 76.9) | 61.7 ^A (57.1, 66.3) | 53.0 ^{AB} (42.9, 63.1) |
| High-Intensity Decel. Distance | 27.4 (25.4, 29.5) | 24.5 ^A (22.8, 26.1) | 19.5 ^{AB} (15.6, 23.4) | 27.5 (25.9, 29.1) | 22.6 ^A (20.6, 24.7) | 19.8 ^A (15.3, 24.2) |
| Max-Intensity Decel. Distance | 28.1 (25.9, 30.3) | 24.6 ^A (22.7, 26.5) | 19.3 ^{AB} (15.0, 23.7) | 27.9 (26.0, 29.7) | 22.7 ^A (20.5, 25.0) | 20.8 ^A (15.8, 25.7) |

Table 2. Sunday Ratings of Perceived Stress and Sleep Quality: Line 1: Adjusted Predictions at the Means

Line 2: Lower and Upper limits of 95% Confidence Interval

^A Significantly different (p < 0.05) for 1 or 2. ^B Significantly different (p < 0.05) for 3.

All distance measures are represented as meters.

| Movement Variables | Perceived Stress | | | Perceived Sleep Quality | | |
|---|----------------------------|---|---|----------------------------|-----------------------------------|-----------------------------------|
| | 1 or 2 | 3 | 4 or 5 | 1 or 2 | 3 | 4 or 5 |
| Total Distance | 3314.8 (3055.4, 3574.3) | 3647.9 ^A (3512.5, 3783.3) | 3729.9 ^A (3551.3, 3908.6) | 3761.0 (3540.6, 3981.4) | 3628.6 (3443.4, 3813.7) | 3552.1 (3405.8, 3698.3) |
| Low-Intensity Distance | 2812.7 (2613.3, 3012.1) | 3070.1 ^A (2966.0, 3174.2) | 3126.1 ^A (2988.8, 3263.3) | 3160.7 (2991.5, 3329.9) | 3073.6 (2931.5, 3215.8) | 2977.9 (2865.6, 3090.2) |
| Medium-Intensity Distance | 315.8 (270.8, 360.9) | 369.3 ^A (3458., 392.8) | 385.7 ^A (354.7, 416.7) | 373.2 (334.9, 411.5) | 359.6 (327.4, 391.8) | 367.0 (341.5, 392.4) |
| High-Intensity Distance | 129.6 (102.4, 156.7) | 153.1 (138.9, 167.3) | 158.6 (139.9, 177.3) | 164.3 (141.3, 187.3) | 145.5 (126.2, 164.8) | 148.4 (133.1, 163.6) |
| Sprinting Distance | 52.1 (36.5, 67.7) | 51.7 (43.5, 59.8) | 54.6 (43.9, 65.4) | 58.2 (45.1, 71.4) | 46.9 (35.9, 58.0) | 53.8 (45.1, 62.5) |
| Player Load | 380.2 (353.9, 406.4) | 419.5 ^A (405.8, 433.2) | 435.7 ^A (417.6, 453.7) | 432.9 (410.5, 455.3) | 415.9 (397.0, 434.7) | 413.7 (398.8, 428.6) |
| Low-Intensity Accel. Distance | 1510.7 (1388.4, 1632.9) | 1644.2 (1580.4, 1708.0) | 1693.9 ^A (1609.8, 1778.1) | 1713.4 (1609.8, 1817.0) | 1643.4 (1556.3, 1730.5) | 1602.7 (1533.9, 1671.5) |
| Medium-Intensity Accel. Distance | 83.4 (73.9, 92.9) | 94.9 ^A (90.0, 99.9) | 97.2 ^A (90.7, 103.7) | 100.1 (92.1, 108.1) | 93.3 (86.5, 100.0) | 91.2 (85.9, 96.5) |
| High-Intensity Accel. Distance | 43.2 (38.3, 48.2) | 49.7 ^A (47.1, 52.3) | 50.7 ^A (47.2, 54.1) | 50.9 (46.6, 55.1) | 49.2 (45.7, 52.8) | 47.9 (45.1, 50.7) |
| Max-Intensity Accel. Distance | 63.2 (56.3, 70.2) | 71.4 ^A (67.8, 75.0) | 72.3 (67.5, 77.1) | 74.6 (68.7, 80.5) | 70.1 (65.1, 75.0) | 68.5 (64.6, 72.5) |
| Low-Intensity Decel. Distance | 951.8 (870.8, 1032.9) | 1037.2 (995.9, 1079.5) | 1072.0 ^A (1016.2, 1127.8) | 1059.2 (990.3, 1128.0) | 1036.8 (978.9, 1094.6) | 1023.2 (977.5, 1068.9) |
| Medium-Intensity Decel. Distance | 58.8 (51.1, 66.5) | 67.8 ^A (63.8, 71.8) | 69.5 ^A (64.2, 74.8) | 69.9 (63.3, 76.4) | 66.8 (61.3, 72.3) | 65.6 (61.3, 69.9) |
| High-Intensity Decel. Distance | 21.9 (18.6, 25.3) | 25.7 (23.9, 27.4) | 25.9 (23.5, 28.2) | 27.0 (24.2, 29.9) | 24.9 (22.5, 27.3) | 24.3 (22.4, 26.2) |
| Max-Intensity Decel. Distance | 22.3 (18.5, 26.0) | 25.6 (23.7, 27.6) | 26.7 (24.1, 29.3) | 29.1 (25.9, 32.3) | 24.5 ^A (21.8, 27.2) | 24.3 ^A (22.2, 26.4) |

Table 3. Thursday Ratings of Perceived Fatigue: Line 1: : Adjusted Cumulative Monday – Wednesday Practice Session Predictions at the Means

Line 2: Lower and Upper limits of 95% Confidence Interval

^A Significantly different (p < 0.05) for 1 or 2 that were better than Sunday. ^B Significantly different (p < 0.05) for 1 or 2 that were same or worse than Sunday.

^C Significantly different (p < 0.05) for a 3 that were better than Sunday. ^D Significantly different (p < 0.05) for a 3 that were same or worse than Sunday.

^E Significantly different (p < 0.05) for 4 or 5 that were better than Sunday.

All distance measures are represented as meters.

| Movement Variables | 1 or 2 on Thursday | | 3 on Thursday | | 4 or 5 on Thursday | |
|---|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|---------------------------------------|
| | Better than Sunday | Same or Worse than Sunday | Better than Sunday | Same or Worse than Sunday | Better than Sunday | Same or Worse than Sunday |
| Total Distance | 6349.5 (5521.9, 7177.0) | 6479.0 (6339.8, 6618.2) | 6560.7 (6363.8, 6757.5) | 6381.4 (6267.2, 6495.6) | 6501.7 (6280.6, 6722.9) | 6194.8 (5846.7, 6542.8) |
| Low-Intensity Distance | 5071.5 (4434.6, 5708.4) | 5224.6 (5117.6, 5331.6) | 5270.6 (5119.3, 5422.0) | 5110.8 (5022.9, 5198.7) | 5207.2 (5037.2, 5377.2) | 5015.4 (4747.5, 5283.3) |
| Medium-Intensity Distance | 844.7 (697.0, 992.4) | 816.2 (791.3, 841.1) | 840.3 (805.1, 875.5) | 823.8 (803.5, 844.2) | 848.5 (809.1, 888.0) | 761.6 ^{EC} (699.7, 823.5) |
| High-Intensity Distance | 370.0 (278.2, 461.8) | 356.5 (341.0, 371.9) | 376.3 (354.3, 398.3) | 367.1 (354.5, 379.8) | 371.5 (346.9, 396.1) | 334.6 (296.0, 373.2) |
| Sprinting Distance | 73.7 (41.5, 105.9) | 71.7 (66.3, 77.1) | 74.2 (66.5, 81.9) | 75.7 (71.3, 80.2) | 80.1 (71.5, 88.7) | 74.7 (60.9, 88.4) |
| Player Load | 801.5 (720.3, 882.6) | 801.4 (787.8, 815.0) | 813.5 (794.2, 832.7) | 793.7 (782.5, 804.8) | 800.3 (778.8, 821.9) | 783.1 (749.1, 817.1) |
| Low-Intensity Accel. Distance | 3000.2 (2619.9, 3380.5) | 2988.0 (2923.9, 3052.1) | 3026.3 (2935.8, 3116.8) | 2950.0 (2897.5, 3002.4) | 3005.4 (2903.8, 3107.0) | 2833.9 (2673.2, 2994.7) |
| Medium-Intensity Accel. Distance | 191.8 (165.1, 218.5) | 189.9 (185.3, 194.4) | 193.8 (187.5, 200.1) | 189.7 (186.0, 193.4) | 193.7 (186.5, 200.8) | 178.8 ^{EC} (167.6, 190.1) |
| High-Intensity Accel. Distance | 106.2 (91.2, 121.3) | 105.1 (102.6, 107.7) | 108.4 (104.8, 111.9) | 104.9 (102.8, 106.9) | 107.9 (103.9, 111.9) | 101.1 (94.7, 107.4) |
| Max-Intensity Accel. Distance | 189.4 (164.8, 214.0) | 185.6 (181.4, 189.8) | 189.9 (184.0, 195.7) | 185.1 (181.7, 188.5) | 188.3 (181.8, 194.9) | 175.7 ^{EC} (165.4, 186.0) |
| Low-Intensity Decel. Distance | 2294.9 (2032.6, 2557.2) | 2271.7 (2227.4, 2315.9) | 2304.5 (2242.0, 2367.0) | 2269.4 (2233.2, 2305.5) | 2294.9 (2225.0, 2364.8) | 2172.8 (2061.8, 2283.9) |
| Medium-Intensity Decel. Distance | 173.0 (147.6, 198.3) | 168.7 (164.4, 173.0) | 173.7 (167.7, 179.7) | 170.2 (166.7, 173.7) | 172.1 (165.3, 178.9) | 159.0 ^{EC} (148.4, 169.7) |
| High-Intensity Decel. Distance | 65.0 (53.5, 59.7) | 63.1 (61.1, 65.0) | 66.0 (63.2, 68.7) | 63.9 (62.4, 65.5) | 66.0 (63.0, 69.1) | 59.0 ^{EC} (54.1, 63.8) |
| Max-Intensity Decel. Distance | 48.4 (37.1, 59.7) | 47.0 (45.1, 48.9) | 49.3 (46.6, 52.0) | 46.8 (45.2, 48.3) | 48.9 (45.9, 51.9) | 44.1 (39.4, 48.9) |

Table 4. Thursday Ratings of Perceived Soreness: Line 1: Adjusted Cumulative Monday – Wednesday Practice Session Predictions at the Means

Line 2: Lower and Upper limits of 95% Confidence Interval

^A Significantly different (p < 0.05) for 1 or 2 that were better than Sunday. ^B Significantly different (p < 0.05) for 1 or 2 that were same or worse than Sunday.

^C Significantly different (p < 0.05) for a 3 that were better than Sunday. ^D Significantly different (p < 0.05) for a 3 that were same or worse than Sunday.

^E Significantly different (p < 0.05) for 4 or 5 that were better than Sunday.

All distance measures are represented as meters.

| Movement Variables | 1 or 2 on Thursday | | 3 on Thursday | | 4 or 5 on Thursday | |
|---|----------------------------|----------------------------|----------------------------|---------------------------------------|--------------------------------------|---|
| | Better than Sunday | Same or Worse than Sunday | Better than Sunday | Same or Worse than Sunday | Better than Sunday | Same or Worse than Sunday |
| Total Distance | 6477.8 (6211.4, 6744.3) | 6490.1 (6367.2, 6613.1) | 6503.2 (6355.5, 6651.0) | 6299.8 (6162.6, 6437.0) | 6337.2 (6101.8, 6572.7) | 6689.4 ^E (6354.0, 7024.9) |
| Low-Intensity Distance | 5182.6 (4977.1, 5388.1) | 5222.7 (5127.8, 5317.6) | 5218.5 (5104.6, 5332.5) | 5065.5 (4959.7, 5171.2) | 5090.9 (4909.4, 5272.3) | 5344.6 ^D (5086.5, 5602.7) |
| Medium-Intensity Distance | 834.4 (786.7, 882.0) | 827.8 (805.8, 849.8) | 833.1 (806.6, 859.6) | 800.9 (776.4, 825.4) | 810.4 (768.3, 852.5) | 880.1 ^D (820.2, 940.0) |
| High-Intensity Distance | 370.1 (340.4, 399.8) | 365.7 (352.0, 379.4) | 369.8 (353.8, 386.3) | 354.1 (338.7, 369.4) | 349.9 (323.6, 376.2) | 390.7 (353.2, 428.2) |
| Sprinting Distance | 75.1 (64.7, 85.5) | 72.6 (67.8, 77.4) | 75.9 (70.1, 81.6) | 74.6 (69.3, 80.0) | 79.6 (70.3, 88.8) | 78.6 (65.5, 91.7) |
| Player Load | 803.6 (777.5, 829.7) | 805.2 (793.2, 817.1) | 808.2 (793.9, 822.4) | 782.3 ^{CB} (769.0, 795.6) | 781.5 ^C (758.7, 804.3) | 829.5 ^{DE} (797.0, 861.9) |
| Low-Intensity Accel. Distance | 3000.7 (2878.0, 3123.5) | 2994.3 (2937.7, 3051.0) | 2996.3 (2928.2, 3064.5) | 2910.9 (2847.7, 2974.1) | 2930.7 (2822.2, 3039.1) | 3081.1 ^D (2926.9, 3235.3) |
| Medium-Intensity Accel. Distance | 191.7 (183.1, 200.2) | 191.1 (187.1, 195.0) | 192.4 (187.7, 197.2) | 185.6 (181.2, 190.0) | 188.1 (180.5, 195.7) | 201.1 ^D (190.3, 212.0) |
| High-Intensity Accel. Distance | 106.8 (101.9, 111.6) | 106.1 (103.9, 108.3) | 106.6 (104.0, 109.3) | 102.9 (100.4, 105.4) | 104.8 (100.5, 109.1) | 111.6 ^D (105.5, 117.7) |
| Max-Intensity Accel. Distance | 188.0 (180.1, 195.9) | 186.0 (182.3, 189.6) | 188.9 (184.5, 193.3) | 181.4 ^C (177.3, 185.4) | 183.2 (176.2, 190.2) | 197.0 ^{DE} (187.0, 207.0) |
| Low-Intensity Decel. Distance | 2302.0 (2217.5, 2386.4) | 2284.3 (2245.3, 2323.3) | 2295.0 (2248.1, 2341.8) | 2230.1 (2186.7, 2273.6) | 2236.0 (2161.4, 2310.6) | 2345.7 ^D (2239.3, 2452.1) |
| Medium-Intensity Decel. Distance | 172.2 (164.0, 180.3) | 170.3 (166.5, 174.1) | 172.2 (167.7, 176.7) | 165.9 (161.7, 170.1) | 166.8 (159.6, 174.0) | 179.3 ^D (168.9, 189.6) |
| High-Intensity Decel. Distance | 64.7 (60.9, 68.4) | 63.6 (61.9, 65.3) | 65.3 (63.2, 67.3) | 62.5 (60.6, 64.4) | 62.9 (59.6, 66.3) | 68.9 ^{DE} (64.2, 73.6) |
| Max-Intensity Decel. Distance | 47.7 (44.0, 51.3) | 47.3 (45.6, 48.9) | 48.3 (46.3, 50.3) | 45.7 (43.8, 47.6) | 47.2 (44.0, 50.5) | 51.6 ^D (47.0, 56.2) |

Table 5. Thursday Ratings of Perceived Stress: Line 1: Adjusted Cumulative Monday – Wednesday Practice Session Predictions at the Means

Line 2: Lower and Upper limits of 95% Confidence Interval

^A Significantly different (p < 0.05) for 1 or 2 that were better than Sunday. ^B Significantly different (p < 0.05) for 1 or 2 that were same or worse than Sunday.

^C Significantly different (p < 0.05) for a 3 that were better than Sunday. ^D Significantly different (p < 0.05) for a 3 that were same or worse than Sunday.

^E Significantly different (p < 0.05) for 4 or 5 that were better than Sunday.

All distance measures are represented as meters. (**There were no instances of individuals reporting a 1 or 2 on Thursday that were better than Sunday)

| Movement Variables | 1 or 2 on Thursday | | 3 on Thursday | | 4 or 5 on Thursday | |
|----------------------------------|--------------------|----------------------------|----------------------------|----------------------------|---|--|
| | Better than Sunday | Same or Worse than Sunday | Better than Sunday | Same or Worse than Sunday | Better than Sunday | Same or Worse than Sunday |
| Total Distance | - | 6516.1 (6324.2, 6708.0) | 6366.4 (6114.0, 6618.8) | 6394.5 (6287.8, 6501.2) | 6215.4 ^B (6028.8, 6402.0) | 6649.4 ^{DE} (6454.7, 6844.0) |
| Low-Intensity Distance | - | 5265.6 (5116.7, 5414.4) | 5092.0 (4896.5, 5287.5) | 5151.9 (5069.4, 5234.5) | 5013.2 ^B (4868.9, 5157.6) | 5285.8 ^E (5135.2, 5436.3) |
| Medium-Intensity Distance | - | 812.1 (778.1, 846.1) | 831.4 (786.6, 876.2) | 809.0 (790.1, 828.0) | 758.8 (752.6, 819.0) | 882.0 ^{BDE} (847.3, 916.6) |
| High-Intensity Distance | - | 362.5 (341.2, 383.7) | 372.0 (344.0, 400.0) | 354.3 (342.5, 366.2) | 346.8 (326.1, 367.5) | 391.9 ^{DE} (370.3, 413.5) |
| Sprinting Distance | - | 74.2 (66.7, 81.6) | 76.4 (66.5, 86.2) | 72.4 (68.2, 76.6) | 68.9 (61.6, 76.2) | 83.5 ^{DE} (75.9, 91.2) |
| Player Load | - | 797.9 (779.0, 816.7) | 794.8 (770.0, 819.6) | 795.1 (784.7, 805.6) | 780.0 (761.6, 798.3) | 820.9 ^{DE} (801.9, 839.9) |
| Low-Intensity Accel. Distance | - | 2975.8 (2886.9, 3064.7) | 2949.6 (2832.9, 3066.3) | 2950.5 (2901.0, 3000.0) | 2895.4 (2809.1, 2981.7) | 3072.0 ^{DE} (2980.9, 3163.0) |
| Medium-Intensity Accel. Distance | - | 189.8 (183.7, 196.0) | 189.1 (181.0, 197.2) | 188.7 (185.3, 192.1) | 181.3 (175.3, 187.2) | 199.6 ^{DE} (193.3, 205.9) |
| High-Intensity Accel. Distance | - | 105.3 (101.8, 108.8) | 105.6 (101.1, 110.2) | 104.3 (102.4, 106.2) | 101.5 (98.2, 104.9) | 111.0 ^{BDE} (107.4, 114.5) |
| Max-Intensity Accel. Distance | - | 186.3 (180.6, 192.1) | 186.9 (179.4, 194.5) | 183.7 (180.5, 186.9) | 180.5 (175.0, 186.1) | 192.6 ^{DE} (186.8, 198.4) |
| Low-Intensity Decel. Distance | - | 2267.5 (2206.6, 2328.4) | 2254.4 (2174.5, 2334.3) | 2253.5 (2219.7, 2287.4) | 2211.6 (2152.6, 2270.6) | 2360.2 ^{DE} (2297.7, 2422.7) |
| Medium-Intensity Decel. Distance | - | 169.0 (163.2, 174.9) | 171.0 (163.4, 178.7) | 167.6 (164.4, 170.9) | 162.5 (156.8, 168.1) | 179.1 ^{BDE} (173.1, 185.0) |
| High-Intensity Decel. Distance | - | 63.3 (60.6, 65.9) | 64.2 (60.6, 67.7) | 63.1 (61.6, 64.6) | 61.4 (58.7, 64.0) | 67.6 ^{DE} (64.9, 70.4) |
| Max-Intensity Decel. Distance | - | 47.3 (44.7, 49.9) | 48.6 (45.1, 52.0) | 46.4 (44.9, 47.8) | 44.7 (42.1, 47.2) | 50.4 ^{DE} (47.7, 53.0) |

Table 6. Thursday Ratings of Perceived Sleep Quality: Line 1: : Adjusted Cumulative Monday – Wednesday Practice Session Predictions at the Means

Line 2: Lower and Upper limits of 95% Confidence Interval

^A Significantly different (p < 0.05) for 1 or 2 that were better than Sunday. ^B Significantly different (p < 0.05) for 1 or 2 that were same or worse than Sunday.

^C Significantly different (p < 0.05) for a 3 that were better than Sunday. ^D Significantly different (p < 0.05) for a 3 that were same or worse than Sunday.

^E Significantly different (p < 0.05) for 4 or 5 that were better than Sunday.

All distance measures are represented as meters.

| Movement Variables | 1 or 2 on Thursday | | 3 on Thursday | | 4 or 5 on Thursday | |
|---|----------------------------|----------------------------|----------------------------|-----------------------------------|-----------------------------------|---|
| | Better than Sunday | Same or Worse than Sunday | Better than Sunday | Same or Worse than Sunday | Better than Sunday | Same or Worse than Sunday |
| Total Distance | 6501.4 (5838.1, 7164.8) | 6382.6 (6204.6, 6560.5) | 6172.8 (5878.5, 6467.2) | 6429.8 (6298.1, 6561.4) | 6454.2 (6310.7, 6597.7) | 6506.0 (6370.8, 6641.2) |
| Low-Intensity Distance | 5269.8 (4759.9, 5779.8) | 5123.3 (4986.4, 5260.3) | 4964.3 (4737.9, 5910.6) | 5158.4 (5057.2, 5259.6) | 5164.6 (5054.2, 5275.1) | 5248.4 ^C (5144.2, 5352.6) |
| Medium-Intensity Distance | 799.0 (680.0, 918.1) | 813.1 (781.0, 845.1) | 796.4 (743.8, 849.0) | 822.1 (798.5, 845.7) | 837.5 (811.8, 863.2) | 824.0 (799.8, 848.2) |
| High-Intensity Distance | 350.6 (277.1, 424.1) | 358.7 (338.9, 378.6) | 340.3 (307.5, 373.1) | 367.1 (352.5, 381.8) | 373.3 (357.4, 389.2) | 360.2 (345.2, 375.2) |
| Sprinting Distance | 77.3 (51.7, 102.9) | 72.9 (66.0, 79.8) | 62.5 (51.1, 73.8) | 76.0 ^C (70.9, 81.1) | 74.9 (69.3, 80.4) | 76.6 ^C (71.3, 81.8) |
| Player Load | 816.1 (750.2, 882.0) | 796.3 (778.9, 813.7) | 774.9 (746.1, 803.6) | 799.8 (786.9, 812.6) | 803.5 (789.4, 817.5) | 799.4 (786.2, 812.6) |
| Low-Intensity Accel. Distance | 3039.9 (2733.8, 3346.0) | 2964.2 (2882.3, 3046.1) | 2865.8 (2730.4, 3001.3) | 2981.9 (2921.3, 3042.4) | 2993.4 (2927.3, 3059.4) | 2967.5 (2905.3, 3029.7) |
| Medium-Intensity Accel. Distance | 189.6 (168.1, 211.2) | 188.6 (182.8, 194.3) | 184.4 (174.9, 193.9) | 189.8 (185.5, 194.1) | 193.0 (188.3, 197.6) | 190.2 (185.8, 194.6) |
| High-Intensity Accel. Distance | 104.6 (92.5, 116.6) | 104.5 (101.3, 107.8) | 101.4 (96.0, 106.8) | 105.8 (103.4, 108.2) | 106.5 (103.9, 109.1) | 105.9 (103.4, 108.4) |
| Max-Intensity Accel. Distance | 184.1 (164.4, 203.9) | 184.3 (179.0, 189.6) | 179.0 (170.3, 187.8) | 186.6 (182.7, 190.5) | 187.9 (183.6, 192.2) | 185.4 (181.3, 189.4) |
| Low-Intensity Decel. Distance | 2261.0 (2050.4, 2471.5) | 2263.9 (2207.4, 2320.4) | 2208.0 (2114.7, 2301.3) | 2277.9 (2236.2, 2319.6) | 2287.9 (2242.3, 2333.4) | 2271.2 (2228.4, 2314.1) |
| Medium-Intensity Decel. Distance | 165.1 (144.8, 185.4) | 167.3 (161.8, 172.8) | 164.8 (155.8, 173.8) | 170.2 (166.1, 174.2) | 172.9 (168.5, 177.3) | 169.3 (165.2, 173.5) |
| High-Intensity Decel. Distance | 62.5 (53.2, 71.8) | 62.8 (60.3, 65.3) | 60.7 (56.6, 64.8) | 64.5 (62.7, 66.4) | 65.6 ^C (63.6, 67.6) | 63.2 (61.3, 65.1) |
| Max-Intensity Decel. Distance | 48.1 (39.1, 57.1) | 46.9 (44.5, 49.4) | 43.4 (39.4, 47.4) | 47.4 (45.6, 49.2) | 48.4 ^C (46.5, 50.4) | 47.1 (45.3, 48.9) |

Figure 1. Perceived Wellness Questionnaire

| Category | 5 | 4 | 3 | 2 | 1 |
|---|--------------------|---------------------|--|----------------------------------|--------------------------|
| Fatigue | Very Fresh | Fresh | Normal | More Tired Than Normal | Always Tired |
| Sleep Quality | Very Restful | Good | Difficulty Falling Asleep | Restless Sleep | Cannot Sleep |
| General Soreness | Feeling Great | Feeling Good | Normal | Increase in Soreness / Tightness | Very Sore |
| Stress Levels | Very Relaxed | Relaxed | Normal | Feeling Stressed | Very Stressed |
| Mood | Very Positive Mood | Generally Good Mood | Less Interested in Others / Activities than Normal | Aggravated / Short Tempered | Very Annoyed / Irritable |
| How Many Hours Did You Sleep? (Sleep Quantity) | More Than 10 Hrs. | 8-10 Hrs. | 6-8 Hrs. | 4-6 Hrs. | Less than 4 Hrs. |