1   **The influence of changes in acute training load on daily sensitivity of morning-**

2   **measured fatigue variables in elite soccer players.**

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23 **The influence of changes in acute training load on daily sensitivity of morning-**

24 **measured fatigue variables in elite soccer players**

25 **Abstract**

26 **Purpose** To determine the sensitivity of a range of potential fatigue measures to daily
27 training load accumulated over the previous two, three and four days during a short in-season
28 competitive period in elite senior soccer players (n=10).

29 **Methods** Total high-speed running distance, perceived ratings of wellness (fatigue, muscle
30 soreness, sleep quality), counter-movement jump height (CMJ), submaximal heart rate
31 (HRex), post-exercise heart rate recovery (HRR) and heart rate variability (HRV: Ln rMSSD)
32 were analysed during an in-season competitive period (17 days). General linear models were
33 used to evaluate the influence of two, three and four day total high-speed running distance
34 accumulation on fatigue measures.

35 **Results** Fluctuations in perceived ratings of fatigue were correlated with fluctuations in total
36 high-speed running distance accumulation covered on the previous 2-days (r=-0.31; small), 3
37 -days (r=-0.42; moderate) and 4-days (r=-0.28; small) (p<0.05). Changes in HRex (r=0.28;
38 small; p= 0.02) were correlated with changes in 4-day total high-speed running distance
39 accumulation only. Correlations between variability in muscle soreness, sleep quality, CMJ,
40 HRR% and HRV and total high-speed running distance were negligible and not statistically
41 significant for all accumulation training loads.

42 **Conclusions** Perceived ratings of fatigue and HRex were sensitive to fluctuations in acute
43 total high-speed running distance accumulation, although, sensitivity was not systematically
44 influenced by the number of previous days over which the training load was accumulated.
45 The present findings indicate that the sensitivity of morning-measured fatigue variables to
46 changes in training load is generally not improved when compared with training loads
47 beyond the previous days training.

48

Introduction

The locomotor demands of elite soccer have progressively increased in recent years. [1,2] Since leading teams are also required to compete in a high number of matches over the course of season, [3] implementation of effective recovery strategies are paramount in order to avoid the debilitating effects associated with overtraining and injury. [4] Increasing attention in the literature has therefore focused upon evaluating the effectiveness of a range of monitoring tools which may serve as valid indicators of fatigue status of athletes. [5] For the purpose of this manuscript, fatigue will be defined as an inability to complete a task that was once achievable within a recent time frame. [6]

Recent research has examined the sensitivity of potential measures of fatigue to daily fluctuations in training load in Australian Rules Football (AFL). [7,8] In AFL players, perceived ratings of wellness, [7,8] sub-maximal heart rate (HRex) [7] and an index (LnSD1) of vagal-related heart rate variability (HRV) [7] were sensitive to the fluctuations in daily training load during a pre-season training period. Similarly, in elite soccer players competing in the English Premier League (EPL), [9] both rating of perceived fatigue and vagal related HRV measure Ln rMSSD were most sensitive to the previous days fluctuations in training load experienced during the in-season competition period. Furthermore, in the same population, only perceived ratings of wellness were sensitive to within-week fluctuations in match and training load during typical in-season competition weeks. [10] Collectively, these findings demonstrate that these measures, particular perceived ratings of wellness, show promise as acute, simple, non-invasive assessments for tracking the fatigue status of elite team sport athletes.

Physiological adaptation to training is the culmination of repeated daily applications of training load. [11] The level of fatigue experienced by an athlete at any one point in time is therefore unlikely to purely reflect the load incurred from the previous day's activity, [9] but rather the load accumulated from a number of training days. Indeed high-intensity exercise and eccentric type activity leads to increases in muscle soreness that may be present for up to 72-hours following the exercise stress. [12,13] In line with such observations, Buchheit (2014) recently suggested that HRV indices, used as an indicator of the athletes training status, may be more sensitive to changes in training loads when averaged across 7-days compared to a single daily measurement. [14] Similarly, reductions and increases in heart rate recovery (HRR) have been seen in response to weekly increases in training load and performance in physically active subjects and elite cyclists respectively. [15,16]

Recent observations in elite senior soccer players have demonstrated that potential fatigue measures, particularly perceived ratings of wellness, were sensitive to within-week fluctuations in match and training load during typical competition weeks. [9] Changes in these measures across the training week may, therefore, to some extent reflect the periodised training load incurred over a number of the preceding days and not solely the previous days training. It is possible therefore, that the relationship between such potential markers of fatigue and training load may vary as a function of the number of accumulated training days. The response to a single training session may not have the same physiological effect or magnitude compared to multiple training sessions performed over a short period of time. Therefore, our aim was to determine whether the sensitivity of a range of potential fatigue measures would vary when compared to the training load accumulated over the previous two, three or four days during a short in-season competitive phase in elite soccer players. These data would enable comparison with previous observations in the same population which

96 examined the sensitivity of the same measures to the previous day's fluctuations in training
97 load.[8]

Methods

Subjects

Data were collected from 10 senior outfield soccer players (19.1±0.6 years; 1.84±0.7m; 75.4±7.6 kg) competing in the EPL over a 17-day period (February) during the in-season competition phase.

Design

Players took part in normal team training throughout the 17-day period as prescribed by the coaching staff. This included two competitive reserve team home matches (day 1 and 10), three rest days (day 6, 11 and 16) and twelve training sessions. All players were fully familiarised with the fatigue assessments in the weeks prior to completion of the main experimental trials. Fatigue measures were assessed each morning prior to the players commencing normal training. Perceived ratings of wellness measurements were assessed every day during the 17-day period. Physiological measurements were assessed every day with the exception of match and rest days. Each day players arrived at the training ground laboratory having refrained from caffeine intake at least 12-hours prior to each assessment point. All assessments were conducted at the same time of the day in order to avoid the circadian variation in body temperature. [17] Players were not allowed to consume fluid at any time during the fatigue assessments. The study was approved by the Liverpool John Moores University Ethics Committee. All players provided written informed consent. Prior to inclusion into the study, players were examined by the club physician and were deemed to be free from illness and injury.

Methodology

Training Load Assessment Individual player daily training and match load was monitored throughout the 17-day assessment period. Each player was also monitored during each training session and match using a portable global positioning system (GPS) technology (GPSports SPI Pro X 5 Hz, Canberra, Australia). This type of system has previously been shown to provide valid and reliable estimates of instantaneous velocity during acceleration, deceleration, and constant velocity movements during linear, multidirectional and soccer-specific activities [18,19]. All devices were activated 15-min before the data collection to allow acquisition of satellite signals. [20] The minimum acceptable number of available satellite signals was 8 (range 8-11). [21] Players wore the same GPS device for each session in order to avoid inter-unit error [21]. Based on GPS data, locomotive speed above the threshold of 14.8 km/h was classified as high-speed running. Total high-speed running distance was employed in the present study as an index of training and match load due to its frequent inclusion in attempts to quantify the load incurred by elite players during training and match-play. [22] However, high speed running will underestimate the true load incurred by the athlete since it does not account for the stress associated with the frequent accelerations and decelerations which occur during soccer. [23] It should be noted, however, that initial analysis in the present

140   study highlighted a large correlation (r=0.57) between total high-speed running distance and
141   session ratings of perceived exertion (sRPE) which has previously been used as a global
142   indicator of internal load in soccer players. [24]

143

144   *Perceived Ratings of Wellness*

145   A psychometric questionnaire was used daily prior to any training or exercise to assess
146   general indicators of player wellness. [9,10] The questionnaire comprised three questions
147   relating to perceived sleep quality (coefficient of variation 13%), muscle soreness (coefficient
148   of variation 9%) and fatigue (coefficient of variation 12%). [9] Each question scored on a
149   seven-point Likert scale [scores of 1-7 with 1 and 7 representing very, very poor (negative
150   state of wellness) and very, very good (positive state of wellness) respectively].

151   *Countermovement Jump* Countermovement jump [9](coefficient of variation 4%)[9] (CMJ)
152   performance was evaluated using a jump mat (Fusion Sport, Queensland, Australia).
153   Participants performed five CMJ efforts in total, two practice and three assessment jumps
154   ensuring the hands were affixed to the hips throughout the jump. The highest jump was used
155   as the criterion measure of performance.

156   *Heart rate indices* Players completed an indoor submaximal 5-min cycling (Keiser,
157   California, USA) /5-min recovery test as part of the warm up prior to commencing every
158   training session. [9] All players were assessed together at a fixed exercise intensity of 130 watts
159   (85 rpm). The present intensity was selected to minimize anaerobic energy contribution [25] and
160   to permit a rapid return of heart rate to baseline for short-term HRV measurements. On
161   completion of exercise the players remained seated in silence for 5-min. HRV expressed as
162   the square root of the mean of the sum of squares of differences between adjacent normal R-
163   R intervals (rMSSD, coefficient of variation 28%) [9] and the natural logarithm of the rMSSD
164   (Ln rMSSD, coefficient of variation 10%) [9] were calculated as previously described [25] using
165   Polar software (Polar Precision Performance SW 5.20, Polar Electro, Kemple, Finland). Heart
166   rate recovery (HRR) expressed as the absolute (HRR, coefficient of variation 14%) [9] and
167   relative (%HRR, coefficient of variation 10%) [9] change in HR between the final 30-sec
168   (average) of the 5-min cycling test and 60 sec after cessation of exercise were calculated as
169   previously described. [9,16,25]

170

171   **Statistical Analysis**

172   Data were analysed with general linear models, which allowed for the fact that data were
173   collected within-subjects over time. [26] Recently, step-wise regression approaches have been
174   criticised for reliable variable selection in a model. [27,28] Our added problem was the predicted
175   high multicolinearity between the various independent variables in our study. Therefore, we
176   used a combination of expert knowledge regarding which variables hold superior
177   practical/clinical importance [28] and a multicolinearity correlation coefficient of >0.5 for initial
178   variable selection. Total high-speed running distance was selected in order to provide an
179   indication of training and match load (independent variable) in the present study. We then
180   quantified the relationships between the various predictors and outcomes using model I
181   (unadjusted model) and model II (fully adjusted model from which partial correlation
182   coefficients and associated 95% confidence intervals for each predictor could be derived). To
183   calculate acute training load accumulation, the rolling mean 2, 3 and 4-day total high-speed
184   running distances were then related to the subsequent day's morning-measured fatigue

185   variables. The following criteria were adopted to interpret the magnitude of the correlation (r)

186   between test measures: <0.1 trivial, 0.1 to 0.3 small, 0.3 to 0.5 moderate, 0.5 to 0.7 large, 0.7

187   to 0.9 very large, and 0.9 to 1.0 almost perfect. [29] The level of statistical significance was set

188   at $p < 0.05$ for all tests.

189

Results

Partial correlations, least squares regression slope (B) and significance for the relationship between total high-speed running distance (over 2-4 days) and morning-measured fatigue variables are shown in Tables 1-7. Absolute variability in training load and fatigue measures over the 17 day period can be viewed in a recent publication [9] All players competed in both matches during the 17-day period with a median of 79 min playing time per player (range = 32-93 min). Variability in ratings of perceived fatigue were correlated to variability in total high-speed running distance covered on the previous 2, 3 and 4 days ($p<0.05$; Table 1). Small-to-moderate correlations were observed for 2 ($r = -0.31$), 3 ($r=-0.42$) and 4 ($r = -0.28$) day cumulative total high-speed running distance. Correlations between variability in perceived sleep quality and muscle soreness and total high-speed running distance across all days were trivial to small and not statistically significant (Table 2 and 3).

Insert Tables 1-3 here

Correlations between variability in CMJ and total high-speed running distance across all days were trivial to small and not statistically significant (Table 4).

Insert Table 4 here

Correlations between variability in HRex and total high-speed running distance across all days were trivial to small and only statistically significant with 4-day cumulative total high-speed running distance ($r=0.28$; $p=0.02$; Table 5).

Insert Table 5 here

Correlations between variability in HRR (%) and Ln rMSSD and total high-speed running distance for all days were trivial and not statistically significant (Table 6 and 7).

Insert Tables 6 and 7 here

Discussion

The aim of the current study was to determine whether the sensitivity of a range of morning-measured fatigue variables to changes in training load was influenced by the number of previous days over which the training load was accumulated in elite soccer players. When compared with previous data published on the current population, the present findings indicate that the sensitivity of morning-measured fatigue measures to changes in training load is generally not improved when compared with training loads beyond the previous days training. [9]

The use of simple perceived ratings of wellness is an efficient and practical approach to determining the fatigue status of elite team sport athletes. [8–10,30] Previous observations on elite soccer players showed a moderate-to-strong significant correlation between the players perceived rating of fatigue and the previous days total high-speed running distance (r=-0.51; p<0.001). [9] Furthermore, the slope of the regression model indicated that every ~400m increase in total high-speed running distance led to a one unit decrease (For example a player may change from very poor level of fatigue to very, very poor level of fatigue following an additional ~400m total high-speed running distance) in fatigue with 37 % of the variance in training load explained by all the statistically significant predictors. [9] In contrast, the current findings demonstrate that the sensitivity of morning-measured perceived fatigue, to changes in training load is reduced from significantly moderate to significantly small (r=-0.42 to -0.28) when compared with the training load observed beyond the previous days training [9] Indeed, the variance in training load explained by all the statistically significant predictors decreased to 15% when training load was accumulated over a number (2-4) of days, highlighting the importance of immediately preceding load in elite soccer players. This apparent importance of the previous days training load on morning-measured fatigue may to some extent be explained by the nature of training cycles undertaken by elite soccer players. During the in-season competition period, players rotate around weekly cycles comprising one to two matches (very high load) interspersed with training sessions (moderate to high load) and recovery sessions. [22,31,32] This cycle of daily loading peaks and-troughs within a short time frame may, therefore, only lead to changes in fatigue status that are largely representative of the previous days training. The influence of accumulated training load on morning measured perceived fatigue may be more relevant to endurance based sports where load is distributed and sustained over extended training blocks.

Small significant correlations have been reported between daily perceived ratings of sleep quality (r=0.2) and muscle soreness (r=0.3) and the previous days training load during pre-season training in elite AFL players. [7] In contrast, in EPL players the relationship between daily training load and perceived ratings of sleep quality and muscle soreness were trivial and non-significant. [9] Furthermore, in the current study, we demonstrate that the magnitude of these relationships are not influenced by the number of days over which training load was accumulated. Muscle soreness has been found to be significantly elevated between 24 and 72-hours following a soccer match [12,13,33]. Moreover, sleep quality has been seen to decrease around periods of competition. [34] In the present study, only two match days were included in the sample of 17-days, consequently, the limited match exposure and training intensity may not have been sufficient to influence muscle soreness and sleep quality. In a previous study from the same population of players, match demands accounted for ~40% of total weekly load, moreover, perceived ratings of wellness were found to be lowest on the day post-match,

260 [10] further showing the debilitating effects of a match on fatigue status. Indeed, the average
261 daily training load in the current study (RPE-TL 361) is considerably lower than that reported
262 during an AFL pre-season training camp (RPE-TL 746) where daily readings of muscle
263 soreness and sleep quality were associated with changes in load. [7] Future work involving a
264 greater frequency of matches is therefore warranted in order to fully examine the influence of
265 changes in loading on morning-measured perceived ratings of muscle soreness and sleep.

266 Previously, in elite soccer players, a small, positive daily correlation was observed ($r=0.23$)
267 between CMJ height and total high-speed running distance suggesting improved performance
268 with increased total high-speed running distance. [9] It has been reported that the assessment of
269 neuromuscular function via the use of jump protocols may be impaired up to 72-hours post-
270 match. [35,36] However, in the present study, a non-significant trivial to-small relationship was
271 found between changes in CMJ height and total high-speed running distance accumulation
272 over 2-4-days. Collectively, the findings from the current study and those from earlier
273 investigations, [9,37] demonstrate that CMJ height is generally insensitive to acute changes in
274 workload in elite soccer players. CMJ height alone may be too crude of a measure in order to
275 detect changes in training load, however, alternative CMJ derived neuromuscular parameters
276 may hold sensitivity to alterations in load irrespective of the limited change in CMJ height.
277 For example, neuromuscular parameters (eccentric, concentric, and total duration, time to
278 peak force/power, flight time:contraction time ratio) derived from CMJ have been found
279 suitable for detection of neuromuscular fatigue. [38] Reductions in 18 different neuromuscular
280 variables were found following a high-intensity fatiguing protocol in college-level team sport
281 athletes. [38] Furthermore, reductions in the flight time contraction time ratio have been found
282 across a season in AFL players indicating sensitivity to increases in load over time. [39] Future
283 research is required to investigate whether alternative measures derived from CMJ are
284 sensitive to changes in training load in elite soccer players.

285 In recent years heart rate (HR) indices (HRV, HRR and HRex) have been used as a popular
286 method to measure variations in the autonomic nervous system (ANS) in an attempt to
287 understand athlete adaptation/fatigue status. [14] The use of vagal related time domain indices
288 such as Ln rMSSD have been found to have greater reliability and are ideal for assessments
289 over short periods when compared to spectral indices of HRV. [40,41] A small significant
290 correlation ($r=-0.2$; $p=0.04$) was found between the daily fluctuations in Ln rMSSD and total
291 high-speed running distance in elite soccer players from an earlier study. [9] In this study, the
292 slope of the regression model indicated that every ~300m increase in total high-speed running
293 distance led to a decrease of one unit in HRV i.e. more sympathetic dominance the greater the
294 training load. [7,9,42] In the current study, non-significant, trivial correlations were observed
295 between fluctuations in 2, 3 and 4-day total high-speed running distance and changes in
296 morning-measured HRV, implying no additional effect on HRV beyond the previous days of
297 training load. The limited relationships may reflect the low loads incurred by players
298 observed in the current study. Buchheit et al, (2013) found significant daily correlations
299 ($r=0.40$) with a comparable vagal related parameter HRV (Ln SD1) during a pre-season camp
300 in AFL players. [7] A possible reason for the small-to-moderate correlation found may be due
301 to the enhanced training load performed by AFL players. [7] Another potential reason for the
302 lack of sensitivity observed for HRV in the present study may be due to the inherent variation
303 of this measure. Indeed, based on data derived from endurance sports it is suggested that the
304 use of one single data point could be misleading for practitioners due to the high day-to-day
305 variation in these indices. [43] When data were averaged over a week or using 7-day rolling
306 averages, sensitivity to training load and performance has been improved compared to a
307 single assessment point. A similar observation in young Handball players has also been

308 reported when single monthly assessments were found to have less than 20% sensitivity to
309 training status. [44] Future work is required to observe whether more frequent measures of
310 HRV improve sensitivity to training load. Furthermore, future research is needed to establish
311 how HRV responds to more extended and sustained periods of training and match load in
312 elite soccer players.

313 In the present study, small significant increases in HRex were associated with increases in 4-
314 days accumulated total high-speed running distance. Contrastingly, Buchheit et al. (2013)
315 found a large negative correlation between daily training load and HRex suggesting a
316 reduction in heart rate following increases in training load. [7] However, this data was collected
317 during a short pre-season AFL training camp in the heat where environmental and/or training
318 induced changes in plasma volume are more likely responsible than alterations stemmed
319 solely from the previous days training load. [7] Reductions in heart rate have also been
320 observed in athletes involved in extremely high training loads. [45] Indeed, HRex during
321 intensified training intensities showed significant reductions in overreached triathletes. Le
322 Meur and colleagues (2013) suggested the cause of this reduction in heart rate to be a hyper-
323 activation of the parasympathetic nervous system via central, cardiac and/or periphery
324 mechanisms. [46,47] In contrast to Le Meur and colleagues (2013) the results of the current
325 study suggest, although, speculative, an acute stimulation of the sympathetic nervous system
326 thus increasing HRex following a short continued period of training. Indeed, both in
327 recreational marathon runners and world class rowers, a significant increase in sympathetic
328 dominance following a training block in the lead up to competition has been observed. [48,49]

329 Sensitivity between HRR% and 2-4 day THIR accumulation was trivial and non-significant
330 in the present study. Previous data also failed to find a relationship between daily HRR% and
331 total high-speed running distance over a 17-day competitive period. [9] In contrast, previous
332 studies have observed responses between both acute and chronic training load and HRR.
333 Borresen and Lambert (2007) found that HRR decreased with an increase in training load and
334 subsequently a tendency for a faster HRR with a decrease in training load. The authors
335 speculate, however, that the reduced HRR with an increase in training load may be explained
336 by the severe increase in training load (TRIMP increased by 55%), potentially inducing
337 overreaching, and hence a parasympathetic predominance as previously discussed [45]. The use
338 of HRex and HRR in healthy athletes to predict changes in performance or fatigue should be
339 treated with caution and interpreted together with other measures of fatigue, such as
340 perceived ratings of wellness. [14,50] As a consequence, if HR-derived assessments of
341 fatigue/adaptation are to be effective in team sports, a higher volume of assessments may be
342 required as previously discussed. However, undertaking such measures may prove difficult
343 with the large volume of athletes engaged in team sports. [14]

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350 **Practical Applications**

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352 Perceived ratings of fatigue show particular promise as simple, non-invasive assessments of
353 fatigue status in elite soccer players during an in-season competitive phase. The present
354 findings also indicate that the sensitivity of morning-measured fatigue variables to changes in
355 training load is generally not improved when compared with training loads beyond the
356 previous days training, therefore, it is likely to be most effective when taken on a daily basis.
357 Future research is needed to determine the acute and longitudinal usefulness of HRex, HRR
358 and vagal related HRV as a monitoring tool in team sports.

359

360 **Conclusion**

361 The sensitivity of morning-measured fatigue variables to changes in training load is not
362 improved when compared with training loads beyond the previous days training. Perceived
363 ratings of fatigue shows the most promise as a simple, non-invasive assessment of fatigue
364 status in elite soccer players in detection of acute load fluctuations during an in-season
365 competitive phase compared to the other markers of fatigue measured.

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525

526   Table 1: Partial correlations (95% CI), least squares regression slope (B) and significance for
527   the relationship between morning-measured perceived fatigue and total high-speed running
528   distance over the previous 2, 3 and 4-days.

	Correlation Coefficient (95% CI)	Magnitude	B	P-value
2-day	-0.31 (-0.51 to -0.78)	Small	149.167	p=0.01
3-day	-0.42 (-0.61 to -0.18)	Moderate	166.509	p<0.001
4-day	-0.28 (-0.52 to -0.01)	Small	108.53	p=0.03

529

530   Table 2: Partial correlations (95% CI), least squares regression slope (B) and significance for
531   the relationship between morning-measured perceived sleep quality and total high-speed
532   running distance over the previous 2, 3 and 4-days

	Correlation Coefficient (95% CI)	Magnitude	B	P-value
2-day	-0.03 (-0.27 to 0.21)	Trivial	-10.633	p=0.83
3-day	-0.1 (-0.35 to 0.16)	Trivial	-9.869	p=0.81
4-day	0.04 (-0.27 to 0.28)	Trivial	15.774	p=0.75

533

534   Table 3: Partial correlations (95% CI), least squares regression slope (B) and significance for
535   the relationship between morning-measured perceived muscle soreness and total high-speed
536   running distance over the previous 2, 3 and 4-days

	Correlation Coefficient (95% CI)	Magnitude	B	P-value
2-day	-0.19 (-0.41 to 0.05)	Trivial/Small	-58.443	p=0.12
3-day	-0.16 (-0.40 to 0.10)	Trivial	-36.258	p=0.23
4-day	-0.13 (-0.4 to 0.15)	Trivial	-28.05	p=0.37

537

538

539 Table 4: Partial correlations (95% CI), least squares regression slope (B) and significance for
540 the relationship between morning-measured countermovement jump performance and total
541 high-speed running distance) over the previous 2, 3 and 4 days

	Correlation Coefficient (95% CI)	Magnitude	B	P-value
2-day	0.13 (-0.11 to 0.36)	Trivial	24.944	p= 0.29
3-day	0.21 (-0.05 to 0.42)	Small	31.478	p=0.11
4-day	0.23 (-0.05 to 0.48)	Small	34.02	p=0.10

542

543

544 Table 5: Partial correlations (95% CI), least squares regression slope (B) and significance for
545 the relationship between morning-measured sub-maximal heart rate and total high-speed
546 running distance over the previous 2, 3 and 4 days

	Correlation Coefficient (95% CI)	Magnitude	B	P-value
2-day	0.18 (-0.06 to 0.40)	Trivial	5.17	p=0.10
3-day	0.21 (-0.05 to 0.44)	Small	4.863	p=0.07
4-day	0.28 (0.05 to 0.52)	Small	5.948	p=0.02

547

548 Table 6: Partial correlations (95% CI), least squares regression slope (B) and significance for
549 the relationship between morning-measured Ln rMSSD (HRV) and total high-speed running
550 distance over the previous 2, 3 and 4-days.

	Correlation Coefficient (95% CI)	Magnitude	B	P-value
2-day	<-0.01 (-0.25 to 0.29)	Trivial	-1.31	p= 0.99
3-day	<0.01 (-0.27 to 0.25)	Trivial	9.426	p=0.91
4-day	-0.15 (-0.41 to 0.13)	Trivial	-95.337	p=0.279

551

552

553 Table 7: Partial correlations (95% CI), least squares regression slope (B) and significance for
554 the relationship between morning-measured heart rate recovery (HRR%) and total high-speed
555 running distance over the previous 2, 3 and 4-days

	Correlation Coefficient (95% CI)	Magnitude	B	P-value
2-day	<0.1 (-0.14 to 0.33)	Trivial	0.178	p=0.97
3-day	<0.1 (-0.16 to 0.35)	Trivial	1.138	p=0.76
4-day	-0.03 (-0.23 to 0.32)	Trivial	-1.584	p=0.68

556