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## Relationships Between Different Internal and External Training Load Variables and Elite International Women's Basketball Performance

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1 Relationships Between Different Internal and External Training Load Variables and Elite 2 International Women's Basketball Performance 3 4 **Original Investigation** 5 6 Joseph O.C. Coyne<sup>1,2</sup>, Aaron J. Coutts<sup>3,4</sup>, Robert U. Newton<sup>1</sup> & G. Gregory Haff<sup>1,5</sup> 7 8 9 <sup>1</sup>Centre for Exercise and Sports Science Research, Edith Cowan University, Joondalup, WA 10 6027, Australia <sup>2</sup> UFC Performance Institute, Las Vegas NV 89118 United States 11 12 <sup>3</sup> Human Performance Research Centre, University of Technology Sydney (UTS), Moore Park 13 Rd, Moore Park NSW 2021, Australia <sup>4</sup> School of Sport, Exercise and Rehabilitation, University of Technology Sydney (UTS), 14 15 Moore Park Rd, Moore Park NSW 2021, Australia <sup>5</sup> Directorate of Psychology and Sport, University of Salford, Salford, Greater Manchester, 16 17 United Kingdom 18 CORRESPONDING AUTHOR: Joseph Coyne MAILING ADDRESS: 18 Bondi Pl, Kingscliff NSW 2487, Australia TELEPHONE: +61 411 529 390 EMAIL: coach@josephcoyne.com 19 BRIEF RUNNING HEAD: Training Load and Basketball Performance 20 21 22 **ABSTRACT WORD COUNT: 249** 23 24 TEXT-ONLY WORD COUNT: 3566 25 26 NUMBER OF TABLES: 2 27 28 NUMBER OF FIGURES: 1 29 30 SUPPLEMENTARY MATERIAL: 1

- 1 Relationships Between Different Internal and External Training Load Variables and Elite
- 2 International Women's Basketball Performance

- 3 ABSTRACT
- 4 *Purpose*: To investigate the relationships between internal and external training load (TL) 5 metrics with elite international women's basketball performance.
- 6 *Methods*: Sessional ratings of perceived exertion, PlayerLoad<sup>TM</sup>/minute and training duration
- 7 were collected from thirteen elite international level female basketball athletes ( $29.0 \pm 3.7$  years,
- 8  $186.0 \pm 9.8$  cm,  $77.9 \pm 11.6$  kg) during the 18 weeks prior to the International Basketball
- 9 Federation (FIBA) Olympic qualifying event for the 2016 Rio Olympic Games. Training stress
- balance (TSB), differential load and the training efficiency index (TE<sub>1</sub>) were calculated with 10
- 11 three different smoothing methods. These TL metrics and their change in the last 21 days prior
- 12 to competition were examined for their relationship to competition performance as coach ratings of performance. 13
- 14 *Results*: For a number of TL variables, there were consistent significant small to moderate
- 15 correlations with performance and significant small to large differences between successful
- and unsuccessful performances. However, these differences were only evident for external TL 16
- 17 when using exponentially weighted moving averages to calculate TL. The variable that seemed
- most sensitive to performance was the change in  $TE_I$  in the last 21 days prior to competition 18
- 19 (performance r=0.47-0.56, p<0.001 and difference between successful and unsuccessful
- performance  $p < 0.001, f^2 = 0.305 0.431$ ) 20
- Internal and external TL variables were correlated with performance and 21 Conclusions:
- 22 distinguished between successful and unsuccessful performances amongst the same players
- 23 during international women's basketball games. Manipulating TL in the last 3 weeks prior to
- competition may be worthwhile for basketball players' performance; especially in internal TL. 24
- 25
- **KEYWORDS** 26
- 27 Monitoring, Simple Moving Average, Exponentially Weighted Moving Average, REJIEN
- 28 Periodization

### 29 INTRODUCTION

Basketball is a five versus five open skill team sport that involves intermittent high intensity 30 efforts regardless of sex.<sup>1</sup> Competitions at an international level (i.e. country versus country) 31 32 normally culminate every four years at the Olympic Games. There are a number of matches 33 and tournaments prior to the Olympic Games that are necessary for qualification and/or seeding. 34 These matches and tournaments are characterized by a high number of basketball games within 35 a few days which could lead to poor performance and increases in illness and injury risk.<sup>2</sup> As such, monitoring and adjusting training loads (TL) to reduce likelihoods of poor performance 36 or injury/illness is considered important for practitioners.<sup>3,4</sup> Although there appears to be 37 38 research available in amateur<sup>5</sup>, NCAA Division I<sup>6</sup> and European professional<sup>7</sup> women's

- 39 basketball, there seems to be a knowledge gap on the practice and competition TL demands in
- 40 elite international women's basketball.

41 There are a number of different measures used to monitor TL in basketball.<sup>3</sup> These different 42 measures are used to assess either internal load (i.e. the athlete's response to the training) or external load (i.e. the actual work performed in training).<sup>8</sup> It is recommended that both these 43 44 constructs are monitored, along with their relationship, to optimize the training of athletes.<sup>4,8,9</sup> 45 For instance, a consistent trend of greater external TLs with lower internal TL responses over 46 time in an athlete may represent a positive adaptation to training and vice versa for a negative 47 adaptation.<sup>10</sup> The training efficiency index (TE<sub>l</sub>), which is an allometric log-transformed ratio 48 of external to internal TL, is one method of quantifying the relationship between internal and external TL in team sport athletes.<sup>10</sup> In regards to internal TL, one of the most widely reported 49 50 measures in basketball is sessional ratings of perceived exertion (sRPE),<sup>3</sup> which is generally 51 recommended as a primary TL measure in most team sports.<sup>11</sup> There is also evidence for a 52 relationship between sRPE and in-game performance in other open skill team sports (e.g. 53 Australian Rules football).<sup>12,13</sup> In regards to external TL, tri-axial accelerometry, and in particular PlayerLoad<sup>TM</sup> (PL), is a validated commonly used measure that seems well suited to 54 monitor external loads in basketball.<sup>3,5,14</sup> However, the evidence for a relationship between 55 56 sRPE or tri-axial accelerometry with in-game performance in basketball is limited (potentially 57 due to the complexity of team sport performance)<sup>4</sup> and bears further investigation.

58 Despite there being a variety of athlete monitoring measures used in basketball, TL models are generally constructed using training impulse (TRIMP) data.<sup>15,16</sup> TRIMP is the product of an 59 intensity factor and a volume/duration factor.<sup>16</sup> An athlete's response to training can then be 60 quantified (to an extent) from TRIMP values as the difference between longer-term chronic 61 62 positive "fitness" and shorter-term acute negative "fatigue" functions.<sup>15,16</sup> Recently, this 63 concept has led to the development of the acute to chronic workload ratio (ACWR), which is a measure of relative change in TL.<sup>17</sup> The ACWR is calculated as the ratio between the simple 64 65 moving averages (SMA) of TL over acute and chronic periods.<sup>17</sup> However, significant concerns have been recently presented on the ACWR. Although the effects of mathematical 66 coupling on the ACWR had trivial effect in one study<sup>18</sup>, there may be critical statistical issues 67 with the ACWR (e.g. failure to normalise correctly)<sup>19</sup> and the previous literature using the 68 ratio.<sup>20</sup> For practitioners concerned with these issues but still wishing to measure changes in 69 TL, alternatives include training stress balance (TSB)<sup>21</sup> and differential load.<sup>13,22</sup> TSB is 70 71 calculated as the difference between the chronic and acute periods and differential load is an exponential smoothing of week-to-week rate of change in TL.<sup>13,21</sup> Regarding smoothing of 72 TL, there have also been discussions over the most suitable moving average methods.<sup>23</sup> 73 74 Exponentially weighted moving averages (EWMA) have been endorsed as a more suitable smoothing method to SMA.<sup>23,24</sup> However, like SMA, there are also conceptual issues with 75 EWMA (e.g. individual "fitness" and "fatigue" gain and decay rates)<sup>9</sup> and there have also been 76

different EWMA calculations presented in the available TL research.<sup>13,24</sup> These different
 smoothing methods all produce different TL values for acute and chronic periods. It is also
 not established which smoothing method produces TL metrics that have superior relationships
 to performance.

81

82 In light of the lack of available research on elite international women's basketball practice and 83 competition TL and the call for more work on understanding how TL metrics relate to 84 performance in all team sports, not just basketball<sup>4</sup>; further investigation in these areas is 85 warranted. Therefore, the three primary aims of this study are to: i) provide data of common 86 sRPE and tri-axial accelerometry TL metrics used in basketball for practitioners working in 87 elite international women's basketball; ii) examine whether different external/internal TL 88 metrics and their relationship to one another were correlated to in-game performance; and iii) 89 determine if meaningful differences existed in these TL metrics between successful and 90 unsuccessful in-game performances in elite international women's basketball. We 91 hypothesized that there would be correlations between TL metrics and performance and 92 significant differences in TL metrics between higher and lower performers. Due to the debate 93 over the different smoothing methods for TL metrics and the criticisms of the ACWR, this investigation has presented alternative change in load measures (TSB and differential load) and 94 95 the three main smoothing methods used in previous literature to add to the evidence base for

- 96 practitioners.
- 97
- 98 METHODS
- 99 Participants

Thirteen elite international level female basketball athletes participated in this study (age 29.0 100 101  $\pm$  3.7 years, stature 186.0  $\pm$  9.8 cm, body mass 77.9  $\pm$  11.6 kg). All athletes were part of the 102 final squad selected for the 2016 Rio Olympics and had previously competed in senior 103 professional competitions and/or internationally at the Olympic, World Championship or 104 World Junior Championship levels. The data for this study was initially collected within the 105 athletes' training environment and was released de-identified from the athletes and respective National Olympic Committee. Approval for this investigation was granted by the University 106 107 Human Ethics Committee (Approval #19521) and conforms to the Code of Ethics of the World 108 Medical Association (Declaration of Helsinki).

- 109
- 110 Design

111 This investigation was a retrospective observational study. TL data were collected from the 112 participants for 18 weeks prior to the International Basketball Federation (FIBA) Olympic 113 qualifying event for the 2016 Rio Olympic Games. Illness or injury incidents that caused an 114 athlete to modify technical training or seek medical attention were also noted throughout the 115 data collection period.<sup>25</sup> Correlations of different TL metrics with competitive performance 116 were examined. Differences in the TL metrics of higher and lower performers were also 117 investigated.

- 118
- 119 *Methodology*

120 Training impulse (TRIMP) was calculated from internal and external TL and included 121 competition workloads i.e. games/tournaments. Internal TRIMP was the product of sRPE and

session duration (t).<sup>26</sup> External TRIMP was the product of PlayerLoad<sup>TM</sup>/minute (PL/min)

derived from Catapult Sports (Melbourne, Australia) accelerometers and session duration (t).<sup>5</sup>

124 PlayerLoad<sup>TM</sup> is an arbitrary unit derived from triaxial measures of rate of change in

- acceleration and is validated for use in basketball.<sup>14</sup> The following metrics were calculated
- daily from the internal and external TRIMP data: i) acute TL (7 day average), ii) chronic TL

127 (21 day average); iii) TSB (chronic - acute TL), iv) differential load, v) TE<sub>1</sub> average over 5 days (TE<sub>1</sub>5) and vi) TE<sub>1</sub> average over 7 days (TE<sub>1</sub>7) using established methods.<sup>10,13,15,27</sup> The 128 129  $TE_I$  was smoothed over 5 and 7 days to reduce measurement noise (similar to current 130 recommendations for heart rate variability)<sup>28</sup> and give an overall indication of the athletes' internal response to the external TL for the last week. These variables were calculated and 131 presented as SMA, EWMA as per Williams et al (EWMA-W)<sup>23</sup> and EWMA as per Lazarus et 132 133 al (EWMA-L)<sup>13</sup>. The key difference between SMA and EWMA methods is that EWMA will 134 give an increased weighting to the most recent TL an athlete completes in a period whereas 135 SMA will provide an even weighting of the TL over the period.

136

137 The acute and chronic periods were set at 7 and 21 days respectively. Differential load was 138 also assessed using 7- and 21-day exponential decays. The period length determination was 139 based on the typical training micro-mesocycle combination employed by the head coach.<sup>9</sup> Based on research in elite weightlifting performance<sup>29</sup>, TSB was assessed as: i) absolute values, 140 141 which represented the value on the day of the competition; ii) the value 21 days prior to competition subtracted from the value on the day of the competition (CH21); and iii) the 142 143 volatility (calculated as the standard deviation) of values in the last 21 days prior to competition 144 (VOL21). The change in TE<sub>1</sub>5 and TE<sub>1</sub>7 over the 21 days prior to competition was also 145 examined. The last 21 days prior to competition was chosen for the time period of interest 146 based on the results of existing performance modelling research and tapering research in a 147 basketball setting.<sup>30-32</sup> Lastly, the percentage of training burdened by injury/illness compared 148 to total training time was considered in the last 21 days before competition.<sup>25</sup> This percentage 149 of burdened training to total training was based on any injury or illness that affected an athlete's training (e.g. a shoulder injury may have limited shooting volume in training) or required 150 medical intervention. Any injury or illness incidents were identified by the team doctor or 151 152 physical therapist and their respective lengths were noted by the research team. If athletes were 153 absent from training due to injury/illness, TRIMP was recorded as zero to enable continuous 154 calculations.

155

TL and injury/illness metrics were then compared against performance expressed as coach 156 157 ratings of performance. Coach ratings of performance have been used in other open skill team 158 sports<sup>33</sup> and in this investigation, were the average of three different 1-10 scales (physical, 159 mental and technical performance). All ratings were collected individually from the head coach and assistant coach within 24 hours of team performance. The final coach rating 160 161 represented the average of both coaches' ratings across all three performance dimensions 162 (physical, mental and technical). Efficiency, which is a common overall basketball value statistic, was also calculated where available from individual player's box scores.<sup>34</sup> Coach 163 ratings were used in preference over the efficiency statistic to adequately capture an athlete's 164 165 holistic individual contribution to team performance and strategy bearing in mind the 166 complexity of team sport performance, playing positions, line-up and strength of the 167 opposition.<sup>4,9</sup> To account for coaches' biases towards certain players and factors like playing 168 positions, the coach ratings were converted into z-scores for each individual player. Then the allocation into either the successful performances (better than average, n=96) or unsuccessful 169 170 performances (worse than average performances, n=61) was determined by whether the 171 coaches' rating z-score was greater or lesser than 0.2; representing the smallest worthwhile 172 change.35

173

#### 174 Statistical Analysis

175 Statistical analyses were performed using statistical software (R statistics packages: *lmerTest*,

176 rmcorr, and performance; https://www.r-project.org) or purposefully designed Excel

177 spreadsheets (Microsoft Corporation, Washington, U.S.). All data were analyzed as mean  $\pm$ 178 standard deviation (SD). The alpha level for significance for all tests was defined as  $p \le 0.05$ . 179 Repeated measure correlation analyses with 95% confidence intervals were used to determine 180 if there were any linear relationships between the TL metrics across different smoothing 181 methods, training burdened by injury/illness and coach ratings of performance. Correlations were interpreted as per the recommendations of Hopkins et al.<sup>35</sup> R-z transformations were also 182 183 applied to determine if there were any significant differences between correlations amongst the various smoothing methods. Due to the repeated measure data structure in the TL metrics, 184 185 linear mixed models with the athlete as the random intercept were then used to assess 186 differences between successful and unsuccessful performances. All models were checked for 187 a) linearity, b) residual independence, and c) residual normality. Again due to the repeated measure data structure, effect sizes of any differences from the models (marginal  $f^2$ )<sup>36</sup> were 188 189 then calculated and interpreted as trivial (<0.02), small (0.02-0.14), moderate (0.15-0.34) and 190 large (>0.35).<sup>37</sup>

191

### 192 RESULTS

193 A total of 1642 training, 15 games and 167 competition data points across the participants were 194 included in the present analysis. The average sRPE was  $5.53 \pm 1.67$  AU and the average 195 PL/min was  $4.62 \pm 1.97$  AU over all recorded sessions. The average training sRPE was 196 significantly different with small effect size from the average competition sRPE  $(5.37 \pm 1.62)$ 197 and 7.11  $\pm$  1.22 AU respectively, p < 0.001,  $f^2 = 0.105$ ). This was also the case for PL/min in 198 training versus competition with large effect size  $(4.08 \pm 1.02 \text{ and } 9.72 \pm 1.51 \text{ AU}, p < 0.001)$ 199  $f^2=2.344$ ). The repeated measure correlation between sRPE and PL/min was moderate (r=0.43, 200 p < 0.001). The daily internal TRIMP average was  $648 \pm 496$  AU and the daily external TRIMP average was  $398 \pm 282$  AU. In competition, the average coach rating was  $6.40 \pm 1.51$  and 201 202 average efficiency score was  $6.88 \pm 5.55$ . The repeated measure correlation between coach 203 ratings and efficiency from individual player's box scores was moderate (r=0.35, p=0.02). The 204 time series of  $TE_{17}$  and external/internal TL TSB (calculated using EWMA-W) with coach 205 ratings of performance as z-scores are presented in Figure 1.

- 206
- 207 208

## FIGURE 1 ABOUT HERE

209 Repeated measure correlations between coaches' ratings of performance and the different TL metrics are presented in Table 1. There were consistent significant small to moderate 210 211 correlations with performance across all the external TL metrics when calculated with EWMA-212 W or EWMA-L with the exception of weekly change and chronic TL EWMA-L. Only external 213 TL TSB VOL21 was correlated with performance when calculated with SMA. There were also consistent small to large significant correlations between all the internal TL metrics and 214 215 performance calculated with all the smoothing methods. The only exceptions to this were 216 weekly change, acute TL SMA and chronic TL EWMA-W/-L. There were no significant correlations between  $TE_{1}5$  or  $TE_{1}7$  and performance. However, there were moderate to large 217 significant correlations between the change in TE<sub>1</sub>5 and TE<sub>1</sub>7 over the last 21 days preceding 218 competition and performance. There was no significant correlation between training burdened 219 220 by injury or illness in the last 21 days prior to competition and performance in this investigation 221 (r=-0.04, p=0.60).

- 222
- 223
- 224

#### TABLE 1 ABOUT HERE

There were significant differences in a number of the TL metrics between successful and unsuccessful performances in this investigation. For the external TL metrics (presented in 227 Table 2A), there were consistent significant differences with small effect size between 228 successful and unsuccessful performances in acute TL, TSB, TSB VOL21, and both 7- and 21day differential load when calculated with EWMA-W and EWMA-L. In contrast, when using 229 230 SMA, there was only one external TL variable (TSB VOL21) that was significantly different between successful and unsuccessful performances. For the internal TL metrics (presented in 231 232 Table 2B), there were consistent significant differences across all smoothing methods with 233 small to large effect size between successful and unsuccessful performances in TSB, TSB 234 CH21 and both 7- and 21-day differential load. For the training efficiency index variables 235 (presented in Table 2C), there were significant differences with moderate to large effect sizes 236 between successful and unsuccessful performances in the change in TE<sub>1</sub>5 and TE<sub>1</sub>7 over the 21 237 days prior to competition. These differences were significant across all smoothing methods. 238 There was not a significant difference between successful and unsuccessful performance in the 239 training burdened by injury or illness in the last 21 days prior to competition (p=0.79,  $f^2<0.001$ ).

240 241

242

#### TABLE 2A-C AROUND HERE

#### 243 DISCUSSION

244 To our knowledge, this is the first investigation to detail values of both internal and external 245 TL in an elite international women's basketball team in the qualification stages for the Olympic 246 Games. For external TL, the levels of PL/min were greater than previously reported in amateur 247 and NCAA Division I female basketball athletes.<sup>5,6</sup> Weekly internal TL was also greater than 248 previously published levels in European professional female basketball athletes.<sup>7</sup> The higher 249 playing standard of athletes in this investigation compared to the previous research (i.e. 250 professional international level versus professional national level or collegiate) may explain 251 these differences. It is reasonable that the higher playing standards of international basketball 252 would require more regular training at higher workloads along with players more able to 253 regularly handle these higher workloads. Along with the average daily external TRIMP levels, 254 this information may help coaches and practitioners progress the workloads of athletes to an 255 international level and prescribe workloads at that same level. Of interest was the significant 256 differences between competition and training PL/min levels which were similar to previous research in amateur female basketball athletes.<sup>5</sup> Although training will not always be at 257 258 competition intensity and skill development (e.g. shooting drills) or periods of coach feedback will reduce the average PL/min of the session, the magnitude of this difference may have 259 represented a situation where competition intensities were not being replicated often enough in 260 261 Practitioners are recommended to monitor differences between training and training. 262 competition external TL, and in particular the intensities in different components of training 263 (e.g. competition-style scrimmages versus lower intensity skill development) to help ensure athletes are adequately prepared for the intensity demands of competition. 264

265

266 In this investigation, successful performances were characterized by a higher TSB (~10-20 AU external TL, ~50 AU internal TL) and a lower differential load when compared to unsuccessful 267 performances. Further, the TE<sub>1</sub>5 and TE<sub>1</sub>7 change over the last 21 days before competition had 268 the greatest correlations and largest effect sizes of all the variables when assessed against 269 270 successful and unsuccessful performances. It is interesting the relationship between changes 271 in TE<sub>1</sub>5 and TE<sub>1</sub>7 and performance were much stronger than TE<sub>1</sub>5 and TE<sub>1</sub>7 on the day of competition. This finding indicates relatively higher internal to external TL levels prior to the 272 273 taper as beneficial in this investigation. This finding may also be related to previous tapering 274 research that suggested an increase in TL  $\sim 20\%$  prior to the taper leads to better taper outcomes.<sup>38</sup> As the TE<sub>1</sub> quantifies the external-internal TL interaction<sup>10</sup>, this finding is novel 275 in that the taper prior to basketball games in this investigation were greater in internal than 276

277 external TL for successful performances. Related to this finding was the greater internal TSB CH21 of ~140-250 AU for successful compared to unsuccessful performances; which is similar 278 to previous research on elite weightlifting performance.<sup>29</sup> These findings are consistent with 279 the suggestion that internal TL ultimately determines the training outcome (in this case, 280 basketball in-game performance) for athletes.<sup>8</sup> These findings also reinforce the need for 281 practitioners to be cognizant of the potential differences between external and internal TL and 282 283 to use and compare both to optimize performance in basketball athletes.<sup>8</sup> Based on the results of this study, external TL may not require as much of a taper relative to internal TL as 284 285 basketball athletes are approaching competition. In practice, this outcome may be achieved 286 "naturally" as athletes become fitter to a consistent external TL and therefore perceive the same 287 workload in training sessions to be easier. We also suggest that a reduction in internal TL 288 relative to external TL could be achieved by coaches reducing the amount of novel cognitive 289 work<sup>39</sup> an athlete needs to complete in training prior to competition or by modifying other 290 coaching behaviours (e.g. more frequent positive reinforcement) that may make athletes 291 subjectively feel "fresher". It is of interest that this may hold true for both subjective (e.g. 292 sRPE) and objective measures (e.g. heart rate) of internal load.<sup>39</sup>

293

294 Another item of interest from this investigation was that the significant correlations and 295 differences for external TL and performance were only significant when smoothing the TL 296 variables with EWMA-W or EWMA-L. These findings support previous research on injury 297 risk in Australian Rules football<sup>24</sup> that suggested EWMA smoothing methods may be more 298 appropriate for calculating TL which is potentially due to the increased weighting EWMA 299 gives the more recent TL when compared to SMA. However, given there was no significant 300 difference between correlations for internal TL metrics and performance, this raises the 301 consideration that different smoothing methods may be more appropriate depending on 302 whether the TL is internal or external. It is likely this is again due to the different weightings 303 SMA and EWMA assign earlier or later values in acute and chronic periods. It also raises the 304 consideration that internal TL may be as or more sensitive to performance when calculated 305 using SMA with a greater weighting of TL values in the early stages of acute and chronic 306 periods. There also appeared to be little to no difference between the different change in TL 307 measures used (i.e. TSB, differential load) in correlation magnitude or effect size in this 308 investigation. For practitioners concerned with statistical and methodological issues from 309 previous literature on the ACWR, both the TSB and differential load appear to be non-ratio change in TL measures that have relationships to performance. This recommendation is 310 311 supported by previous research on both performance in Australian football<sup>13</sup> and injury risk in 312 English cricket.<sup>22</sup>

313

314 There are a number of potential limitations with this study. Firstly, having only two coaches 315 assessing basketball performance and both coaches being from the same national team as the 316 players was a potential limitation. Although the coaches were blinded to one another when rating the performances, this situation may have been prone to bias (e.g. coaches generally 317 have preferred players) or similar ratings (e.g. normally an assistant coach will appraise 318 performance relatively similar to the head coach on the same team). Using independent expert 319 320 raters (e.g. experienced coaches not associated with the team but who would still understand 321 the roles and game plans for individual players) and a greater number of raters would be recommended in the future. Another potential limitation was the timeframes chosen for acute, 322 323 chronic and taper periods may not be applicable to other basketball teams or to other 324 professional basketball leagues where the game schedule may be both more condensed and 325 over a longer period. There were also only two TL variables measured and other internal (e.g. 326 heart rate measures) and external (e.g. other inertial movement analysis) measures may provide

different results. Lastly, as this was only one national team monitored across a single
 international competitive season, practitioners should interpret this investigation's findings and
 level of evidence as a case study. More research is warranted in elite basketball populations
 (both men and women) on the relationship between internal and external TL and performance.

331332 PRACTICAL APPLICATIONS

333 Coaches and practitioners can use the descriptive values of PL/min and sRPE and the 334 comparison between competition and training intensities (especially with external TL) in this investigation to help prepare athletes for international basketball competition. It also seems 335 336 that the TSB or differential load is correlated with basketball performance and distinguishes 337 between better and worse performances amongst the same players. The TSB and differential 338 load seem to be suitable alternatives to the ACWR for practitioners wanting to measure change 339 in TL, with the TSB being the most parsimonious. Increasing internal TL TSB in the last 3 weeks prior to competition seems to be worthwhile for basketball athletes and there may also 340 341 be differences between optimal changes in external TL and internal TL in the taper period. We recommend the internal-external TL interaction should be monitored in some manner (e.g. 342 343  $TE_{1}$  and potentially manipulated to optimise performance in basketball; ideally at an individual athlete level. It may also be worthwhile for practitioners working in basketball to 344 345 deliberately plan for these outcomes. Lastly, it may be most appropriate to use an EWMA to 346 calculate TL especially if using external TL measures.

- 347
- 348 CONCLUSIONS

To the authors' knowledge, this is the first investigation to provide normative values for 349 PL/min and sRPE derived TL metrics in an elite international women's basketball team during 350 the qualifying stages for an Olympic Games. This investigation demonstrated consistent 351 352 significant small to large correlations between different TL variables and basketball 353 performance and there were also significant differences with small to large effect size between 354 successful and unsuccessful performance groups. Successful basketball performances were 355 characterized by a higher TSB, larger TSB change in the last 21 days before competition and 356 lower differential load compared to non-successful performances in the same basketball 357 players. However, these results seemed to appear to a greater extent in internal TL as evidenced by a greater positive change in the training efficiency index for successful performances. 358 359 Different smoothing methods did not seem to impact these results for internal TL however external TL variables seemed more sensitive to performance when calculated using an EWMA. 360

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<ol> <li>Stojanovic E, Stojijkovic N, Scanlan AT, Dalbo VJ, Berkelmans DM, Milanovic Z, The Activity Demands and Physiological Responses Encountered During Basketball Match-Play: A Systematic Review. Sports Med. 2018;48(1):111-135.</li> <li>McLean BD, Strack D, Russell J, Coutts AJ, Quantifying Physical Demands in the National Basketball Association-Challenges Around Developing Best-Practice Models for Athlete Care and Performance. Int J Sports Physiol Perform. 2019;14(4):414-420.</li> <li>Fox JL, Scanlan AT, Stanton R. A Review of Player Monitoring Approaches in Basketball: Current Trends and Future Directions. J Strength Cond Res. 2017;31(7):2021-2029.</li> <li>Fox JL, Stanton R, Sargent C, Wintour SA, Scanlan AT. The Association Between Training Load and Performance in Team Sports: A Systematic Review. Sports Med. 2018;48(12):2743-2774.</li> <li>Reina Român M, Garcia-Rubio J, Feu S, Ibáñez SJ. Training and Competition Load Monitoring and Analysis of Women's Amateur Basketball by Playing Position: Approach Study. Front Psychol. 2019;9(2689).</li> <li>Ransdell LB, Murray T, Gao Y, Jones P, Bycura D. A 4-Year Profile of Game Demands in Ellic Women's Division 1 College Basketball. The Journal of Strength &amp; Conditioning Research. 2020;34(3):632-638.</li> <li>Paulauskas H, Kreivyte R, Scanlain AT, Moreira A, Stupsinskas L, Conte D. Monitoring Workload in Ellic Female Basketball Players During the In-Season Phase: Weekly Fluctuations and Effect of Playing Time. Int J Sports Physiol Perform. 2019;14(7):941-948.</li> <li>Impellizzeri FM, Marcora SM, Coutts AJ. Internal and external training load: 15 years on. Int J Sports Physiol Perform. 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ. Internal and external training load: 15 years on. Int J Sports Physiol Perform. 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ. Internal and external training load intensity in team sports: A meta-analysis. Sports Med. 2018;48(3):641-658.</li> <li>Delaney</li></ol>	375	REFEI	RENCES
<ul> <li>The Activity Demands and Physiological Responses Encountered During Basketball Match-Play: A Systematic Review. <i>Sports Med.</i> 2018;48(1):111-135.</li> <li>McLean BD, Strack D, Russell J, Coutts AJ. Quantifying Physical Demands in the National Basketball Association-Challenges Around Developing Best-Practice Models for Athlete Care and Performance. <i>Int J Sports Physiol Perform.</i> 2019;14(4):414-420.</li> <li>Fox JL, Scanlan AT, Stanton R. A Review of Player Monitoring Approaches in Basketball: Current Trends and Future Directions. <i>J Strength Cond Res.</i> 2017;31(7):2021-2029.</li> <li>Fox JL, Stanton R, Sargent C, Wintour SA, Scanlan AT. The Association Between Training Load and Performance in Team Sports: A Systematic Review. <i>Sports Med.</i> 2018;48(12):2743-2774.</li> <li>Reina Román M, Garcia-Rubio J, Feu S, Ibáñez SJ. Training and Competition Load Monitoring and Analysis of Womer's Amateur Basketball by Playing Position: Approach Study. <i>Front Psychol.</i> 2019;9(2689).</li> <li>Ransdell LB, Murray T, Gao Y, Jones P, Bycura D. A 4-Year Profile of Game Demands in Elite Women's Division I College Basketball. <i>The Journal of Strength &amp; Conditioning Research.</i> 2020;34(3):632-638.</li> <li>Paulauskas H, Kreivyte R, Scanlan AT, Moreira A, Siupsinskas L, Conte D. Monitoring Workload in Elite Female Basketball Players During the In-Season Phase: Weckly Fluctuations and Effect of Playing Time. <i>Int J Sports Physiol Perform.</i> 2019;14(7):941-948.</li> <li>Impelitzzeri FM, Marcora SM, Coutts AJ. Internal and external training load: 15 years on. <i>Int J Sports Physiol Perform.</i> 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ, Newton RU, Nimphins S. The current state of subjective training load monitoring—a practical perspective and call to action. <i>Sports Med Open.</i> 2018;4(1):58.</li> <li>Delaney JA, Duthic GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. <i></i></li></ul>	376	1.	Stojanovic E, Stojiljkovic N, Scanlan AT, Dalbo VJ, Berkelmans DM, Milanovic Z.
<ul> <li>Match-Play, A Systematic Review. Sports Med. 2018;48(1):111-135.</li> <li>McLean BD, Strack D, Russell J, Coutts AJ. Quantifying Physical Demands in the National Basketball Association-Challenges Around Developing Best-Practice Models for Athlete Care and Performance. Int J Sports Physiol Perform. 2019;14(4):414-420.</li> <li>Fox JL, Scanlan AT, Stanton R. A Review of Player Monitoring Approaches in Basketball: Current Trends and Future Directions. J Strength Cond Res. 2017;31(7):2021-2029.</li> <li>Fox JL, Stanton R, Sargent C, Wintour SA, Scanlan AT. The Association Between Training Load and Performance in Team Sports: A Systematic Review. Sports Med. 2018;48(12):2743-2774.</li> <li>Reina Román M, Garcia-Rubio J, Feu S, Ibáñez SJ. Training and Competition Load Monitoring and Analysis of Women's Amateur Basketball by Playing Position: Approach Study. Front Psychol. 2019;9(2689).</li> <li>Ransdell LB, Murray T, Gao Y, Jones P, Bycura D. A 4-Year Profile of Game Demands in Elite Women's Division I College Basketball. The Journal of Strength &amp; Conditioning Research. 2020;34(3):632-638.</li> <li>Paulauskas H, Kreivyte R, Scanlan AT, Moreira A, Siupsinskas L, Conte D. Monitoring Workload in Elite Female Basketball Players During the In-Season Phase: Weekly Fluctuations and Effect of Playing Time. Int J Sports Physiol Perform. 2019;14(7):941-948.</li> <li>Impellizzeri FM, Marcora SM, Coutts AJ. Internal and external training load: 15 years on. Int J Sports Physiol Perform. 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ, Newton RU, Nimphius S. The current state of subjective training load monitoring—a practical perspective and call to action. Sports Med Open. 2018;4(1):58.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficience; Index. Science and Medicine in Football. 2018:1-8.</li> <li>McLaren SJ, Macpherson TW, Coutts AJ, Hu</li></ul>	377		The Activity Demands and Physiological Responses Encountered During Basketball
<ol> <li>McLean BD, Strack D, Russell J, Coutts AJ. Quantifying Physical Demands in the National Basketball Association-Challenges Around Developing Best-Practice Models for Athlete Care and Performance. Int J Sports Physiol Perform. 2019;14(4):414-420.</li> <li>Fox JL, Stanlan AT, Stanton R. A Review of Player Monitoring Approaches in Basketball: Current Trends and Future Directions. J Strength Cond Res. 2017;31(7):2021-2029.</li> <li>Fox JL, Stanton R, Sargent C, Wintour SA, Scanlan AT. The Association Between Training Load and Performance in Team Sports: A Systematic Review. Sports Med. 2018;48(12):2743-2774.</li> <li>Reina Román M, Garcia-Rubio J, Feu S, Ibáñez SJ. Training and Competition Load Monitoring and Analysis of Women's Amateur Basketball by Playing Position: Approach Study. Front Psychol. 2019;9(2689).</li> <li>Ransdell LB, Murray T, Gao Y, Jones P, Bycura D. A 4-Year Profile of Game Demands in Elite Women's Division 1 College Basketball. The Journal of Strength &amp; Conditioning Research. 2020;34(3):632-638.</li> <li>Paulauskas H, Kreivyt R, Scanlan AT, Morcira A, Siupsinskas L, Conte D. Monitoring Workload in Elite Female Basketball Players During the In-Season Phase: Weekly Fluctuations and Effect of Playing Time. Int J Sports Physiol Perform. 2019;14(7):941-948.</li> <li>Impellizzeri FM, Marcora SM, Coutts AJ. Internal and external training load: 15 years on. Int J Sports Physiol Perform. 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ. Internal and external training load: 15 years on. Int J Sports Physiol Perform. 2019;14(2):270-273.</li> <li>Delaney JA, Duthic GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. Science and Medicine in Football, 2018;1-8.</li> <li>Delaney JA, Duthic GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index.</li></ol>	378		Match-Play: A Systematic Review. Sports Med. 2018;48(1):111-135.
<ul> <li>National Basketball Association-Challenges Around Developing Best-Practice Models for Athlete Care and Performance. Int J Sports Physiol Perform. 2019;14(4):414-420.</li> <li>Fox JL, Scanlan AT, Stanton R. A Review of Player Monitoring Approaches in Basketball: Current Trends and Future Directions. J Strength Cond Res. 2017;31(7):2021-2029.</li> <li>Fox JL, Stanton R, Sargent C, Wintour SA, Scanlan AT. The Association Between Training Load and Performance in Team Sports: A Systematic Review. Sports Med. 2018;48(12):2743-2774.</li> <li>Reina Román M, García-Rubio J, Feu S, Ibáñez SJ. Training and Competition Load Monitoring and Analysis of Women's Amateur Basketball by Playing Position: Approach Study. Front Psychol. 2019;9(2689).</li> <li>Ransdell LB, Murray T, Gao Y, Jones P, Bycura D. A 4-Year Profile of Game Demands in Elite Women's Division I College Basketball. The Journal of Strength &amp; Conditioning Research. 2020;34(3):632-638.</li> <li>Paulauskas H, Kreivyte R, Scanlan AT, Moreira A, Siupsinskas L, Conte D. Monitoring Workload in Elite Female Basketball Players During the In-Season Phase: Weekly Fluctuations and Elfect of Playing Time. Int J Sports Physiol Perform. 2019;14(7):941-948.</li> <li>Impellizzeri FM, Marcora SM, Coutts AJ, Internal and external training load: 15 years on. Int J Sports Physiol Perform. 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ, Newton RU, Nimphius S. The current state of subjective training load monitoring—a practical perspective and call to action. Sports Med Open. 2018;4(1):58.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of an ovel training efficiency index. Science and Medicine in Football. 2018:1-8.</li> <li>McL aren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load minetisty in team sports: A meta-analysis. Sports Med.</li></ul>	379	2.	McLean BD. Strack D. Russell J. Coutts AJ. Quantifying Physical Demands in the
<ul> <li>Models for Athlete Care and Performance. Int J Sports Physiol Perform. 2019;14(4):414-420.</li> <li>Fox JL, Scanlan AT, Stanton R. A Review of Player Monitoring Approaches in Basketball: Current Trends and Future Directions. J Strength Cond Res. 2017;31(7):2021-2029.</li> <li>Fox JL, Stanton R, Sargent C, Wintour SA, Scanlan AT. The Association Between Training Load and Performance in Team Sports: A Systematic Review. Sports Med. 2018;48(12):2743-2774.</li> <li>Reina Román M, Garcia-Rubio J, Feu S, Ibáñez SJ. Training and Competition Load Monitoring and Analysis of Women's Amateur Basketball by Playing Position: Approach Study. Front Psychol. 2019;9(2689).</li> <li>Ransdell LB, Murray T, Gao Y, Jones P, Bycura D. A 4-Year Profile of Game Demands in Elite Women's Division I College Basketball. The Journal of Strength &amp; Conditioning Research. 2020;34(3):632-638.</li> <li>Paulauskas H, Kreivyte R, Scanlan AT, Moreira A, Siupsinskas L, Conte D. Monitoring Workload in Elite Female Basketball Players During the In-Season Phase: Weekly Fluctuations and Effect of Playing Time. Int J Sports Physiol Perform. 2019;14(7):941-948.</li> <li>Coyno JOC, Gregory Haff G, Coutts AJ, Internal and external training load: 15 years on. Int J Sports Physiol Perform. 2019;14(2):270-273.</li> <li>Coyno JOC, Gregory Haff G, Coutts AJ, Newton RU, Nimphius S. The current state of subjective training load monitoring—a practical perspective and call to action. Sports Med Open. 2018;4(1):58.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external works lavetarian Football. 2018:1-8.</li> <li>McLaren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. Sports Med. 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in neofess</li></ul>	380		National Basketball Association-Challenges Around Developing Best-Practice
<ul> <li>2019;14(4):414-420.</li> <li>Fox JL, Scanlan AT, Stanton R. A Review of Player Monitoring Approaches in Basketball: Current Trends and Future Directions. J Strength Cond Res.</li> <li>2017;31(7):2021-2029.</li> <li>Fox JL, Stanton R, Sargent C, Wintour SA, Scanlan AT. The Association Between Training Load and Performance in Team Sports: A Systematic Review. Sports Med.</li> <li>2018;48(12):2743-2774.</li> <li>Reina Román M, Garcia-Rubio J, Feu S, Ibáñez SJ. Training and Competition Load Monitoring and Analysis of Womer's Amateur Basketball by Playing Position: Approach Study. Front Psychol. 2019;9(2689).</li> <li>Ransdell LB, Murray T, Gao Y, Jones P, Bycura D. A 4-Year Profile of Game Demands in Elite Womer's Division I College Basketball. The Journal of Strength &amp; Conditioning Research. 2020;34(3):632-638.</li> <li>Paulauskas H, Kreivyte R, Scanlan AT, Moreira A, Siupsinskas L, Conte D. Monitoring Workload in Elite Female Basketball Players During the In-Season Phase: Weekly Fluctuations and Effect of Playing Time. Int J Sports Physiol Perform. 2019;14(7):941-948.</li> <li>Impellizzeri FM, Marcora SM, Coutts AJ. Internal and external training load: 15 years on. Int J Sports Physiol Perform. 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ, Newton RU, Nimphius S. The current state of subjective training load monitoring—a practical perspective and call to action. Sports Med Open. 2018;4(1):58.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. Science and Medicine in Football. 2018;1-8.</li> <li>McLaren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. Sports Med. 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and</li></ul>	381		Models for Athlete Care and Performance Int. J Sports Physiol Perform.
<ol> <li>Fox JL, Scanlan AT, Stanton R. A Review of Player Monitoring Approaches in Basketball: Current Trends and Future Directions. <i>J Strength Cond Res.</i> 2017;31(7):2021-2029.</li> <li>Fox JL, Stanton R, Sargent C, Wintour SA, Scanlan AT. The Association Between Training Load and Performance in Team Sports: A Systematic Review. <i>Sports Med.</i> 2018;48(12):2743-2774.</li> <li>Reina Román M, García-Rubio J, Feu S, Ibáñez SJ. Training and Competition Load Monitoring and Analysis of Women's Amateur Basketball by Playing Position: Approach Study. <i>Front Psychol.</i> 2019;9(2689).</li> <li>Ransdell LB, Murray T, Gao Y, Jones P, Bycura D. A 4-Year Profile of Game Demands in Elite Women's Division 1 College Basketball. <i>The Journal of Strength &amp; Conditioning Research.</i> 2020;34(3):632-638.</li> <li>Paulauska H, Kreivyte R, Scanlan AT, Moreira A, Siupsinskas L, Conte D. Monitoring Workload in Elite Female Basketball Players During the In-Season Phase: Weekly Fluctuations and Elfect of Playing Time. <i>Int J Sports Physiol Perform.</i> 2019;14(7):941-948.</li> <li>Impellizzeri FM, Marcora SM, Coutts AJ. Internal and external training load: 15 years on. <i>Int J Sports Physiol Perform.</i> 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ, Newton RU, Nimphius S. The current state of subjective training load monitoring—a practical perspective and call to action. <i>Sports Med Open.</i> 2018;4(1):58.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. <i>Science and Medicine in Football.</i> 2018:1-8.</li> <li>McLaren SJ, Maepherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. <i>Sports Med.</i> 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional A</li></ol>	382		2019.14(4).414-420
<ul> <li>Basketball: Current Trends and Future Directions. J Strength Cond Res. 2017;31(7):2021-2029.</li> <li>Fox JL, Stanton R, Sargent C, Wintour SA, Scanlan AT. The Association Between Training Load and Performance in Team Sports: A Systematic Review. Sports Med. 2018;48(12):2743-2774.</li> <li>Reina Román M, Garcia-Rubio J, Feu S, Ibáñez SJ. Training and Competition Load Monitoring and Analysis of Women's Amateur Basketball by Playing Position: Approach Study. Front Psychol. 2019;9(2689).</li> <li>Ransdell LB, Murray T, Gao Y, Jones P, Bycura D. A 4-Year Profile of Game Demands in Elite Women's Division I College Basketball. The Journal of Strength &amp; Conditioning Research. 2020;34(3):632-638.</li> <li>Paulauskas H, Kreivyte R, Scanlan AT, Moreira A, Siupsinskas L, Conte D. Monitoring Workload in Elite Female Basketball Players During the In-Season Phase: Weekly Fluctuations and Effect of Playing Time. Int J Sports Physiol Perform. 2019;14(7):941-948.</li> <li>Impelitzzeri FM, Marcora SM, Coutts AJ, Internal and external training load: 15 years on. Int J Sports Physiol Perform. 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ, Newton RU, Nimphius S. The current state of subjective training load monitoring—a practical perspective and call to action. Sports Med Open. 2018;4(1):58.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. Science and Medicine in Football. 2018;4(3):641-658.</li> <li>Graham SR, Cormack S, Parfit G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an inseason training macrocycle. Int J Sports Physiol Perform. 2017;1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. Front Physiol. 2017;8:930.</li> <li>Staunton C, Wundersitz D,</li></ul>	383	3	Fox JL Scanlan AT Stanton R A Review of Player Monitoring Approaches in
<ol> <li>2017;31(7):2021-2029.</li> <li>Fox JL, Stanton R, Sargent C, Wintour SA, Scanlan AT. The Association Between Training Load and Performance in Team Sports: A Systematic Review. <i>Sports Med.</i> 2018;48(12):2743-2774.</li> <li>Reina Román M, García-Rubio J, Feu S, Ibáñez SJ. Training and Competition Load Monitoring and Analysis of Women's Amateur Basketball by Playing Position: Approach Study. <i>Front Psychol.</i> 2019;9(2689).</li> <li>Ransdell LB, Murray T, Gao Y, Jones P, Bycura D. A 4-Year Profile of Game Demands in Elite Women's Division 1 College Basketball. <i>The Journal of Strength &amp; Conditioning Research.</i> 2020;34(3):632-638.</li> <li>Paulauskas H, Kreivyte R, Scanlan AT, Moreira A, Siupsinskas L, Conte D. Monitoring Workload in Elite Female Basketball Players During the In-Season Phase: Weekly Fluctuations and Effect of Playing Time. <i>Int J Sports Physiol Perform.</i> 2019;14(7):941-948.</li> <li>Impellizzeri FM, Marcora SM, Coutts AJ. Internal and external training load: 15 years on. <i>Int J Sports Physiol Perform.</i> 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ. Newton RU, Nimphius S. The current state of subjective training load monitoring—a practical perspective and call to action. <i>Sports Med Open.</i> 2018;4(1):58.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. <i>Science and Medicine in Football.</i> 2018:1-8.</li> <li>McLaren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. <i>Sports Physiol Perform.</i> 2017;1-25.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an in- season training macrocycle. <i>Int J Sports Physiol Perform.</i> 2017;1-25.</li> <li>Graham SR, Cormack S, Pa</li></ol>	384		Basketball: Current Trends and Future Directions J Strength Cond Res.
<ol> <li>Fox JL, Stanton R, Sargent C, Wintour SA, Scanlan AT. The Association Between Training Load and Performance in Team Sports: A Systematic Review. Sports Med. 2018;48(12):2743-2774.</li> <li>Reina Román M, García-Rubio J, Feu S, Ibáñez SJ. Training and Competition Load Monitoring and Analysis of Women's Amateur Basketball by Playing Position: Approach Study. Front Psychol. 2019;9(2689).</li> <li>Ransdell LB, Murray T, Gao Y, Jones P, Bycura D. A 4-Year Profile of Game Demands in Elite Women's Division I College Basketball. The Journal of Strength &amp; Conditioning Research. 2020;34(3):632-638.</li> <li>Paulauskas H, Kreivyte R, Scanlan AT, Moreira A, Siupsinskas L, Conte D. Monitoring Workload in Elite Female Basketball Players During the In-Season Phase: Weekly Fluctuations and Effect of Playing Time. Int J Sports Physiol Perform. 2019;14(7):941-948.</li> <li>Impellizzeri FM, Marcora SM, Coutts AJ. Internal and external training load: 15 years on. Int J Sports Physiol Perform. 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ. Newton RU, Nimphius S. The current state of subjective training load monitoring—a practical perspective and call to action. Sports Med Open. 2018;4(1):58.</li> <li>Delaney JA, Duthic GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. Science and Medicine in Football. 2018;1-8.</li> <li>McLaren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. Sports Med. 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an in- season training macrocycle. Int J Sports Physiol Perform. 2017;1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load meas</li></ol>	385		2017.31(7).2021-2029
<ul> <li>Training Load and Performance in Team Sports: A Systematic Review. Sports Med. 2018;48(12):2743-2774.</li> <li>Reina Román M, García-Rubio J, Feu S, Ibáñez SJ. Training and Competition Load Monitoring and Analysis of Women's Amateur Basketball by Playing Position: Approach Study. Front Psychol. 2019;9(2689).</li> <li>Ransdell LB, Murray T, Gao Y, Jones P, Bycura D. A 4-Year Profile of Game Demands in Elite Women's Division I College Basketball. The Journal of Strength &amp; Conditioning Research. 2020;34(3):632-638.</li> <li>Paulauskas H, Kreivyte R, Scanlan AT, Moreira A, Siupsinskas L, Conte D. Monitoring Workload in Elite Female Basketball Players During the In-Season Phase: Weekly Fluctuations and Effect of Playing Time. Int J Sports Physiol Perform. 2019;14(7):941-948.</li> <li>Impellizzeri FM, Marcora SM, Coutts AJ. Internal and external training load: 15 years on. Int J Sports Physiol Perform. 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ, Newton RU, Nimphius S. The current state of subjective training load monitoring—a practical perspective and call to action. Sports Med Open. 2018;4(1):58.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. Science and Medicine in Football. 2018:1-8.</li> <li>McL aren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. Sports Med. 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an in-season training macrocycle. Int J Sports Physiol Perform. 2017;1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. Front Physiol. 2017;8</li></ul>	386	4	Fox IL Stanton R Sargent C Wintour SA Scanlan AT The Association Between
<ol> <li>Training Foundational and Technological Action Systematic Review Systematics and the relationship of the action of the systematic review Systematic Review Systematics (Second Systematics) (Second Systematic</li></ol>	387	1.	Training Load and Performance in Team Sports: A Systematic Review Sports Med
<ul> <li>Reina Román M, García-Rubio J, Feu S, Ibáñez SJ. Training and Competition Load Monitoring and Analysis of Women's Amateur Basketball by Playing Position: Approach Study. Front Psychol. 2019;9(2689).</li> <li>Ransdell LB, Murray T, Gao Y, Jones P, Bycura D. A 4-Year Profile of Game Demands in Elite Women's Division I College Basketball. The Journal of Strength &amp; Conditioning Research. 2020;34(3):632-638.</li> <li>Paulauskas H, Kreivyte R, Scanlan AT, Moreira A, Siupsinskas L, Conte D. Monitoring Workload in Elite Female Basketball Players During the In-Season Phase: Weekly Fluctuations and Effect of Playing Time. Int J Sports Physiol Perform. 2019;14(7):941-948.</li> <li>Impellizzeri FM, Marcora SM, Coutts AJ. Internal and external training load: 15 years on. Int J Sports Physiol Perform. 2019;14(2):270-273.</li> <li>Coyne IOC, Gregory Haff G, Coutts AJ, Newton RU, Nimphius S. The current state of subjective training load monitoring—a practical perspective and call to action. <i>Sports Med Open</i>. 2018;4(1):58.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. Science and Medicine in Football. 2018:1-8.</li> <li>McLaren SJ, Maepherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. Sports Med. 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an in- season training macrocycle. Int J Sports Physiol Perform. 2017:1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. Front Physiol. 2017;8:930.</li> <li>Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Fo</li></ul>	388		2018·48(12)·2743-2774
<ul> <li>Monitoring and Analysis of Womer's Amateur Basketball by Playing Position: Approach Study. <i>Front Psychol.</i> 2019;9(2689).</li> <li>Ransdell LB, Murray T, Gao Y, Jones P, Bycura D. A 4-Year Profile of Game Demands in Elite Women's Division I College Basketball. <i>The Journal of Strength &amp; Conditioning Research.</i> 2020;34(3):632–638.</li> <li>Paulauskas H, Kreivyte R, Scanlan AT, Moreira A, Siupsinskas L, Conte D. Monitoring Workload in Elite Female Basketball Players During the In-Season Phase: Weekly Fluctuations and Effect of Playing Time. <i>Int J Sports Physiol Perform.</i> 2019;14(7):941-948.</li> <li>Impellizzeri FM, Marcora SM, Coutts AJ. Internal and external training load: 15 years on. <i>Int J Sports Physiol Perform.</i> 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ, Newton RU, Nimphius S. The current state of subjective training load monitoring—a practical perspective and call to action. <i>Sports Med Open.</i> 2018;4(1):58.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. <i>Science and Medicine in Football.</i> 2018:1-8.</li> <li>McLaren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. <i>Sports Med.</i> 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an in- season training macrocycle. <i>Int J Sports Physiol Perform.</i> 2017:1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. <i>Front Physiol.</i> 2017;8:930.</li> <li>Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports Med.</i> 2017;38(14):1090-1096.</li> <li>Bourd</li></ul>	389	5	Reina Román M. García-Rubio I. Feu S. Ibáñez SI. Training and Competition Load
<ul> <li>Approach Study. Front Psychol. 2019;9(2689).</li> <li>Ransdell LB, Murray T, Gao Y, Jones P, Bycura D. A 4-Year Profile of Game Demands in Elite Women's Division I College Basketball. The Journal of Strength &amp; Conditioning Research. 2020;34(3):632-638.</li> <li>Paulauskas H, Kreivyte R, Scanlan AT, Moreira A, Siupsinskas L, Conte D. Monitoring Workload in Elite Female Basketball Players During the In-Season Phase: Weekly Fluctuations and Effect of Playing Time. Int J Sports Physiol Perform. 2019;14(7):941-948.</li> <li>Impellizzeri FM, Marcora SM, Coutts AJ. Internal and external training load: 15 years on. Int J Sports Physiol Perform. 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ, Newton RU, Nimphius S. The current state of subjective training load monitoring—a practical perspective and call to action. Sports Med Open. 2018;4(1):58.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. Science and Medicine in Football. 2018:1-8.</li> <li>McLaren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. Sports Med. 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an in- season training macrocycle. Int J Sports Physiol Perform. 2017:1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. Front Physiol. 2017;8:930.</li> <li>Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Force to Quantify Basketball Movement Patterns. Int J Sports Med. 2017;38(14):1090-1096.</li> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring ath</li></ul>	390	5.	Monitoring and Analysis of Women's Amateur Basketball by Playing Position:
<ol> <li>Ransdell LB, Murray T, Gao Y, Jones P, Bycura D. A 4-Year Profile of Game Demands in Elite Women's Division I College Basketball. <i>The Journal of Strength &amp;</i> <i>Conditioning Research</i>. 2020;34(3):632-638.</li> <li>Paulauskas H, Kreivyte R, Scanlan AT, Moreira A, Siupsinskas L, Conte D. Monitoring Workload in Elite Female Basketball Players During the In-Season Phase: Weekly Fluctuations and Effect of Playing Time. <i>Int J Sports Physiol Perform</i>. 2019;14(7):941-948.</li> <li>Impellizzeri FM, Marcora SM, Coutts AJ. Internal and external training load: 15 years on. <i>Int J Sports Physiol Perform</i>. 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ, Newton RU, Nimphius S. The current state of subjective training load monitoring—a practical perspective and call to action. <i>Sports Med Open</i>. 2018;4(1):58.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. <i>Science and Medicine in Football</i>. 2018:1-8.</li> <li>McLaren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. <i>Sports Physiol Perform</i>. 2017:1-25.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an in- season training macrocycle. <i>Int J Sports Physiol Perform</i>. 2017:1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. <i>Front Physiol</i>. 2017;8:930.</li> <li>Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports Med</i>. 2017;38(14):1090-1096.</li> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads: Consensus stat</li></ol>	301		Approach Study Front Psychol 2010:0(2680)
<ol> <li>Kalsderf D., Multig Y., Gab T., Subes T., Spitsa T., Studia D. A. et al. Home of Game Demands in Elite Women's Division 1 College Basketball. <i>The Journal of Strength &amp;</i> <i>Conditioning Research</i>. 2020;34(3):632-638.</li> <li>Paulauskas H, Kreivyte R, Scanlan AT, Moreira A, Siupsinskas L, Conte D. Monitoring Workload in Elite Female Basketball Players During the In-Season Phase: Weekly Fluctuations and Effect of Playing Time. <i>Int J Sports Physiol Perform</i>. 2019;14(7):941-948.</li> <li>Impellizzeri FM, Marcora SM, Coutts AJ. Internal and external training load: 15 years on. <i>Int J Sports Physiol Perform</i>. 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ, Newton RU, Nimphius S. The current state of subjective training load monitoring—a practical perspective and call to action. <i>Sports Med Open</i>. 2018;4(1):58.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. <i>Science and Medicine in Football</i>. 2018:1-8.</li> <li>McLaren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. <i>Sports Med</i>. 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an in- season training macrocycle. <i>Int J Sports Physiol Perform</i>. 2017;1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. <i>Front Physiol</i>. 2017;8:930.</li> <li>Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports Med</i>. 2017;38(14):1090-1096.</li> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads: Conse</li></ol>	302	6	Pansdell J B. Murray T. Gao V. Jones P. Byoura D. A. A. Vear Profile of Game
<ul> <li>Conditioning Research. 2020;34(3):632-638.</li> <li>Paulauskas H, Kreivyte R, Scanlan AT, Moreira A, Siupsinskas L, Conte D. Monitoring Workload in Elite Female Basketball Players During the In-Season Phase: Weekly Fluctuations and Effect of Playing Time. <i>Int J Sports Physiol Perform</i>. 2019;14(7):941-948.</li> <li>Impellizzeri FM, Marcora SM, Coutts AJ. Internal and external training load: 15 years on. <i>Int J Sports Physiol Perform</i>. 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ, Newton RU, Nimphius S. The current state of subjective training load monitoring—a practical perspective and call to action. <i>Sports Med Open</i>. 2018;4(1):58.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. <i>Science and Medicine in Football</i>. 2018:1-8.</li> <li>McLaren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. <i>Sports Med</i>. 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an in- season training macrocycle. <i>Int J Sports Physiol Perform</i>. 2017:1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. <i>Front Physiol</i>. 2017;8:930.</li> <li>Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports Med</i>. 2017;38(14):1090-1096.</li> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads: Consensus statement. <i>Int J Sports Physiol Perform</i>. 2017;12(Suppl 2):161-170.</li> <li>Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of Training for Athletic Performance. <i>Aust J Sci Med</i>. 1</li></ul>	303	0.	Demands in Elite Women's Division I College Basketball. The Journal of Strength &
<ol> <li>Paulauskas H, Kreivyte R, Scanlan AT, Moreira A, Siupsinskas L, Conte D. Monitoring Workload in Elite Female Basketball Players During the In-Season Phase: Weekly Fluctuations and Effect of Playing Time. <i>Int J Sports Physiol Perform.</i> 2019;14(7):941-948.</li> <li>Impellizzeri FM, Marcora SM, Coutts AJ. Internal and external training load: 15 years on. <i>Int J Sports Physiol Perform.</i> 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ, Newton RU, Nimphius S. The current state of subjective training load monitoring—a practical perspective and call to action. <i>Sports Med Open.</i> 2018;4(1):58.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. <i>Science and Medicine in Football.</i> 2018:1-8.</li> <li>McLaren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. <i>Sports Med.</i> 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an in- season training macrocycle. <i>Int J Sports Physiol Perform.</i> 2017:1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. <i>Front Physiol.</i> 2017;8:930.</li> <li>Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports Med.</i> 2017;38(14):1090-1096.</li> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads: Consensus statement. <i>Int J Sports Physiol Perform.</i> 2017;12(Suppl 2):161-170.</li> <li>Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of Training for Athletic Performance. <i>Aust J Sci Med.</i> 1975(7):57-61</li></ol>	30/		Conditioning Research 2020:34(3):632,638
<ol> <li>F. Faluatas II, Ricivic R, Scalali A I, Morcha A, Subsinskas L, Colle D. Monitoring Workload in Elite Female Basketball Players During the In-Season Phase: Weekly Fluctuations and Effect of Playing Time. <i>Int J Sports Physiol Perform.</i> 2019;14(7):941-948.</li> <li>Impellizzeri FM, Marcora SM, Coutts AJ. Internal and external training load: 15 years on. <i>Int J Sports Physiol Perform.</i> 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ, Newton RU, Nimphius S. The current state of subjective training load monitoring—a practical perspective and call to action. <i>Sports Med Open.</i> 2018;4(1):58.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. <i>Science and Medicine in Football.</i> 2018:1-8.</li> <li>McLaren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. <i>Sports Med.</i> 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an in- season training macrocycle. <i>Int J Sports Physiol Perform.</i> 2017:1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. <i>Front Physiol.</i> 2017;8:930.</li> <li>Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports Med.</i> 2017;38(14):1090-1096.</li> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads: Consensus statement. <i>Int J Sports Physiol Perform.</i> 2017;12(Suppl 2):161-170.</li> <li>Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of Training for Athletic Performance. <i>Aust J Sci Med.</i> 1975(7):57-61</li></ol>	305	7	Paulauskas H Kraivuta P. Scanlan AT Moraira A Siunsinskas I. Conte D
<ul> <li>Wolntohng Wolkload in Enter Fendae Basketoan Flayers During the In-Season Flase.</li> <li>Weekly Fluctuations and Effect of Playing Time. <i>Int J Sports Physiol Perform.</i> 2019;14(7):941-948.</li> <li>Impellizzeri FM, Marcora SM, Coutts AJ. Internal and external training load: 15 years on. <i>Int J Sports Physiol Perform.</i> 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ, Newton RU, Nimphius S. The current state of subjective training load monitoring—a practical perspective and call to action. <i>Sports Med Open.</i> 2018;4(1):58.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. <i>Science and Medicine in Football.</i> 2018:1-8.</li> <li>McLaren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. <i>Sports Med.</i> 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an inseason training macrocycle. <i>Int J Sports Physiol Perform.</i> 2017:1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. <i>Front Physiol.</i> 2017;8:930.</li> <li>Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports Med.</i> 2017;3:(14):1090-1096.</li> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads: Consensus statement. <i>Int J Sports Physiol Perform.</i> 2017;12(Suppl 2):161-170.</li> <li>Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of Training for Athletic Performance. <i>Aust J Sci Med.</i> 1975(7):57-61.</li> </ul>	395	1.	Manitoring Workload in Elita Famala Paskethall Dlayers During the In Season Dhase:
<ol> <li>Weekly Hucharons and Elect of Haying Time. <i>Int's Sports Physiol Perform.</i> 2019;14(7):941-948.</li> <li>Impellizzeri FM, Marcora SM, Coutts AJ. Internal and external training load: 15 years on. <i>Int J Sports Physiol Perform.</i> 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ, Newton RU, Nimphius S. The current state of subjective training load monitoring—a practical perspective and call to action. <i>Sports Med Open.</i> 2018;4(1):58.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. <i>Science and Medicine in Football.</i> 2018:1-8.</li> <li>McLaren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. <i>Sports Med.</i> 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an inseason training macrocycle. <i>Int J Sports Physiol Perform.</i> 2017:1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. <i>Front Physiol.</i> 2017;8:930.</li> <li>Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports Med.</i> 2017;38(14):1090-1096.</li> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads: Consensus statement. <i>Int J Sports Physiol Perform.</i> 2017;12(Suppl 2):161-170.</li> <li>Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of Training for Athletic Performance. <i>Aust J Sci Med.</i> 1975(7):57-61.</li> </ol>	207		Weakly Eluctuations and Effect of Playing Time. Int I Sports Physical Parform
<ol> <li>Impellizzeri FM, Marcora SM, Coutts AJ. Internal and external training load: 15 years on. Int J Sports Physiol Perform. 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ, Newton RU, Nimphius S. The current state of subjective training load monitoring—a practical perspective and call to action. <i>Sports Med Open</i>. 2018;4(1):58.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. <i>Science and Medicine in Football</i>. 2018:1-8.</li> <li>McLaren SJ, Macpherson TW, Coutts AJ, Hurst C, Spers R. Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. <i>Sports Med</i>. 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an in- season training macrocycle. <i>Int J Sports Physiol Perform</i>. 2017:1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. <i>Front Physiol</i>. 2017;8:930.</li> <li>Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports Med</i>. 2017;38(14):1090-1096.</li> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads: Consensus statement. <i>Int J Sports Physiol Perform</i>. 2017;12(Suppl 2):161-170.</li> <li>Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of Training for Athletic Performance. <i>Aust J Sci Med</i>. 1975(7):57-61.</li> </ol>	200		2010-14(7)-041 049
<ol> <li>Imperized TW, Mateora SM, Couts AJ. International and externational training total. 15 years on. <i>Int J Sports Physiol Perform.</i> 2019;14(2):270-273.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ, Newton RU, Nimphius S. The current state of subjective training load monitoring—a practical perspective and call to action. <i>Sports Med Open.</i> 2018;4(1):58.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. <i>Science and Medicine in Football.</i> 2018:1-8.</li> <li>McLaren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. <i>Sports Med.</i> 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an inseason training macrocycle. <i>Int J Sports Physiol Perform.</i> 2017:1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. <i>Front Physiol.</i> 2017;8:930.</li> <li>Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports Med.</i> 2017;38(14):1090-1096.</li> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads: Consensus statement. <i>Int J Sports Physiol Perform.</i> 2017;12(Suppl 2):161-170.</li> <li>Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of Training for Athletic Performance. <i>Aust J Sci Med.</i> 1975(7):57-61.</li> </ol>	300	8	Impallizzeri FM Marcora SM Coutte AL Internal and external training load: 15 years
<ol> <li>Gonda M. M. Sports Physiol Perform. 2019;14(2):210-213.</li> <li>Coyne JOC, Gregory Haff G, Coutts AJ, Newton RU, Nimphius S. The current state of subjective training load monitoring—a practical perspective and call to action. <i>Sports Med Open.</i> 2018;4(1):58.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. <i>Science and Medicine in Football.</i> 2018:1-8.</li> <li>McLaren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. <i>Sports Med.</i> 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an inseason training macrocycle. <i>Int J Sports Physiol Perform.</i> 2017:1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. <i>Front Physiol.</i> 2017;8:930.</li> <li>Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports Med.</i> 2017;38(14):1090-1096.</li> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads: Consensus statement. <i>Int J Sports Physiol Perform.</i> 2017;12(Suppl 2):161-170.</li> <li>Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of Training for Athletic Performance. <i>Aust J Sci Med.</i> 1975(7):57-61.</li> </ol>	<i>4</i> 00	0.	on Int I Sports Physiol Parform 2010:14(2):270-273
<ul> <li>401 9. Coyne Joe, Oregory Hair O, Coutts AJ, Rewton RO, Minphilds S. Hie current state of subjective training load monitoring—a practical perspective and call to action. <i>Sports Med Open.</i> 2018;4(1):58.</li> <li>404 10. Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. <i>Science and Medicine in Football.</i> 2018:1-8.</li> <li>407 11. McLaren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. <i>Sports Med.</i> 2018;48(3):641-658.</li> <li>410 12. Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an in- season training macrocycle. <i>Int J Sports Physiol Perform.</i> 2017:1-25.</li> <li>413 13. Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. <i>Front Physiol.</i> 2017;8:930.</li> <li>416 14. Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports Med.</i> 2017;38(14):1090-1096.</li> <li>419 15. Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads: Consensus statement. <i>Int J Sports Physiol Perform.</i> 2017;12(Suppl 2):161-170.</li> <li>421 16. Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of Training for Athletic Performance. <i>Aust J Sci Med.</i> 1975(7):57-61.</li> </ul>	400	0	Covne IOC Gregory Haff G. Coutts AI Newton BU Nimphius S. The current state
<ul> <li>Sports Med Open. 2018;4(1):58.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship</li> <li>between internal and external work in team sports: development of a novel training</li> <li>efficiency index. Science and Medicine in Football. 2018:1-8.</li> <li>McLaren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The</li> <li>relationships between internal and external measures of training load and intensity in</li> <li>team sports: A meta-analysis. Sports Med. 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted</li> <li>and actual match performance in professional Australian Footballers during an in-</li> <li>season training macrocycle. Int J Sports Physiol Perform. 2017:1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load</li> <li>measure predicting match performance in an elite team sport. Front Physiol.</li> <li>2017;8:930.</li> <li>Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of</li> <li>Accelerometry-Derived Force to Quantify Basketball Movement Patterns. Int J Sports</li> <li>Med. 2017;38(14):1090-1096.</li> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads:</li> <li>Consensus statement. Int J Sports Physiol Perform. 2017;12(Suppl 2):161-170.</li> <li>Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of</li> <li>Training for Athletic Performance. Aust J Sci Med. 1975(7):57-61.</li> </ul>	401	9.	of subjective training lead monitoring a practical perspective and call to action
<ol> <li>Sports Med Open. 2016;4(1):36.</li> <li>Delaney JA, Duthie GM, Thornton HR, Pyne DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. Science and Medicine in Football. 2018:1-8.</li> <li>McLaren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. Sports Med. 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an in- season training macrocycle. Int J Sports Physiol Perform. 2017:1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. Front Physiol. 2017;8:930.</li> <li>Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Force to Quantify Basketball Movement Patterns. Int J Sports Med. 2017;38(14):1090-1096.</li> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads: Consensus statement. Int J Sports Physiol Perform. 2017;12(Suppl 2):161-170.</li> <li>Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of Training for Athletic Performance. Aust J Sci Med. 1975(7):57-61.</li> </ol>	402		Sports Mod Open 2018:4(1):58
<ol> <li>Detailey JA, Duthe OM, Homon TRC, Fyle DB. Quantifying the relationship between internal and external work in team sports: development of a novel training efficiency index. <i>Science and Medicine in Football</i>. 2018:1-8.</li> <li>McLaren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. <i>Sports Med</i>. 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an in- season training macrocycle. <i>Int J Sports Physiol Perform</i>. 2017;1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. <i>Front Physiol</i>. 2017;8:930.</li> <li>Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports Med</i>. 2017;38(14):1090-1096.</li> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads: Consensus statement. <i>Int J Sports Physiol Perform</i>. 2017;12(Suppl 2):161-170.</li> <li>Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of Training for Athletic Performance. <i>Aust J Sci Med</i>. 1975(7):57-61.</li> </ol>	403	10	Deleney IA Duthie CM Thernton HP Dyna DP Quantifying the relationship
<ul> <li>detween internal and external work in team sports, development of a nover training</li> <li>efficiency index. <i>Science and Medicine in Football</i>. 2018:1-8.</li> <li>McLaren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The</li> <li>relationships between internal and external measures of training load and intensity in</li> <li>team sports: A meta-analysis. <i>Sports Med</i>. 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted</li> <li>and actual match performance in professional Australian Footballers during an in-</li> <li>season training macrocycle. <i>Int J Sports Physiol Perform</i>. 2017:1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load</li> <li>measure predicting match performance in an elite team sport. <i>Front Physiol</i>.</li> <li>2017;8:930.</li> <li>Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of</li> <li>Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports</i></li> <li><i>Med</i>. 2017;38(14):1090-1096.</li> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads:</li> <li>Consensus statement. <i>Int J Sports Physiol Perform</i>. 2017;12(Suppl 2):161-170.</li> <li>Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of</li> <li>Training for Athletic Performance. <i>Aust J Sci Med</i>. 1975(7):57-61.</li> </ul>	404	10.	between internal and external work in team sports: development of a nevel training
<ol> <li>Hitchely Index. Science and Medicine in Pooloali. 2018;1-8.</li> <li>McLaren SJ, Macpherson TW, Coutts AJ, Hurst C, Spears IR, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. Sports Med. 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an in- season training macrocycle. Int J Sports Physiol Perform. 2017:1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. Front Physiol. 2017;8:930.</li> <li>Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Force to Quantify Basketball Movement Patterns. Int J Sports Med. 2017;38(14):1090-1096.</li> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads: Consensus statement. Int J Sports Physiol Perform. 2017;12(Suppl 2):161-170.</li> <li>Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of Training for Athletic Performance. Aust J Sci Med. 1975(7):57-61.</li> </ol>	405		officiency index. Science and Medicine in Factball 2018:1.8
<ul> <li>In. McLaten SJ, Machielson TW, Coutts AJ, Hurst C, Spears IK, Weston M. The relationships between internal and external measures of training load and intensity in team sports: A meta-analysis. <i>Sports Med.</i> 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an inseason training macrocycle. <i>Int J Sports Physiol Perform.</i> 2017:1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. <i>Front Physiol.</i> 2017;8:930.</li> <li>Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports Med.</i> 2017;38(14):1090-1096.</li> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads: Consensus statement. <i>Int J Sports Physiol Perform.</i> 2017;12(Suppl 2):161-170.</li> <li>Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of Training for Athletic Performance. <i>Aust J Sci Med.</i> 1975(7):57-61.</li> </ul>	400	11	Malaran SI Maanharaan TW Coutta AI Hurst C Spaara IB Waatan M. Tha
<ul> <li>relationships between internal and external measures of training foad and intensity in team sports: A meta-analysis. <i>Sports Med.</i> 2018;48(3):641-658.</li> <li>Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an inseason training macrocycle. <i>Int J Sports Physiol Perform.</i> 2017:1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. <i>Front Physiol.</i> 2017;8:930.</li> <li>Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports Med.</i> 2017;38(14):1090-1096.</li> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads: Consensus statement. <i>Int J Sports Physiol Perform.</i> 2017;12(Suppl 2):161-170.</li> <li>Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of Training for Athletic Performance. <i>Aust J Sci Med.</i> 1975(7):57-61.</li> </ul>	407	11.	relationshing between internal and external managered of training load and intensity in
<ul> <li>409</li> <li>12. Graham SR, Cormack S, Parfitt G, Eston R. Relationships between model predicted and actual match performance in professional Australian Footballers during an in- season training macrocycle. <i>Int J Sports Physiol Perform</i>. 2017:1-25.</li> <li>13. Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. <i>Front Physiol</i>. 2017;8:930.</li> <li>14. Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports</i> <i>Med</i>. 2017;38(14):1090-1096.</li> <li>15. Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads: Consensus statement. <i>Int J Sports Physiol Perform</i>. 2017;12(Suppl 2):161-170.</li> <li>16. Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of Training for Athletic Performance. <i>Aust J Sci Med</i>. 1975(7):57-61.</li> </ul>	408		team sports: A mote analysis. Sports Mod. 2019:49(2):641,659
<ul> <li>410 12. Granam SK, Coffnack S, Parfitt G, Eston K. Relationships between model predicted</li> <li>411 and actual match performance in professional Australian Footballers during an in-</li> <li>412 season training macrocycle. <i>Int J Sports Physiol Perform</i>. 2017:1-25.</li> <li>413 13. Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load</li> <li>414 measure predicting match performance in an elite team sport. <i>Front Physiol.</i></li> <li>415 2017;8:930.</li> <li>416 14. Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of</li> <li>417 Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports</i></li> <li>418 <i>Med.</i> 2017;38(14):1090-1096.</li> <li>419 15. Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads:</li> <li>420 Consensus statement. <i>Int J Sports Physiol Perform.</i> 2017;12(Suppl 2):161-170.</li> <li>421 16. Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of</li> <li>422 Training for Athletic Performance. <i>Aust J Sci Med.</i> 1975(7):57-61.</li> </ul>	409	10	Crohom SD. Cormool: S. Dorfitt C. Eston D. Dolotionshing between model predicted
<ul> <li>and actual match performance in professional Australian Footballers during an in-</li> <li>season training macrocycle. <i>Int J Sports Physiol Perform</i>. 2017:1-25.</li> <li>Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load</li> <li>measure predicting match performance in an elite team sport. <i>Front Physiol</i>.</li> <li>2017;8:930.</li> <li>Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of</li> <li>Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports</i></li> <li><i>Med</i>. 2017;38(14):1090-1096.</li> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads:</li> <li>Consensus statement. <i>Int J Sports Physiol Perform</i>. 2017;12(Suppl 2):161-170.</li> <li>Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of</li> <li>Training for Athletic Performance. <i>Aust J Sci Med</i>. 1975(7):57-61.</li> </ul>	410	12.	ord actual match nonformance in professional Australian Easthallars during an in
<ul> <li>season training macrocycle. <i>Int J Sports Physiol Perform</i>. 2017;1-25.</li> <li>13. Lazarus BH, Stewart AM, White KM, et al. Proposal of a global training load measure predicting match performance in an elite team sport. <i>Front Physiol.</i> 2017;8:930.</li> <li>14. Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports</i> <i>Med.</i> 2017;38(14):1090-1096.</li> <li>15. Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads: Consensus statement. <i>Int J Sports Physiol Perform.</i> 2017;12(Suppl 2):161-170.</li> <li>16. Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of Training for Athletic Performance. <i>Aust J Sci Med.</i> 1975(7):57-61.</li> </ul>	411		and actual match performance in professional Australian Footballers during an in-
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<ul> <li>Ineasure predicting match performance in an enterteam sport. <i>Prom Physiol.</i> 2017;8:930.</li> <li>Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports Med.</i> 2017;38(14):1090-1096.</li> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads: Consensus statement. <i>Int J Sports Physiol Perform.</i> 2017;12(Suppl 2):161-170.</li> <li>Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of Training for Athletic Performance. <i>Aust J Sci Med.</i> 1975(7):57-61.</li> </ul>	415	13.	Lazarus BH, Slewart AM, while KM, et al. Proposal of a global training load
<ul> <li>2017,8.930.</li> <li>14. Staunton C, Wundersitz D, Gordon B, Kingsley M. Construct Validity of Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports</i> <i>Med.</i> 2017;38(14):1090-1096.</li> <li>15. Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads: Consensus statement. <i>Int J Sports Physiol Perform.</i> 2017;12(Suppl 2):161-170.</li> <li>16. Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of Training for Athletic Performance. <i>Aust J Sci Med.</i> 1975(7):57-61.</li> </ul>	414		2017.8.020
<ul> <li>416 14. Staunton C, Wundersitz D, Gordon B, Kingstey M. Construct Validity of</li> <li>417 Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports</i></li> <li>418 <i>Med.</i> 2017;38(14):1090-1096.</li> <li>419 15. Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads:</li> <li>420 Consensus statement. <i>Int J Sports Physiol Perform.</i> 2017;12(Suppl 2):161-170.</li> <li>421 16. Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of</li> <li>422 Training for Athletic Performance. <i>Aust J Sci Med.</i> 1975(7):57-61.</li> </ul>	413	14	2017,0.950. Stounton C. Wandersitz D. Conden D. Kingeley, M. Construct Validity of
<ul> <li>Accelerometry-Derived Force to Quantify Basketball Movement Patterns. <i>Int J Sports</i></li> <li><i>Med.</i> 2017;38(14):1090-1096.</li> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads:</li> <li>Consensus statement. <i>Int J Sports Physiol Perform.</i> 2017;12(Suppl 2):161-170.</li> <li>Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of</li> <li>Training for Athletic Performance. <i>Aust J Sci Med.</i> 1975(7):57-61.</li> </ul>	410	14.	Staunton C, wunderstiz D, Gordon B, Kingsley M. Construct Validity of
<ul> <li><i>Med.</i> 2017;38(14):1090-1096.</li> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads:</li> <li>Consensus statement. <i>Int J Sports Physiol Perform.</i> 2017;12(Suppl 2):161-170.</li> <li>Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of</li> <li>Training for Athletic Performance. <i>Aust J Sci Med.</i> 1975(7):57-61.</li> </ul>	41/		Accelerometry-Derived Force to Quantify Basketball Movement Patterns. Int J Sports
<ul> <li>Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads:</li> <li>Consensus statement. <i>Int J Sports Physiol Perform</i>. 2017;12(Suppl 2):161-170.</li> <li>Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of</li> <li>Training for Athletic Performance. <i>Aust J Sci Med</i>. 1975(7):57-61.</li> </ul>	418	1.7	<i>Med.</i> 2017;38(14):1090-1096.
<ul> <li>420 Consensus statement. Int J Sports Physiol Perform. 2017;12(Suppl 2):161-170.</li> <li>421 16. Banister EW, Calvert, T.W., Savage, M.V. and Bach, T.M. A Systems Model of</li> <li>422 Training for Athletic Performance. Aust J Sci Med. 1975(7):57-61.</li> </ul>	419	15.	Bourdon PC, Cardinale M, Murray A, et al. Monitoring athlete training loads:
<ul> <li>Banister EW, Calvert, I.W., Savage, M.V. and Bach, I.M. A Systems Model of</li> <li>Training for Athletic Performance. <i>Aust J Sci Med.</i> 1975(7):57-61.</li> </ul>	420	16	Consensus statement. Int J Sports Physiol Perform. 2017;12(Suppl 2):161-170.
422 Iraining for Athletic Performance. <i>Aust J Sci Med.</i> 19/5(/):5/-61.	421	16.	Banister EW, Calvert, I.W., Savage, M.V. and Bach, I.M. A Systems Model of
	422		Training for Athletic Performance. Aust J Sci Med. 19/5(/):5/-61.

423 424 425	17.	Hulin BT, Gabbett TJ, Blanch P, Chapman P, Bailey D, Orchard JW. Spikes in acute workload are associated with increased injury risk in elite cricket fast bowlers. <i>Br J Sports Med</i> , 2014:48(8):708-712
426 427	18.	Coyne JOC, Nimphius S, Newton RU, Haff GG. Does mathematical coupling matter to the Acute to Chronic Workload Ratio? A case study from elite sport. <i>Int J Sports</i>
428 429 430	19.	<i>Physiol Perform</i> . 2019:1-8. Lolli L, Batterham AM, Hawkins R, et al. The acute-to-chronic workload ratio: an inaccurate scaling index for an unnecessary normalisation process? <i>Br J Sports Med.</i>
431		2018.
432	20.	Wang C, Vargas JT, Stokes T, Steele R, Shrier I. Analyzing Activity and Injury:
433		Lessons Learned from the Acute: Chronic Workload Ratio. Sports Med. 2020.
434	21.	Allen H, Coggan, A. Training and Racing With A Powermeter. 2nd ed. Boulder, CO:
435		Velopress; 2010.
436	22.	Tysoe A, Moore IS, Ranson C, McCaig S, Williams S. Bowling loads and injury risk
437		in male first class county cricket: Is differential load an alternative to the acute-to-
438		chronic workload ratio? Journal of Science and Medicine in Sport.
439	23.	Williams S, West S, Cross MJ, Stokes KA. Better way to determine the acute:chronic
440		workload ratio? Br J Sports Med. 2016;51(3):209.
441	24.	Murray NB, Gabbett TJ, Townshend AD, Blanch P. Calculating acute:chronic
442		workload ratios using exponentially weighted moving averages provides a more
443		sensitive indicator of injury likelihood than rolling averages. Br J Sports Med.
444		2016;51(9):749.
445	25.	Raysmith BP, Drew MK. Performance success or failure is influenced by weeks lost
446		to injury and illness in elite Australian Track and Field athletes: a 5-year prospective
447		study. J Sci Med Sport. 2016;19(10):778-783.
448	26.	Foster C, Florhaug JA, Franklin J, et al. A new approach to monitoring exercise
449		training. J Strength Cond Res. 2001;15(1):109-115.
450	27.	Delaney JA, McKay, B.A., Thornton, H.R., Murray, A., & Duthie, G.M. Training
451		efficiency and athlete wellness in collegiate female soccer. Sports Performance &
452		<i>Science Reports.</i> 2018;1(19):1-3.
453	28.	Buchheit M. Monitoring training status with HR measures: do all roads lead to Rome?
454	• •	<i>Front Physiol.</i> 2014;5(73).
455	29.	Coyne JOC, Haff, G.G., Coutts, A.C., Netwon, R.U. & Nimphius, S. The relationship
456		between internal training load variables during a taper and elite weightlifting success.
45/		National Strength & Conditioning Association National Conference; 2018;
458	20	Indianapolis, IN, U.S.
459	30.	Bosquet L, Montpetit J, Arvisais D, Mujika I. Effects of tapering on performance: a
460	21	meta-analysis. Med Sci Sports Exerc. 2007;39(8):1358-1365.
401	51.	moraes H, Aoki MS, Freitas CG, Arruda A, Drago G, Moreira A. SigA response and incidence of upper respiratory treat infections during intensified training in youth
402		historice of upper respiratory fract infections during intensified training in youth historical playars. <i>Biol Sport</i> , 2017;24(1):40,55
405	27	Miloski P. Aski MS. do Eroitos CC. et al. Doos Tostostorono Modulato Mood States
404	32.	and Dhysical Derformance in Young Desketball Players? I Strength Cond Pas
405		2015-20(0)-2474 2481
400	33	2013,29(3).2474-2401. Mooney M. O'Brien B. Cormack S. Coutts A. Berry I. Young W. The relationship
468	55.	hetween physical capacity and match performance in elite Australian football.
469		mediation approach <i>LSci Med Sport</i> 2011:14(5):447-452
470	34	Efficiency (basketball) Wikinedia
471	51.	https://en.wikipedia.org/wiki/Efficiency (basketball) Published 2020 Accessed
., 1		<u></u>

- 472 35. Hopkins WG, Marshall SW, Batterham AM, Hanin J. Progressive statistics for studies
  473 in sports medicine and exercise science. *Med Sci Sports Exerc.* 2009;41(1):3-12.
- 474 36. Aiken LS, & West, S. G. *Multiple regression: Testing and interpreting interactions.*475 Newbury Park: Sage; 1991.
- 476 37. Cohen J. A power primer. *Psychol Bull*. 1992;112(1):155-159.
- 477 38. Thomas L, Mujika I, Busso T. A model study of optimal training reduction during
  478 pre-event taper in elite swimmers. *J Sports Sci.* 2008;26(6):643-652.
- 479 39. Hidalgo-Muñoz AR, Béquet AJ, Astier-Juvenon M, et al. Respiration and Heart Rate
  480 Modulation Due to Competing Cognitive Tasks While Driving. *Frontiers in Human*481 *Neuroscience*. 2019;12(525).
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#### 485 FIGURE CAPTIONS

#### 486

487 Figure 1. A time series of training load variables and performances as z-scores in an elite

- 488 international female basketball team during the qualifying stages for the 2016 Olympic
- 489 Games. The training load variables' time series are indicated by the solid line whereas the
- 490 performances as z-scores are indicated by the circular points. *IL internal load, EL*
- 491 *external load, TSB training stress balance, TEI-7 training efficiency index averaged over*
- 492 *7 days*
- 493
- 494
- 495

to per period

	SMA	EW	EWMA-W			EWMA-L				
	r [95% CI]	р	r [95% CI]	р	SMA r- z p	r [95% CI]	р	SMA r- z p	EWMA- W r-z p	
	External Load									
Weekly Change	0.07 [-0.08, 0.23]	0.34	-	-	-	-	-	-	-	
Acute TL	-0.14 [-0.29, 0.01]	0.07	-0.38 [-0.51, -0.24]	<0.001***	0.02*	-0.35 [-0.48, -0.20]	<0.001***	0.05*	0.76	
Chronic TL	-0.03 [-0.19, 0.13]	0.71	-0.26 [-0.40, -0.11]	<0.001***	0.04*	-0.14 [-0.29, 0.02]	0.09	0.33	0.27	
TSB	0.12 [-0.04, 0.27]	0.14	0.39 [0.24, 0.51]	<0.001***	0.01*	0.33 [0.19, 0.47]	<0.001***	0.05*	0.54	
TSB VOL21	-0.28 [-0.42, -0.13]	<0.001***	-0.24 [-0.38, -0.09]	<0.01**	0.71	-0.25 [-0.40, -0.10]	<0.01**	0.78	0.93	
TSB CH21	0.04 [-0.13, 0.20]	0.66	0.26 [0.11, 0.41]	< 0.001***	0.05*	0.21 [0.06, 0.36]	<0.01**	0.13	0.64	
DIFF 7-day	-	-	-0.21 [-0.36, -0.06]	<0.01**	-	-0.29 [-0.42, -0.13]	<0.001***	-	0.45	
DIFF 21-day	-	-	-0.26 [-0.40, -0.11]	<0.001***	-	-0.19 [-0.34, -0.04]	0.01*	-	0.52	
			Interna	l Load						
Weekly Change	0.06 [-0.09, 0.22]	0.43		-	-	-	-	-	-	
Acute TL	-0.13 [-0.28, 0.03]	0.11	-0.27 [-0.41, -0.12]	<0.001***	0.20	-0.16 [-0.31, -0.01]	0.04*	0.79	0.31	
Chronic TL	0.16 [0.01, 0.31]	0.04*	-0.01 [-0.17, 0.14]	0.82	0.13	0.11 [-0.04, 0.26]	0.16	0.65	0.29	
TSB	0.33 [0.19, 0.47]	<0.001***	0.41 [0.26, 0.53]	<0.001***	0.41	0.40 [0.26, 0.52]	<0.001***	0.48	0.92	
TSB VOL21	-0.36 [-0.49, -0.21]	<0.001***	-0.23 [-0.38, -0.08]	<0.01**	0.21	-0.11 [-0.26, 0.05]	0.17	0.02*	0.28	
TSB CH21	0.64 [0.53, 0.73]	<0.001***	0.53 [0.41, 0.64]	< 0.001***	0.14	0.52 [0.40, 0.63]	<0.001***	0.11	0.90	
DIFF 7-day	-	-	-0.38 [-0.50, -0.23]	<0.001***		-0.45 [-0.56, -0.31]	<0.001***	-	0.45	
DIFF 21-day	-	-	-0.44 [-0.56, -0.30]	<0.001***		-0.32 [-0.46, -0.17]	<0.001***	-	0.22	
Training Efficiency Index										
TE <sub>1</sub> 5	0.08 [-0.08, 0.23]	0.31	0.04 [-0.11, 0.20]	0.59	0.72	0.07 [-0.09, 0.22]	0.38	0.93	0.79	
$TE_{I}7$	0.13 [-0.03, 0.28]	0.11	0.07 [-0.09, 0.22]	0.39	0.59	0.04 [-0.12, 0.20]	0.61	0.42	0.79	
TE <sub>1</sub> 5 CH21	0.56 [0.44, 0.66]	<0.001***	0.51 [0.38, 0.62]	<0.001***	0.54	0.51 [0.38, 0.62]	<0.001***	0.54	1.00	
TE <sub>1</sub> 7 CH21	0.54 [0.41, 0.64]	<0.001***	0.52 [0.39, 0.62]	<0.001***	0.81	0.47 [0.34, 0.58]	< 0.001***	0.41	0.56	

Table 1. Correlations between different training load variables with coaches' ratings of competitive performance for an elite international women's basketball team in the qualifying stages for the 2016 Olympic Games.

Note: SMA – simple moving average, EWMA-W – exponentially weighted moving averages as per Williams et al<sup>23</sup>, EWMA-L - exponentially weighted moving averages as per Lazarus et al<sup>13</sup>, TL – training load, TSB – training stress balance, ACWR – acute to chronic workload ratio, DIFF – differential load, VOL21 - the volatility (standard deviation) of values in the last 21 days prior to competition , CH21 - the value 21 days prior to competition subtracted from the value on the day of the competition, TE<sub>1</sub>5 – training efficiency index 5 day average, TE<sub>1</sub>7 – training efficiency index 7 day average, TE<sub>1</sub> – training efficiency index, r – correlation; CI – confidence interval, \* - p<0.01, \*\*\* - p<0.001

Table 2A-C. Differences in A) external, B) internal and C) training efficiency index training load variables for successful and non-successful basketball performances by an elite international women's basketball team in the qualifying stages for the 2016 Olympic Games.

A.							
		OVERALL	SUCCESSFUL PERFORMANCES	UNSUCCESSFUL PERFORMANCES	р	$f^2$	Effect size
	Week Load	$2787 \pm 772$	$2564 \pm 492$	$2619\pm429$	0.64	0.001	Trivial
	Weekly Change	$-79.8 \pm 706.21$	$-63.1 \pm 544$	$-252 \pm 571$	0.38	0.028	Small
	Acute TL	398 ± 110	$366\pm70.3$	$374 \pm 61.2$	0.64	0.001	Trivial
	Chronic TL	394 ± 81.8	$372\pm68.3$	$380 \pm 67.1$	0.84	0.000	Trivial
SMA	TSB	9.49 ± 67.6	$-13.6 \pm 50.1$	$-9.13 \pm 48.6$	0.68	0.001	Trivial
	TSB VOL21	57.1 ± 22.7	52.3 ± 20.8	$60.7 \pm 19.2$	0.001***	0.046	Small
	TSB CH21	-12.6 ± 92.0	$-26.5 \pm 85.6$	$-21.2 \pm 79.9$	0.61	0.001	Trivial
	Acute TL	$401 \pm 118$	$376 \pm 72.2$	$411 \pm 76.8$	<0.001***	0.042	Small
	Chronic TL	$408\pm95.6$	$370 \pm 63.1$	$387 \pm 65.0$	0.01*	0.008	Trivial
	TSB	$7.75 \pm 53.5$	$-5.73 \pm 29.8$	$-24.4 \pm 38.0$	<0.001***	0.081	Small
EWMA-W	TSB VOL21	$49.7 \pm 12.3$	$46.6 \pm 9.81$	$50.3 \pm 10.3$	<0.01**	0.032	Small
	TSB CH21	$-0.24 \pm 76.5$	$-14.0 \pm 58.7$	-29.1 ± 53.9	0.06	0.020	Small
	DIFF 7-day	$-71.0 \pm 706$	-168 ± 291	$-86.8 \pm 339$	0.05*	0.021	Small
	DIFF 21-day	$-75.9 \pm 231$	-89.8 ± 150	$-24.2 \pm 217$	<0.01**	0.037	Small
	Acute TL	$404 \pm 101$	$369 \pm 64.6$	$393 \pm 67.0$	<0.001***	0.020	Small
	Chronic TL	$418\pm93.7$	$376 \pm 64.2$	$387 \pm 70.0$	0.25	0.002	Trivial
	TSB	$14.2 \pm 41.2$	$7.37 \pm 25.4$	$-6.25 \pm 35.7$	<0.001***	0.048	Small
EWMA-L	TSB VOL21	$32.3\pm9.73$	$30.6 \pm 8.17$	33.3 ± 9.41	0.02*	0.025	Small
	TSB CH21	$0.83\pm57.8$	$-7.41 \pm 52.3$	$-19.5 \pm 49.1$	0.07	0.016	Trivial
	DIFF 7-day	$-75.9 \pm 231$	$-123 \pm 205$	$-29.2 \pm 275$	<0.01**	0.045	Small
	DIFF 21-day	$-86.7 \pm 156$	$-71.8 \pm 92.1$	$-41.5 \pm 150$	0.03*	0.020	Small

B.							
		OVERALL	SUCCESSFUL PERFORMANCES	UNSUCCESSFUL PERFORMANCES	р	$f^2$	Effect size
	Week Load	$4588 \pm 1597$	$2974 \pm 819$	$3110 \pm 793$	0.27	0.006	Trivial
	Weekly Change	$-171 \pm 1642$	$-1408 \pm 826$	$-1518 \pm 991$	0.45	0.004	Trivial
	Acute TL	$655 \pm 228$	$425 \pm 117$	$444 \pm 113$	0.27	0.006	Trivial
	Chronic TL	$667 \pm 152$	$610 \pm 109$	$576 \pm 93.3$	0.02	0.028	Small
SMA	TSB	$26.0 \pm 177$	$185 \pm 81.9$	$135 \pm 92.8$	<0.001***	0.089	Small
	TSB VOL21	$158 \pm 47.1$	$150 \pm 39.3$	$173 \pm 44.0$	<0.001***	0.087	Small
	TSB CH21	$4.60 \pm 286$	$258 \pm 188$	$8.30\pm237$	<0.001***	0.362	Large
	Acute TL	$655 \pm 231$	$427 \pm 106$	$473 \pm 118$	<0.01**	0.041	Small
	Chronic TL	668 ± 159	550 ± 95.3	546 ± 96.7	0.67	0.001	Trivial
	TSB	$13.0 \pm 119$	$123 \pm 61.2$	$72.6 \pm 59.6$	<0.001***	0.171	Moderate
EWMA-W	TSB VOL21	110 ± 22.8	$107 \pm 19.5$	$111 \pm 19.5$	0.11	0.012	Trivial
	TSB CH21	$10.3 \pm 181$	$145 \pm 128$	$4.47 \pm 168$	<0.001***	0.241	Moderate
	DIFF 7-day	$108 \pm 1151$	$-1140 \pm 737$	$-600 \pm 805$	<0.001***	0.130	Small
	DIFF 21-day	$-99.6 \pm 634$	$-640 \pm 406$	$-287 \pm 539$	<0.001***	0.152	Moderate
	Acute TL	$662 \pm 187$	$492 \pm 100$	$515 \pm 106$	0.14	0.010	Trivial
	Chronic TL	$678 \pm 134$	611 ± 85.4	588 ± 87.8	0.02*	0.021	Small
	TSB	$16.0 \pm 100$	119 ± 55.9	73.3 ± 55.6	<0.001***	0156	Moderate
EWMA-L	TSB VOL21	$78.3 \pm 21.8$	82.0 ± 23.6	$81.0 \pm 1.0$	0.80	0.000	Trivial
	TSB CH21	$15.0 \pm 152$	$141 \pm 131$	$-8.84 \pm 155$	<0.001***	0.280	Moderate
	DIFF 7-day	$-92.5 \pm 849$	$-835 \pm 597$	$-301 \pm 709$	<0.001***	0.176	Moderate
	DIFF 21-day	$-65.3 \pm 430$	$-332 \pm 288$	$-161 \pm 420$	<0.001***	0.066	Small

C.							
		OVERALL	SUCCESSFUL PERFORMANCES	NON-SUCCESSFUL PERFORMANCES	р	$f^2$	Effect size
	$TE_I$	$0.89 \pm 0.43$	$1.61 \pm 0.44$	$1.68\pm0.38$	0.22	0.007	Trivial
	$TE_I 5$	$0.88 \pm 0.27$	$1.25\pm0.29$	$1.20\pm0.24$	0.21	0.008	Trivial
SMA	$TE_I7$	$0.88 \pm 0.25$	$1.21\pm0.30$	$1.15\pm0.21$	0.10	0.014	Trivial
SMA	TE <sub>1</sub> 5 CH21	$0.04 \pm 0.37$	$0.54\pm0.36$	$0.03\pm0.42$	<0.001***	0.431	Large
	TE <sub>1</sub> 7 CH21	$0.03 \pm 0.33$	$0.48\pm0.35$	$0.03\pm0.32$	<0.001***	0.416	Large
	$TE_I 5$	$0.88 \pm 0.27$	$1.33\pm0.27$	$1.30\pm0.23$	0.34	0.004	Trivial
	$TE_I7$	$0.88 \pm 0.24$	$1.25\pm0.25$	$1.22\pm0.20$	0.28	0.005	Trivial
E W MA-W	TE <sub>1</sub> 5 CH21	$0.04 \pm 0.36$	$0.61\pm0.33$	$0.23\pm0.33$	<0.001***	0.333	Moderate
	TE <sub>1</sub> 7 CH21	$0.03 \pm 0.32$	$0.52\pm0.30$	$0.16\pm0.29$	<0.001***	0.361	Large
	$TE_I 5$	$0.88 \pm 0.22$	1.19 ± 0.23	$1.17\pm0.19$	0.33	0.004	Trivial
EWMA-L	$TE_I7$	$0.87 \pm 0.20$	$1.20 \pm 0.21$	$1.10\pm0.16$	0.69	0.001	Trivial
	TE <sub>1</sub> 5 CH21	0.03 ± 0.29	$0.45 \pm 0.28$	$0.13\pm0.25$	<0.001***	0.351	Large
	TE <sub>1</sub> 7 CH21	$0.03 \pm 0.25$	$0.34 \pm 0.24$	$0.10 \pm 0.41$	<0.001***	0.305	Moderate

Note: SMA – simple moving average, EWMA-W – exponentially weighted moving averages as per Williams et al<sup>23</sup>, EWMA-L - exponentially weighted moving averages as per Lazarus et al<sup>13</sup>, TL – training load, TSB – training stress balance, ACWR – acute to chronic workload ratio, DIFF – differential load, TE<sub>1</sub> – training efficiency index, TE<sub>1</sub>5 – training efficiency index averaged over 5 days, TE<sub>1</sub>7 – training efficiency index averaged over 7 days, VOL21 - the volatility (standard deviation) of values in the last 21 days prior to competition, CH21 - the value 21 days prior to competition subtracted from the value on the day of the competition, \* - p<0.05, \*\* - p<0.01, \*\*\* - p<0.001,  $f^2$  – Cohen's marginal effect size.



Figure 1. A comparison of training load variables between successful and non-successful performances in an elite international female basketball team during the qualifying stages for the 2016 Olympic Games. IL – internal load, EL – external load, TSB – training stress balance, TEI-7 - training efficiency index averaged over 7 days

209x296mm (150 x 150 DPI)