The impact of tournament load on neuromuscular function, perceived wellness and coach ratings of performance during intensified netball competition.

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Abstract

Purpose: This study examined the effects of tournament load on neuromuscular function, perceived wellness and coach ratings of performance across two 6-day netball tournaments. **Methods**: Thirty-nine female youth netballers (age = 14.6 ± 0.5 years, stature = 165.9 ± 4.7 cm, body mass = 56.5 ± 7.2 kg) were categorised as HIGH (10-11 matches, *n* = 20) or LOW (6 matches, *n* = 19) tournament load. Match load, jump height, perceived wellness and coach ratings of performance were monitored daily. **Results**: HIGH tournament load resulted in greater reductions in jump height on match-day 4 (–8.3, ±5.6%) when compared to LOW. HIGH tournament load resulted in greater reductions in perceived soreness (–0.9, ±1.1 AU) and overall wellness (–2.6, ±2.3 AU) on match-day 3, and a greater reduction in perceived sleep (–0.9, ±1.1 AU) on match-day 4. HIGH tournament load was negatively associated with sleep quality and coach ratings of performance (effect size correlation = -0.34 to -0.47) when compared to LOW. **Conclusion**: Our results indicate that a higher tournament load resulted in greater increases in neuromuscular fatigue, reduced perceived wellness, and lower ratings of performance. Practitioners should consider pre-tournament preparation and monitoring strategies to minimise the physiological disturbances during an intensified tournament.

Keywords: Netball, monitoring, post-match fatigue, youth tournament, tournament structure

Introduction

Netball is a high-intensity intermittent team sport characterised by brief periods of metabolically demanding actions such as sprinting, changing direction and jumping, interspersed with low-intensity activity such as walking [3, 9]. Cup tournaments at both senior and youth levels often consists of several consecutive matches played over consecutive days. Competing in such a tournament structure can impose considerable physiological stress and fatigue compared to single weekly league scenarios since the time to recover after a match is reduced [26]. Furthermore, tournament organisers of youth-sports may also schedule multiple matches per day due to a lack of professionalism and other commitments (education, cost to run tournament, travel cost for teams, etc.), thus potentially and unintentionally increasing the overall physical demands [23, 29].

Competing in multiple matches is reported to negatively impact on maximal speed in youth soccer (4 matches of 30 minutes) [29], reduced running performance and wellness in tag football (3 matches of 40 min) [13] and touch rugby (2-3 matches of 40 minutes) [5] with trivial to small decrease in countermovement jump in rugby union [21] and touch rugby [5]. For example, in the study by Dobbin et al. [5], they demonstrated amongst female athletes, a reduction in high-speed running (22.9 vs. 17.9 $m \cdot min^{-1}$) after 6-7 games (day 3) along with concomitant reductions in wellness (18.7 vs. 15.8 AU) and jump performance (27.9 vs. 25.1 cm). In netball, few studies have explored the responses to tournament match-play, though Birdsey et al. [1] did observed trivial to small reductions in neuromuscular function and large increases in indirect markers of exercise-induced muscle damage after three consecutive days of competition in elite-level netballers. Across the literature, a range of indirect measures have used to determine the impact of tournament structure and loads. Indeed, perceived wellness that included measures of fatigue, soreness, sleep and mood have been used to 'assess' player's recovery status in response to training and tournament loads [30]. Further, perceived wellness and assessment of neuromuscular function (e.g. countermovement jump) have been shown to influence subsequent training load [10, 17, 32] and are sensitive to time-course changes in team-sports tournament [1, 5, 13, 18]. Coach ratings of performance via a Likert scale have been considered as a suitable method for evaluating an individual's physical output and skills performance during matches [19, 31]. Taken together, assessing player's neuromuscular function, perceived wellness and coach ratings of performance are useful monitoring strategies to manage match load during congested tournament scenarios and understand the implications of such demands.

In youth netball, the time-course changes in perceived wellness, countermovement and ratings of performance during intensified tournament structure in youth netballers have yet to be investigated. No research currently exists, and often the tournament structure can vary with reference to the number of games and length. Comparisons of varying tournament structures may have important implications for tournament organisers with regards to match fatigue as well as perceived performance by coaches. The examination of post-match physiological responses with varying tournament loads would serve to inform practitioners in strategizing physical preparation (such as well-developed lower-body power) when approaching congested match schedules. Furthermore, appropriate match scheduling in youth netballers may minimize injury risk within an important demographic whereby injury in their youth might have implications on education, long-term sporting aspirations and long-term health. Therefore, the purpose of this study was to (1) investigate the effects of tournament structure and match load on neuromuscular function, perceived wellness, and coach ratings of performance across a 6-day tournament; and (2) examine the association between tournament structure and match load with markers of neuromuscular function, perceived wellness, and coach ratings of performance across a youth netball tournament.

Methods

Participants

Thirty-nine female youth netballers (age = 14.6 ± 0.5 years, stature = 165.9 ± 4.7 cm, body mass = 56.5 ± 7.2 kg) were recruited and monitored over two individual youth netball tournaments (2017, n = 20 and 2018, n = 19). Three players competed in both 2017 and 2018 tournament and were treated as unique subjects since time-span between tournaments were one year apart which would wash out any post-tournament effects. To estimate the sample size required, the typical error (TE) and smallest worthwhile change (SWC) derived from historical fitness data of the youth netball academy which the players belong were used. Using a customized spreadsheet [14], a SWC of 1.4 cm and a between-subject SD of 2.8 cm of counter-movement jump height were inserted with compatibility limits set at 95%. A minimum sample of 21 participants for each group was required to attain a 75% *likely* clear effect. The players were part of a local, school-based netball academy and trained for ~5 to 6 days during a typical week. Weekly training volume typically comprised of 8 – 14 hours, including 6–10 hours of court-based skill work, and 2–4 hours of strength and conditioning (S&C) sessions. At the time of the study, all players were free from injury and had completed structured training programmes before the tournament. The study was approved by the

Singapore Sport Institute IRB ethics committee (SSI-IRB: PH-Full-030), and all participants provided informed assent. Due to the age of the participants, parental/guardian consent was also obtained.

Design

Using an independent groups design, participants competed in 10-11 matches (2017; HIGH tournament load) or 6 matches (2018; LOW tournament load) over six days. Tournaments were held in November in both years and preceded by a similar phase of training periodization. In 2017, participants completed 2 matches per day except for match-day 3 (MD 3) where a single game was played (*n* = 20). In 2018, participants only competed in a single match per day except for MD3, where two games were scheduled (*n* = 19). All matches lasted 40 minutes (10-minute quarters). Players in both HIGH and LOW groups followed standardized nutrition plans and post-match recovery that consisted of active and passive stretching followed by cold water immersion (10 to 12°c for 10 minutes) at the end of each day throughout the six-day tournament. All players had to have played a minimum of one-quarter of a match in each match-day of the tournament for their data to be included in the analysis.

Data collection

To determine match load, the total court duration of minutes played for each match were multiplied by the session rating of perceived exertion (sRPE) (1-10; “How hard was your work out”) scored by the players [8]. On occasions where 2 matches were played on the same day, match load for the day was determined by summing the sRPE of each match. Countermovement jump height was assessed 15 to 30 minutes after each match using a portable jump mat (SmartSpeed, Fusion Sport, Australia). Each participant performed a total of three countermovement jumps with their hands placed on their hips, pausing for ~5-10 seconds between each jump. The mean jump height of three trials was used within the analysis [4]. Perceived wellness was collected at the start of each day through an electronic questionnaire built using Google forms (Google, USA). The 10-point wellness questionnaire consisted of ratings of perceived fatigue, soreness, sleep, stress, mood and the scores summed to provide overall wellness with a lower score indicating a negative state and higher score indicating a positive state [17]. The perceived wellness questionnaire has previously shown a high association with match running performance during a hockey tournament [17]. To do this, the scores for fatigue, soreness, stress, and mood were reversed so that 0 (not fatigued/no soreness/not stressed/not moody) became 10 as this is a positive score. Sleep remained unchanged with 0 indicating no sleep at all and 10 indicating the athlete slept very, very well. The TE of this questionnaire established from a previous group of female netballers in the same youth netball academy was: perceived fatigue = 0.9 AU, stress = 1.2 AU, mood = 1.0 AU, sleep = 1.3 AU, soreness = 0.9 AU, total wellness = 3.4 AU. Finally, the coach ratings of match performance were obtained from the respective coaches using the following categories: 1 = poor, 2 = moderate, 3 = good, 4 = very good, 5 = excellent, with previously established reliability of Cronbach's alpha of between 0.88 to 0.92 [25]. There was no change in coaches ($n = 2$) across the study period, with both coaches providing a rating for each player after each match.

Statistical analyses

The jump height results were log-transformed to reduce non-uniformity of error and back-transformed to obtain percentage change with all other variables analysed in raw units. Effects on jump height are expressed in percent units with perceived wellness measures and coaches ratings in raw units. Within and between-group comparisons were analysed using a mixed linear model for each outcome measure (SPSS v.26, IBM Corp Armonk, NY) with match-day included as a repeated measure factor and players as a random factor. Group and match-day were included as fixed effects to estimate the within-group changes. The interaction (group*match-day) were included as fixed effects to estimate the between-group differences on the changes across match-day. Dummy variables (coded 0 or 1) in each match-day were also used as covariates and inserted into the model to obtain individual response for comparison between groups. The changes were subsequently expressed as a standardized mean difference (ES) to determine the magnitude, where it was classified as trivial (≤0.20), small (≥0.21 – 0.60), moderate (≥0.61 – 1.20), large (≥1.21 – 2.00) and very large (≥2.01) [17]. Evaluation of the magnitude of individual response was halved before interpreting their magnitude against the thresholds for mean changes or difference [16]. The SWC was set at 0.2 x between-subject standard deviation (SD) [17]. Custom-made spreadsheets were used to derive magnitude-based decisions [15]. The following qualitative probabilities were used: 25% – 75%, *possibly*; 75% – 97.5%, *likely*; 97.5% – 99.5%, *very likely*; >99.5%, *almost certainly* [17]. In the case of having both >2.5% higher or lower values, the true differences were assessed as unclear [17]. The association between tournament load (jump height, sRPE, playing duration), group and MDs were assessed using a linear mixed model, with player and team included as a random factor, match-day as a repeated measure factor and each of the aforementioned as fixed factors. An enter model was used and continuous variables grand mean centred before the results were exported and converted to an effect size correlation [27]. The magnitude of the effect was interpreted (≤0.10, trivial; 0.11-0.30, small; 0.31-0.50, moderate;

0.51-0.70, large; 0.71-0.90, very large; >0.90, almost perfect) and the likelihood of the effect interpreted as above.

Results

Playing duration and sRPE

The mean daily playing duration of the HIGH and LOW tournament groups were 60.5 ± 1.0 min and 36.2 ± 15 min, respectively (ES = 1.82 ± 0.51, *very likely*). The mean daily sRPE for the HIGH and LOW groups were 293.2 ± 83.5 AU and 214.2 ± 116.2 AU, respectively (ES = 0.93 ± 0.05, *likely*).

Between-group differences in neuromuscular function, perceived wellness and coach ratings

The between-group differences for the change (from MD1) in jump height, perceived wellness and coach ratings are presented in Table 1 and Figure 1. A small to moderate, *likely* to *very likely* reduction in jump height were observed on MD4 (–8.3, ±5.6%) and MD5 (–5.6, ±7.2%) in the HIGH compared with LOW group. Differences on MD2 and MD3 were unclear. There was a moderate *likely* reduction in perceived soreness scores (–0.9, ±1.1 AU) on MD3 and MD4 (–0.8, ±0.9 AU), with *unclear* difference on MD5 (–0.5, ±1.0 AU) in the HIGH load compared with LOW load group. A moderate *likely* reduction in perceived rating of sleep were observed on MD4 (–0.9, ±1.1 AU) and MD5 (–0.9, ±0.7 AU) in the HIGH compared with LOW load. No clear differences were observed for MD2 and MD3. Perceived rating of mood showed a moderate *likely* increase on MD2 (0.6, ±0.6 AU) in the HIGH load group compared with LOW and *unclear* on all other MDs. Overall perceived wellness showed a moderate *likely* reduction on MD3 (–2.6, ±2.3 AU), *unclear* on MD4 and a small *likely* reduction on MD5 (–2.1, ±3.1 AU) in HIGH load group. Differences between the HIGH and LOW load in perceived stress, fatigue, and coaches' rating were *unclear* on all MDs.

<Insert Table 1 here>

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Within-group changes in neuromuscular function, perceived wellness and coach ratings

The within-group changes in neuromuscular function, perceived wellness and coach ratings for HIGH and LOW tournament load is presented in Table 2. In the HIGH load group, jump height showed *very likely* trivial decline on MD2 (–0.0, ±3.1%), *very likely* small decline on MD4 (–7.1, ±4.7%) and *possibly* small decline on MD5 (–3.9, ±5.1) but not on MD3 (0.8, ±3.7%). Perceived fatigue showed *likely* small to *almost certainly* moderate decrease across MD2 to MD5 (range –0.6 to –1.6 AU). There was *likely* to *very likely* moderate decrease in perceived soreness from MD2 to MD5 (range –0.8 to –1.2 AU). Perceived sleep showed *possibly* small decrease in MD4 (–0.5, ±0.6 AU) and MD5 (–0.4, ±0.5 AU) respectively. There was *possibly* small to *very likely* moderate increase in perceived stress (range 0.5 to 1.1 AU). There was *possibly* small to *likely* small decrease in overall wellness (range –1.5 to –2.9 AU). Perceived mood and coach ratings were unclear across all MDs.

In the LOW load group, there was *likely* small decrease in perceived soreness scores (–0.6, ±0.8 AU) on MD5 and *possibly* small increase in perceived stress on MD2 (0.4, ±0.5 AU) and MD3 (0.6, ±0.6 AU). There was *likely* small decrease in perceived mood in MD 2 (–0.7, ±0.6 AU) and *possibly* small decrease in MD3 (0.3, ±0.5 AU). Overall wellness *possibly* increased on MD3 (1.1, ±1.8 AU), with coach ratings on MD5 showing a small *possible* increase (0.3, ±0.3 AU). The magnitude of changes in jump height, perceived fatigue, mood and stress were unclear across all MDs.

<Insert Table 2 here>

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The association between tournament load, match-day and playing duration with neuromuscular function, coach ratings of performance and perceived wellness

Results from the linear mixed model indicated that the HIGH load group elicited *very likely* to *most likely* reductions in sleep quality (ES correlation = −0.34) and coach ratings (ES correlation = −0.47) (Figure 2) when compared to the LOW load group, whilst differences in jump height, fatigue, mood, stress and soreness were unclear (Figure 2). The effect of match-day on jump height, coach ratings, and all measures of wellness (except sleep) indicated a negative association on most days (ES correlation = −0.49 to −0.37) when compared to MD1 (Figure 2). Playing duration was positively (*likely* to *very likely*) associated with jump height, coach ratings, stress, mood and sleep, but negatively associated with sorness. sRPE was negatively (*likely* to *very likely*) associated with jump height, mood and stress. sRPE was positively associated with soreness.

<Insert Figure 2 here>

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Discussion

In this study, we report the time-course changes of neuromuscular function, perceived wellness and coach ratings of performance across two intensified youth netball tournament scenarios consisting of HIGH and LOW tournament loads. Our findings indicate that (1) the accumulation of higher load across youth netball tournaments resulted in greater impairment of neuromuscular function from MD4; (2) there were small to moderate reductions in overall perceived wellness, sleep and soreness in the HIGH load group compared to the LOW load group from MD3; and (3) the HIGH load group had a small negative association with a reduction in coach ratings of performance and sleep.

The greater reduction in neuromuscular function observed in the HIGH load group as the tournament progressed is largely in agreement with a previous study in elite netball where trivial to small changes in lower-body power were reported after three consecutive matches [1]. The greater reduction of jump height in the HIGH load group is likely explained by the accumulation of match load but not solely as a function of playing duration (Figure 2A). Indeed, match activities including the frequency of sprint, jumps, decelerations and accelerations, which elicit high mechanical loading, may have contributed to the differences in the magnitude of the decline in jump height [1, 434]. Evidence of individual response was shown on MD 5 where there was larger variability in jump height in the HIGH tournament load compared to the LOW, suggesting a large magnitude of decline across individuals.

Previous studies on youth soccer players have reported no substantial change in post-training lower-body power during an in-season micro-cycle [22] and a congested competition (six matches in five days) [11]. The disparity in results between studies may be explained by differences in playing standard, sex, sporting demands, playing surface, fitness characteristics of the athletes and muscle properties. Indeed, the sex differences in force production during a countermovement jump have previously been reported with males possessing greater concentric force production during a countermovement jump [24]. Likewise, it was recently reported that female touch rugby players reported larger reduction in jump height and relative peak power output across a tournament when compared to males [5]. Collectively, these results suggest that the HIGH tournament load resulted in reductions in jump height in female youth netball players that may be due to preferential damage to type II muscle fibres as a consequence of greater external loads accumulated [33]. These findings have important practical implications for those competing in competitions involved high tournament loads, given large reduction will alter the force-velocity relationship, compromising a player's ability to perform power-based actions as well as potentially increase injury risk.

Perceived soreness, sleep and overall wellness showed a greater reduction in HIGH load group compared to the LOW load as the tournament progressed, which aligns with previous observations in other intensified tournament scenarios [11, 21], albeit with differences in sports, playing standard and tournament structure. The worsening of perceived soreness was not surprising since delayed onset of muscle soreness has been reported to occur 24 to 48 hours after the cessation of exercise with a large eccentric component [33]. Sleep quality was lower than MD1 across all days in the HIGH tournament load, which is in contrast to the LOW tournament load group. Such findings might be explained by the greater change in muscle soreness, inflammation, nervous system activity and central excitation, which are been reported previously following a soccer match [32]. Whilst a greater absolute workload may explain this finding, it is also the case that during the HIGH tournament, players played an additional match later in the day, experienced a delayed recovery, and had their evening meal later than during the LOW tournament load group. These results support the development of protocols that aid sleep during tournaments with a high match load given sleep provides both psychological and physiological recovery that is crucial to performance [20] and the recovery process [28]. The emphasis on good sleep hygiene, pre-sleep routine before a tournament and napping may assist to maximize the sleep quality and duration of youth athletes [2].

There was no clear difference in the changes of perceived fatigue between the HIGH and LOW load, though the standardised mean difference was small-to-moderate. Changes within the HIGH load group showed a *likely* to *almost certainly* increase in perceived fatigue from MD3 with *unclear* changes across MDs in the LOW group. Considering that the maximum playing duration of each match in the tournament was 40 minutes, the repeated exposure to single matches may have been insufficient to elucidate meaningful within-group changes in perceived fatigue in the LOW load group. Whilst within-group changes were observed for day 3, 4 and 5, the unlimited substitution allowed in netball may have enabled coaches to manage individual match load across tournament, explaining the large confidence intervals observed in the between-group differences.

There was a small negative association between tournament load, perceived sleep and coach ratings of performance in the HIGH load group when compared to the LOW load group. Coach ratings of performance have been used in team-sports that consists of both technical, tactical and physical factors representing a proxy of overall match performance [19, 25]. There was a negative association between HIGH tournament load and coach ratings, suggesting a negative impact of multiple matches on coaches' perception of players' performance. Well-developed physical characteristics may also contribute to assist coaches' perceived performance associated with team-sports activities [12, 18]. Such results may also be influenced by the maturation status of the athletes whereby those earlier maturers often possess better physical qualities [7] that may confer an on-court advantage. Our results indicated that an improvement of jump height by a meaningful threshold of 3 cm may bring about a 0.2 AU increase in coach ratings (Supplement 1). Recent evidence has also highlighted that higher training status is associated with better neuromuscular function when fatigued due to greater maximal eccentric strength and shorter eccentric electromechanical delay [6]. The negative association of match-days, sRPE and playing duration with jump height, coach ratings of performance and all perceived wellness measures shows the effect of repeated matches played on measures of fatigue and performance. Therefore, in intensified youth netball tournament scenarios, practitioners should consider the inclusion of these metrics in strategizing the fatigue-recovery monitoring process.

This study has several limitations that warrant discussion. Firstly, our sample was slightly (n = 2) below the required sample. However, the focus was on examining the magnitude of changes with the associated confidence limit across a multi-match, multi-day tournament to give practitioners insights on the impact of tournament load. Secondly, the findings were reflective of a single youth netball academy. We do believe that the observations are representative of a typical youth netball academy with the appropriate training methodology and periodization plans. The objective quantification of match activities using microtechnology may have provided deeper insights into the types, volume, intensities of workload during matches and positional demands. However, like many youth sports, this was not available for this study.

The only objective proxy of neuromuscular function included in this study was the vertical jump. The inclusion of biochemical markers may also likely elucidate the mechanistic component of post-match fatigue and soreness to provide a clearer explanation of the changes. However, both of these measures were unavailable, invasive and possibly out of reach for most youth netball teams during tournaments such as in the present study.

Conclusion

This is the first study to document the time-course neuromuscular responses and wellness during a HIGH and LOW load international youth netball tournament. The magnitude of changes reported across match-days in this study highlight the importance of physical preparation and the potential onset of decline in neuromuscular function as well as the markers of wellness during intensified competition. This study highlighted the potential onset of fatigue and performance decline during an intensified tournament. The findings may assist sport scientists and coaches to develop time-effective recovery strategies delivered at optimal periods during tournament to facilitate the restoration of players' functions. Additionally, tournament organisers may consider the findings when deciding match formats and lengths that are appropriate for youth netballers to maintain performance and potentially attenuate injury risk.

Practical applications

During youth netball tournaments, practitioners should employ a combination of measures to monitor match load, wellness, and neuromuscular functions, especially when confronting tournament scenarios with high exposure to matches. The appropriate monitoring process would assist practitioners to make informed decisions regarding match rotation and substitution strategies to maximize match performance. Additionally, the physical preparation of youth netballers should be focused on maximizing an individual's lower-body power and high-intensity intermittent running ability to reduce the effects of tournament load and maintain coach ratings of performance.

Declarations

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Availability of data and material: No

Code availability: Not applicable

References

1. Birdsey L, Weston M, Russell M, Johnston M, Cook C, Kilduff L (2019) Neuromuscular, physiological and perceptual responses to an elite netball tournament J Sports Sci 37:2169-2174
2. Caia J, Scott T, Halson S, Kelly V (2018) The influence of sleep hygiene education on sleep in professional rugby league athletes Sleep Health 4:364-368
3. Chandler P, Pinder S, Curran J, Gabbett T (2014) Physical demands of training and competition in collegiate netball players J Strength Cond Res 28:2732-2737
4. Claudino JG et al. (2017) The countermovement jump to monitor neuromuscular status: A meta-analysis J Sci Med Sport 20:397-402
5. Dobbin N, Highton J, Thorpe M, Twist C (2020) Sex-related changes in physical performance, wellbeing and neuromuscular function of elite Touch players during a four-day international tournament. International Journal of Sports Physiology and Performance Int J Sports Physiol Perform
6. El-Ashker S, Chaabene H, Prieske O, Abdelkafy A, Ahmed M, Muaidi Q, Granacher U (2019) Effects of neuromuscular fatigue on eccentric strength and electromechanical delay of the knee flexors: the role of training status Frontiers in Physiology 10
7. Emmonds S, Scantlebury S, Murray E, Turner L, Robsinon C, Jones B (2020) Physical Characteristics of Elite Youth Female Soccer Players Characterized by Maturity Status J Strength Cond Res 34:2321-2328
8. Foster C et al. (2001) A new approach to monitoring exercise training J Strength Cond Res 15:109-115
9. Fox A, Spittle M, Otago L, Saunders N (2013) Activity profiles of the Australian female netball team players during international competition: Implications for training practice J Sports Sci 31:1588-1595
10. Gallo T, Cormack S, Gabbett T, Lorenzen C (2016) Pre-training perceived wellness impacts training output in Australian football players J Sports Sci 34:1445-1451
11. Gibson N, McCunn R, MacNay S, Mullen T, Twist C (2018) Playing exposure does not affect movement characteristics or physiological responses of elite youth footballers during an intensified period of competition Science and Medicine in Football 2:288-293
12. Hogarth L, Burkett B, McKean M (2015a) Influence of Yo-Yo IR2 scores on internal and external workloads and fatigue responses of tag football players during tournament competition PloS one 10
13. Hogarth L, Burkett B, McKean M (2015b) Neuromuscular and perceptual fatigue responses to consecutive tag football matches Int J Sports Physiol Perform 10:559-565
14. Hopkins W (2006) Estimating sample size for magnitude-based inferences Sportscience 10:63-70
15. Hopkins W (2007) A spreadsheet for deriving a confidence interval, mechanistic inference and clinical inference from a P value Sportscience 11:16-21
16. Hopkins W (2015) Individual responses made easy J Appl Physiol 118:1444-1446
17. Ihsan M, Tan F, Sahrom S, Choo HC, Chia M, Aziz AR (2017) Pre-game perceived wellness highly associates with match running performances during an international field hockey tournament Eur J Sport Sci 17:593-602

18. Johnston R, Gabbett T, Jenkins D (2015) The influence of physical fitness and playing standard on pacing strategies during a team-sport tournament Int J Sports Physiol Perform 10:1001-1008
19. Johnston R, Watsford M, Pine M, Spurrs R, Murphy A, Pruyn E (2012) Movement demands and match performance in professional Australian football Int J Sports Med 33:89-93
20. Juliff L, Halson S, Hebert J, Forsyth P, Peiffer J (2018) Longer sleep durations are positively associated with finishing place during a national multiday netball competition J Strength Cond Res 32:189-194
21. Lacome M, Carling C, Hager J-P, Dine G, Piscione J (2018) Workload, Fatigue, and Muscle Damage in an Under-20 Rugby Union Team Over an Intensified International Tournament Int J Sports Physiol Perform 13:1059-1066
22. Malone J, Murtagh C, Morgans R, Burgess D, Morton J, Drust B (2015) Countermovement jump performance is not affected during an in-season training microcycle in elite youth soccer players J Strength Cond Res 29:752-757
23. Maraga N, Duffield R, Gescheit D, Perri T, Reid M (2018) Playing not once, not twice but three times in a day: the effect of fatigue on performance in junior tennis players International Journal of Performance Analysis in Sport 18:104-114
24. McMahon J, Rej S, Comfort P (2017) Sex differences in countermovement jump phase characteristics Sci Period Res Tech Sport 5:8
25. Mooney M, O'Brien B, Cormack S, Coutts A, Berry J, Young W (2011) The relationship between physical capacity and match performance in elite Australian football: a mediation approach J Sci Med Sport 14:447-452
26. Moreira A, Bradley P, Carling C, Arruda AFS, Spigolon L, Franciscon C, Aoki MS (2016) Effect of a congested match schedule on immune-endocrine responses, technical performance and session-RPE in elite youth soccer players J Sports Sci 34:2255-2261
27. Rosnow R, Rosenthal R, Rubin D (2000) Contrasts and correlations in effect-size estimation Psychological science 11:446-453
28. Samuels C (2009) Sleep, recovery, and performance: the new frontier in high-performance athletics Neurologic Clinic 20:149-159
29. Sanchez-Sanchez J, Sanchez M, Hernandez D, Ramirez-Campillo R, Martínez C, Nakamura FY (2019) Fatigue in U12 Soccer-7 Players During Repeated 1-Day Tournament Games—A Pilot Study J Strength Cond Res 33:3092-3097
30. Saw A, Main L, Gastin P (2015) Monitoring the athlete training response: subjective self-reported measures trump commonly used objective measures: a systematic review Br J Sports Med:1-13
31. Tangalos C, Robertson S, Spittle M, Paul G (2015) Predictors of Individual Player Match Performance in Junior Australian Football Int J Sports Physiol Perform 10:853-859 doi:10.1123/ijspp.2014-0428
32. Thorpe R, Strudwick A, Buchheit M, Atkinson G, Drust B, Gregson W (2016) Tracking morning fatigue status across in-season training weeks in elite soccer players Int J Sports Physiol Perform 11:947-952
33. Twist C, Eston R (2005) The effects of exercise-induced muscle damage on maximal intensity intermittent exercise performance Eur J Appl Physiol 94:652-658
34. van Gogh M, Wallace L, Coutts A (2020) Positional demands and physical activity profiles of netball J Strength Cond Res 34:1422-1430

Figures Captions

Fig 1: Standardize mean change (± 95% CL) compared with match-day 1 between HIGH vs. LOW tournament load at the respective match-days. Probabilities of the differences: *possibly (25 – 75%); **likely (75 – 97.5%); ***very likely (97.5 – 99.5%)

Fig. 2: Effect size correlation for jump height (a), coach rating (b), fatigue (c), soreness (d), sleep (e), stress (f), mood (g) and overall wellness (h) with 95% compatibility intervals. Probabilities of the differences: *possibly (25 – 75%); **likely (75 – 97.5%); ***very likely (97.5 – 99.5%); ****almost certainly (>99.5%).