Abstract

Objectives: To describe the perceived load, fatigue and recovery profiles during congested and non-congested schedules in international football tournaments. ***Design***: Retrospective single-cohort observational study ***Methods***: Internal load (session-rating of perceived exertion [s-RPE]) and perceived ratings of fatigue, muscle soreness, psychological status, sleep quality, and sleep duration were recorded daily from 37 national team footballers during the competition phase of 3 international tournaments. ANOVA and Effect Size (ES) analyses compared individualised internal load and perceived response profiles between congested and non-congested acute 2-match schedules. Conditions included Acute Congestion (≤4 days between two matches), Non-Congestion (> 4 days between two matches), Single-Match, and No-Match. ***Results***: Significantly higher s-RPE match loads ($p<0.001$) within the single- and multi-match conditions resulted in significantly worsened ($p<0.05$) subjective ratings of perceived fatigue, muscle soreness and sleep duration in the 24-48h post-match. Internal load profiles were not different between the Acute-Congestion or Non-congestion conditions ($p>0.05$); though Acute-Congestion had significantly worsened pre-match subjective ratings compared to Non-Congestion on both MD1 ($p = 0.040$; ES = 0.94) and MD2 ($p = 0.033$; ES = 0.94). However, between-match differences in Acute-Congestion showed no further impairments in perceived response between the first and second matches ($p>0.05$). ***Conclusion***: During international tournaments, internal load and perceived fatigue/recovery profiles are largely determined by their exposure (or lack thereof) to match-play. Periods of acute match congestion impaired players pre-match perceived status when compared to non-congested microcycles. However, acute match congestion does not appear to exacerbate players post-match fatigue/recovery response within the context of international football tournaments.

Keywords: training load; fatigue; recovery; monitoring; national team; international football

Introduction

Major international football tournaments consist of demanding fixtures, with teams required to play 3 matches within 7-11 days, and those in knockout phases playing up to 7 matches over 28-31 days.[1] To optimise tournament performance, balancing the stress of training/competition with sufficient recovery is a major objective for support staff.[2] Such views are articulated in a survey at the 2014 World Cup, whereby national team practitioners ranked reduced recovery periods, accumulated fatigue, and congested match schedules among the most important risk factors for non-contact injury.[3] Similarly, national team practitioners also ranked monitoring tools that quantify match exposure and subjective markers of fatigue and recovery status as commonly used.[3] However, whilst player monitoring practices are ubiquitous within professional football,[3,4] evidence of their usefulness emanates predominately from club-based contexts,[5-7] with limited research available within national team environments.

A common trend in the monitoring practices of elite football teams is the daily use of athlete self-report measures to monitor the psychobiological state or "wellness" of players.[3,4] Although the validity of such scales remains in discussion[8,9], the applicability of monitoring athlete perceived stress and fatigue in professional football has some support, with studies demonstrating their responsiveness to changes in acute training and match loads.[2,10,11] For instance, within an elite professional team, between-day changes in subjective measures of perceived fatigue, muscle soreness and sleep quality were shown to closely reflect acute fluctuations in training/match load across 'standard' in-season weeks (1-match per week).[10] Specifically, significant reductions in total wellness (35-40%) exist the day post-match, with subsequent improvements (17-26% increase) by 48h and a plateau thereafter due to the renewed presence of training load.[10] However, despite the apparent responsiveness of these subjective measures to the acute presence of training/match load, the association between load and wellness in football remains equivocal, with contrasting findings depending on the load variable measured (i.e. internal or external load) and how load is calculated (i.e. previous day load, accumulation of load over multiple-days/week).[2,11,12]

While the aforementioned research examined the perceived fatigue and stress responses of professional footballers during single-match week microcycles, the competition schedules of most successful football teams includes multi-match weeks, as exists during international tournaments.[13,14] Within congested match schedules the time for recovery is reduced, accentuating the need to optimise and monitor recovery process. However, limited research exists detailing the impact of match congestion on player recovery profiles in international competition. Recent studies within club football have shown ratings of perceived fatigue to be significantly worsened in weeks with two-competitive matches compared to one.[15,16] While, gradual decreases in match day total wellness have been observed over a prolonged period of fixture congestion (11 matches in 36 days), indicating that subjective status may be sensitive to chronic accumulations of load.[17] Thus far, no study has examined the acute load and recovery profiles of international footballers during congested match-to-match microcycles. Accordingly, this study examined the effect of match load on self-reported fatigue and recovery profiles during congested and non-congested microcycles within international tournaments. It is hypothesised that match exposure during a congested microcycle will negatively impact perceived recovery profiles when compared to non-congested microcycles.

Methods

Data was collected from 37 professional male football players (26.4 ± 4.1y) selected to compete for the Australian National Football Team at three Fédération Internationale de Football Association (FIFA) sanctioned international football tournaments: 2015 Asian Cup (AC_{2015}), 2017 Confederations Cup (CC_{2017}), and 2018 World Cup (WC_{2018}). All outfield players from the original 23-man squad for each tournament were eligible for inclusion, with goalkeepers excluded due to variations in their training methods and match activity. In total, participating players consisted of 8 central defenders, 6 wide defenders, 12 central midfielders, 6 wide midfielders and 5 strikers. Provisional approval for the study was obtained from the National Federation involved, with individual player data previously collected as a condition of national team duty.[18] Data collection procedures were approved by the institutional Human Research Ethics Committee. Retrospective sharing and conditional usage of the data was undertaken in accordance with a strict data confidentiality agreement, and all data were anonymised before analysis to ensure player confidentiality.

The present observational study followed a retrospective single-cohort study design, in which players´ internal load (training and matches) and perceived fatigue and recovery data were routinely collected from the same national team competing at three international tournaments. Data was assessed from only the competition phases of each tournament, comprising 23-days for the AC_{2015} (winners), 7-days for the CC_{2017} (3rd in group stages), and 12-days for the WC_{2018} (4th in group stages). In total 12 matches were played across the 3 tournaments, in which the observed national team registered 5 wins, 3 draws and 4 losses. Individual player tournament data was then categorised into congested or non-congested 2-match microcycles (i.e. consecutive matches), according to the following classification criteria: 1) Acute-Congestion – participation in 2 successive matches separated by a time interval totalling < 4 days (96h)[19]; 2) Non-Congestion – participation in 2 successive matches separated by a time interval totalling > 4 days (>96h); 3) Single-Match week – 1 match played followed by no-participation in the subsequent match; 4) No-Match week – no participation in successive matches. Match participation was defined as having played ≥ 70 minutes in a single match.[14,16] For instances where microcycles overlapped (i.e. two Acute-Congestion microcycles from 3 consecutive matches) data from the middle match was included within both microcycles. Overall, a combined total of 70 match-to-match microcycles were included for analysis, consisting of 18 Acute-Congestion, 19 Non-Congestion, 10 Single-Match, and 23 No-Match microcycles.

Internal player load for all training and match sessions (including on-field, gym, recovery and rehab training sessions) were monitored throughout the assessment period using the session-rating of perceived exertion (s-RPE) method.[20] Data were manually entered by the players into a tablet application (SMARTABASE, Fusion Sport, Brisbane, Australia), in which the same reporting scale (Modified CR-10 Borg scale)[21] and recording protocol were used across all international tournaments. All players had familiarity with the scale, having used such method for at least 1-year prior. Session load (s-RPE, arbitrary units, AU) was then estimated for each player by multiplying their total training or match session duration (min) by their reported RPE.[20]

Player's perceived ratings were monitored daily each morning (09:00-10:00) prior to training or competition throughout the assessment period. A customised questionnaire measured player's perceived ratings to assess their fatigue and recovery responses to training and competition.[22-24] It comprised 5 items relating to perceived fatigue, general muscle soreness, psychological status, sleep quality, and sleep duration. Each question was scored on a seven-point Likert scale ranging from 1–7, with point increments of 1, and scores of 1 representing "very, very good" and 7 representing "very, very poor", respectively. The five items for a given day were summated to provide a total perceived response score for each player, whereby a higher number represents a worse perceived state.

Descriptive data for internal load and perceived fatigue/recovery response variables are presented as means ± standard deviation (mean ± SD). Due to differences in the time intervals between matches (i.e. 3, 4, or 5-days), individual load and perceived response data were aligned within each 2-match microcycle according to the number of days post-match (i.e. matchday 1 [MD1], matchday 1+1 [MD1+1], matchday 1+2 [MD1+2], matchday 1+3 [MD1+3], and repeated for matchday 2 [MD2]). Subsequent analysis of the training load profile was performed using data up 2-days post-match, while player perceived ratings were analysed using data up to 3-days post-match to assess the full extent of the player responses as a proxy for recovery.

Mixed-design analysis of variances (ANOVA) determined the effect of different acute match congestion microcycles on player's load and perceived fatigue and recovery profiles, with time as the within-subjects factor and microcycle condition as the between-subjects factor. Subsequent follow-up tests were conducted using multiple one-way ANOVAs to determine where these difference/s occurred, with significance set at the $p \leq 0.05$ level. The magnitude of these differences was reported as Cohen's *d* effect sizes (ES) with [90% confidence intervals]. The criteria used to interpret the magnitude of the ES were as follows: 0.0–0.2 = trivial, 0.21–0.6 = small, 0.61–1.2 = moderate, 1.21– 2.0 = large, 2.01–4.0 = very large, >4.0 = nearly perfect.[25] Additionally, Spearman's rank correlation coefficients (r_s) were also calculated to determine the association between internal match load and self-reported variables the day immediately post-match (MD+1). Initial correlations were performed using data from all 2-match microcycles, followed by a secondary analysis in which match loads of zero (i.e. No Match condition) were excluded. The magnitude of the correlations was classified as follows: trivial ($r_s \leq 0.1$), small ($0.1 < r_s \leq 0.3$), moderate ($0.3 < r_s \leq 0.5$), large ($0.5 < r_s \leq 0.7$), very large ($0.7 < r_s \leq 0.9$), almost perfect ($r_s > 0.9$).[25] All statistical analyses were performed using the software package SPSS (version 24.0, Chicago, IL, USA).

Results

Concerning internal load, both main effects of microcycle condition ($F_{[3, 66]}$ = 61.25, p<0.001) and time ($F_{[3, 177]}$ = 439.77, p<0.001) were significant across the 2-match microcycle periods. The interaction between microcycle condition and time was also significant ($F_{[8, 177]}$ = 197.01, p<0.001); with post-hoc comparison tests revealing significantly higher (p<0.001; Figure 1a) match loads for Acute-Congestion (ES = 12.69[12.07,13.31]), Non-Congestion (ES = 12.91[12.32, 13.50]), and Single-Match (ES = 12.36[11.29,13.44]) on MD1, and for Acute-Congestion (ES = 9.98[9.47,10.48]; ES = 12.22[11.60,12.84]) and Non-Congestion (ES = 12.07[11.58,12.55]; ES = 14.69[14.09,15.28]) on MD2. Post-matchday, the No-Match condition reported significantly (p<0.001) higher training loads on MD1+1 compared to all other conditions (ES_{range} = 3.02–3.11); while on MD2+1, training loads were significantly higher (p<0.001) for Single-Match (ES = –3.30[–4.29,–2.32]; ES = –3.14[–4.12,–2.16]) and No-Match (ES = –3.39[–3.87,–2.92]; ES = –3.30[–3.79,–2.82]) conditions compared to Acute-Congestion and Non-Congestion. On MD1+2, Non-Congestion reported significantly higher loads compared to Acute-Congestion (p = 0.063; ES = –0.86[–1.41, –0.30]) and Single-Match (p = 0.009; ES = 1.04[0.54,1.53]), while the No-Match group also had significantly higher (p = 0.011) training loads compared to Single-Match (ES = –0.87[–1.31, –0.44]). Lastly on MD2+2, Acute Congestion reported significantly higher (p = 0.015) training loads compared to Non-Congestion (ES = 1.16[0.57,1.75]).

Concerning total perceived responses, both main effects of microcycle condition ($F_{[3, 66]}$ = 5.42, p = 0.002) and time ($F_{[4, 254]}$ = 57.56, p<0.001) were significant across the 2-match microcycle periods. The interaction between microcycle condition and time was also significant ($F_{[12, 254]}$ = 4.77, p<0.001); with post-hoc comparison tests revealing significantly higher (worsened) total perceived responses for Acute-Congestion compared to Non-Congestion on MD1 (p=0.040; ES = 0.94[0.37,1.50]) and MD2 (p = 0.048; ES = 0.94[0.39,1.49]). Post-matchday, total response values were significantly higher for Acute-

Congestion (p<0.001; ES = 1.81[1.31,2.31]), Non-Congestion (p = 0.009; ES = 1.04[0.52,1.56]), and Single-Match (p = 0.005; ES = 1.21[0.65,1.77]) on MD1+1; while on MD2+1, total response values were significantly higher for Acute-Congestion and Non-Congestion compared to both Single-Match (p = 0.003; ES = 2.20[1.36,3.05]; p = 0.026; ES = 1.51[0.70,2.32]) and No-Match (p<0.001; ES = 2.10[1.61,2.59]; p<0.001; ES = 1.56[1.06,205]) conditions. Thereafter, total perceived response ratings remained significantly (p = 0.048) higher for Acute-Congestion (ES = 0.81[0.31, 1.32]) compared to No-Match on MD1+2, while no significant differences (p>0.05) were evident on MD1+3. Lastly, on MD2+2, total perceived response remained significantly higher for Acute-Congestion (p = 0.005; ES = 1.86[1.08,2.65]) and Non-Congestion (p = 0.017; ES = 1.37[0.67,2.08]) compared to Single-Match, while no significant differences (p>0.05) between microcycle conditions were evident on MD2+3.

In relation to the perceived response sub-scales, significant interaction effects for perceived fatigue, muscle soreness, sleep duration and sleep quality were evident (p<0.05; Table 1), whereby Acute-Congestion and Non-Congestion showed significantly higher post-match ratings of perceived fatigue ($p \leq 0.032$; ES_{range} = 0.98–2.78) and muscle soreness ($p \leq 0.024$; ES_{range} = 1.00–3.33) up to 48h post-match. These significantly higher fatigue ratings remained elevated up to 72h post-match, although higher muscle soreness ratings were only evident at 72h post-MD2. In addition, Acute-Congestion reported significantly higher sleep duration and sleep quality on both MD1+1 and MD2+1 compared to No-Match.

Significant positive correlations (p<0.001; Figure 2) existed between s-RPE match load and the following post-match items: total perceived response (r_s=0.571), fatigue (r_s=0.673), muscle soreness (r_s=0.675), sleep quality (r_s=0.364), and sleep duration (r_s=0.303). However, when data points with zero match load were excluded (i.e. No-Match microcycles) and the correlation analysis repeated, only a small negative correlation (r_s=–

0.255; $p<0.05$) was found between s-RPE match load and sleep duration (i.e. higher load and reduced sleep duration), while no significant correlations were identified for the other post-match perceived response items ($p>0.05$).

Discussion

This study examined the perceived load, fatigue and recovery profiles of international footballers during congested and non-congested tournament schedules. Variations in load and player perceived status profiles were largely determined by exposure to match-play, in turn influencing acute post-match responses. As expected, high internal match loads preceded reduced next-day training loads in single and multi-match conditions. The resultant post-match responses showed worsened ratings of fatigue, muscle soreness, and sleep quality/duration within these 2-match microcycles. Furthermore, pre-match ratings for Acute-Congestion were significantly worse compared to Non-Congestion on both match days. However, within the Acute Congestion conditions no significant differences in perceived status were evident between respective match days. Within the context of international football tournaments, acute match congestion (i.e. 2 matches within 4 days) does not appear to exacerbate post-match perceptual fatigue and recovery responses.

Despite an abundance of club-based data, limited match load and recovery data exists from national team contexts. In the present study, exposure (or lack thereof) to tournament match-play largely determined the change in load profiles between match congestion microcycles. Likely at the instigation of coaching staff, players exposed to >70min playing time resulted in lower training loads over the ensuing days compared to non-playing condition. Although intuitive, this finding reflects a common post-match squad load management strategy, whereby recovery is emphasised for starters/substitutes and maintenance of physical loading for non-players.[26,27] Regardless of the existence or absence of match congestion, similar internal load profiles existed between matches, which concurs with findings from club-based contexts.[16] In further support, external locomotion-based variables have also reported to be not significantly different during congested schedules in both professional[19,28] and international football.[1] Thus, while the absence of external load measures is a potential limitation, the similarities in internal load responses between the conditions suggest an appropriate reference point from which to compare the post-match perceptual recovery profiles.

Differences in perceived fatigue and recovery profiles between the match congestion conditions closely reflected exposure to tournament match-play, hence questioning whether exposure or load are of importance. For instance, similar impairments in total perceived response values were observed up to 48h post-match in both single and multiple matches. Previous research reporting perceptual wellness responses within 'standard' 1 match microcycles[2,10], as well as, both single and multi-match weeks,[16] reported comparable post-match recovery time courses. However, unlike the present study, multi-match congestion was shown to further exacerbate perceived fatigue ratings following the 2nd match.[16] The contradictions between these findings may in part be due to the contextual differences of club football, as the previous study included a club team with excessive post-match travel demands. Further, factors like club training programmes with higher post-match training loads, or limited/reduced access to recovery facilities must also be considered in domestic Australian clubs.[10,17] Nevertheless, within the current study exposure to acute tournament match congestion does not appear to exacerbate international footballer's post-match fatigue and recovery responses. Although the generalisability of this finding is unknown and future research in other national teams over longer tournament periods are warranted.

Closer examination of the between-group comparison of the multi-match conditions alludes to significant variations in player perceptual ratings between Acute-Congestion and Non-Congestion microcycles despite similar load profiles. Specifically, moderate effect sizes existed for worse recovery of perceived fatigue, muscle soreness and sleep duration in Acute-Congestion. Previously, research within club-based contexts identified these parameters as the most responsive to match load during multi-match weeks, citing the repeated matches, logistical demands, and limited opportunity for recovery as justification for the observed responses.[15,16] However, exposure to match load may not be the only determinant of perceived fatigue and recovery responses, as other match-related factors including match outcome and players' individual performance can influence post-match perceived fatigue, stress and sleep.[29] Although, the authors acknowledge these factors were not controlled for within this analysis, their contribution may only be evident up to 24h post-match.[29] Notwithstanding, day-to-day variances within the No-Match condition were also evident within this study. Most notably total perceived response values were worsened on MD1+1, due largely to higher (poorer) ratings in sleep duration, with some late-night fixtures and possible air travel likely compromising player's sleep patterns.[30]

The association between match-day load and the subsequent post-match perceived response had moderate-to-large positive correlations for all items, except psychological status. These findings align with research by Moalla and colleagues[12] who reported similar correlations (r = 0.23–0.48) between daily internal training load (s-RPE) and subjective ratings in professional footballers during pre- and in-season periods. Notably, perceived ratings of fatigue and muscle soreness were the most strongly associated with match loads, likely due to the high physical demands of football match-play resulting in residual post-match fatigue and tiredness.[5] In contrast, sleep quality and sleep duration were less sensitive to match loads, which may be a reflection of their responsiveness to contextual match factors (i.e. reduced recovery time and travel demands) rather than the match load itself. However, removing the no-match condition showed no significant correlations between any perceived response items and s-RPE match load. Thus, player perceptual responses may be responsive to the presence of match load, but is likely not sensitive to the variations/fluctuations evident within congested microcycles. Indeed, recent concerns have been raised relating to the validity and reliability of using single-item and composite scores to measure athlete's training 'response", with these measures unlikely to be influenced by only training and match load.[30,31]

Conclusion

Variations in perceived load, fatigue and recovery profiles between congested and non-congested microcycles were largely determined by exposure to tournament match-play. While a consistent trend of worsened subjective ratings for Acute-Congestion was observed compared to the other congestion conditions, similarities in the magnitude of player responses on MD1 and MD2 suggest that acute match congestion does not exacerbate perceived fatigue and recovery responses within the context of international football tournaments.

Practical implications

During international football tournaments, periods of acute-match congestion were shown to be followed by impaired states of pre-match subjective status compared to non-congested microcycles. However, the sensitivity of players' perceived total response to training and match load appears to be less evident within congested microcycles. Future research should aim to determine the sensitivity, if not validity, of the subjective metrics in relation to external load or another response measure during congested schedules.

Acknowledgements

The authors would like to thank the players, coaches and support staff from Football Federation Australia for their support, cooperation and input into this project. No external funding was provided that contributed to the development of this manuscript. Denny Noor has been supported by "Science and Health in Football" scholarship funded by Saarland University.

References

1. Silva JR, Rumpf M, Hertzog M, Nassis G. Does the FIFA World Cup's congested fixture program affect players' performance? *Asian J Sports Med.* 2017;8(4):e13805.
2. Thorpe R, Strudwick A, Buchheit M, Atkinson G, Drust B, Gregson W. Monitoring fatigue during the in-season competitive phase in elite soccer players. *Int J Sports Physiol Perform.* 2015;10(8):958-964.
3. McCall A, Davison M, Andersen TE, et al. Injury prevention strategies at the FIFA 2014 World Cup: perceptions and practices of the physicians from the 32 participating national teams. *Br J Sports Med.* 2015;49(9):603-608.
4. Akenhead R, Nassis GP. Training load and player monitoring in high-level football: current practice and perceptions. *Int J Sports Physiol Perform.* 2016;11(5):587-593.
5. Silva JR, Rumpf MC, Hertzog M, et al. Acute and residual soccer match-related fatigue: a systematic review and meta-analysis. *Sports Med*. 2018;48(3):539-583.
6. Nedelec M, McCall A, Carling C, Legall F, Berthoin S, Dupont G. Recovery in soccer: part i - post-match fatigue and time course of recovery. *Sports Med.* 2012;42(12):997-1015.
7. Marqués-Jiménez D, Calleja-González J, Arratibel I, Delextrat A, Terrados N. Fatigue and recovery in soccer: evidence and challenges. *Open Sports Sci J.* 2017;10(Suppl 1: M5):52-70.
8. Saw AE, Kellmann M, Main LC, Gastin PB. Athlete self-report measures in research and practice: considerations for the discerning reader and fastidious practitioner. *Int J Sports Physiol Perform*. 2017;12(Suppl 2):127-135.
9. Windt J, Taylor D, Nabhan D, Zumbo BD. What is unified validity theory and how might it contribute to research and practice with athlete self-report measures. *Br J Sports Med*. 2019;53(19):1202-1203.

10. Thorpe R, Strudwick AJ, Buchheit M, Atkinson G, Drust B, Gregson W. The tracking of morning fatigue status across in-season training weeks in elite soccer players. *Int J Sports Physiol Perform*. 2016;11(7):947-952.

11. Thorpe R, Strudwick AJ, Buchheit M, Atkinson G, Drust B, Gregson W. The influence of changes in acute training load on daily sensitivity of morning-measured fatigue variables in elite soccer players. *Int J Sports Physiol Perform*. 2017;12(Suppl 2):107-113.

12. Moalla W, Fessi MS, Farhat F, Nouira S, Wong DP, Dupont G. Relationship between daily training load and psychometric status of professional soccer players. *Res Sports Med*. 2016:1-8.

13. Anderson L, Orme P, Di Michele R, Close GL, Morgans R, Drust B, Morton JP. Quantification of training load during one-, two- and three-game week schedules in professional soccer players from the English Premier League: implications for carbohydrate periodisation. *J Sports Sci*. 2016;34(13):1250-1259.

14. Carling C, McCall A, Le Gall F, Dupont G. The impact of short periods of match congestion on injury risk and patterns in an elite football club. *Br J Sports Med*. 2016;50(12):764-768.

15. Clemente FM, Mendes B, Nikolaidis PT, Calvete F, Carriço S, Owen AL. Internal training load and its longitudinal relationship with seasonal player wellness in elite professional soccer. *Physiology & Behavior*. 2017;179:262-267.

16. Howle K, Waterson A, Duffield R. Recovery profiles following single and multiple matches per week in professional football. *Eur J Sport Sci*. 2019; 19(10):1303-1311.

17. Waterson A. Effect of a congested schedule involving frequent travel on training loads and wellness: A case study of a professional Australian football team. *J Aust Strength Cond*. 2016;24(5):53-60.

18. Winter EM, Maughan RJ. Requirements for ethics approvals. *J Sports Sci*. 2009;27(10):985-985.

19. Lago-Peñas C, Rey E, Lago-Ballesteros J, Casáis, L, Domínguez, E. The influence of a congested calendar on physical performance in elite soccer. *J Strength Cond Re*s. 2011; 25(8):2111–2117.

20. Impellizzeri FM, Rampinini E, Coutts AJ, Sassi A, Marcora SM. Use of RPE-based training load in soccer. *Med Sci Sports Exerc*. 2004;36(6):1042-1047.

21. Foster C, Florhaug JA, Franklin J, Gottschall L, Hrovatin LA, Parker S, Doleshal P, Dodge C. A new approach to monitoring exercise training. *J Strength Cond Res*. 2001;15(1):109-115.

22. Gastin PB, Meyer D, Robinson D. Perceptions of wellness to monitor adaptive responses to training and competition in elite Australian football. *J Strength Cond Res*. 2013;27(9):2518-2526.

23. McLean BD, Coutts AJ, Kelly V, McGuigan MR, Cormack SJ. Neuromuscular, endocrine, and perceptual fatigue responses during different length between-match microcycles in professional rugby league players. *Int J Sports Physiol Perform*. 2010;5(3):367-383.

24. Hooper SL, Mackinnon LT. Monitoring overtraining in athletes: recommendations. *Sports Med*. 1995;20(5):321-327.

25. Hopkins W. A scale of magnitudes for effect statistics. A new view of statistics 2002. Accessed Dec. 1, 2018.

26. Anderson L, Orme P, Di Michele R, Close GL, Milsom J, Morgans R, Drust B, Morton JP. Quantification of seasonal-long physical load in soccer players with different starting status from the English Premier League: implications for maintaining squad physical fitness. *Int J Sports Physiol Perform*. 2016;11(8):1038–1046.

27. Stevens TGA, de Ruiter CJ, Twisk JWR, Geert JP, Savelsbergh GJP, Beek PJ. Quantification of in-season training load relative to match load in professional Dutch Eredivisie football players. *Sci Med Football*. 2017;1(2):117–125.

28. Carling C, Gregson W, McCall A, Moreira A, Wong DP, Bradley PS. Match running performance during fixture congestion in elite soccer: research issues and future directions. *Sports Med*. 2015;45(5):605–613.
29. Fessi MS, Moalla W. Post-match perceived exertion, feeling, and wellness in professional soccer players. *Int J Sports Physiol Perform*. 2018;13(5):631–637.
30. Fullagar HHK, Duffield R, Skorski S, Coutts AJ, Julian R, Meyer T. Sleep and recovery in team sport: current sleep-related issues facing professional team-sport athletes. Int J Sports Physiol Perform. 2015;10:950–957
31. Duignan, C, Doherty, C, Caulfield, B, Blake, C. Single-item self-report measures of team-sport athlete wellbeing and their relationship with training load: A systematic review. J Athl Train. 2020;55(9);944-953
32. Jeffries AC, Wallace L, Coutts AJ, McLaren SJ, McCall A, Impellizzeri FM. Athlete-reported outcome measures for monitoring training responses: A systematic review of risk of bias and measurement property quality according to the COSMIN guidelines. Int J Sports Physiol Perform. 2020;15(9);1203-1215

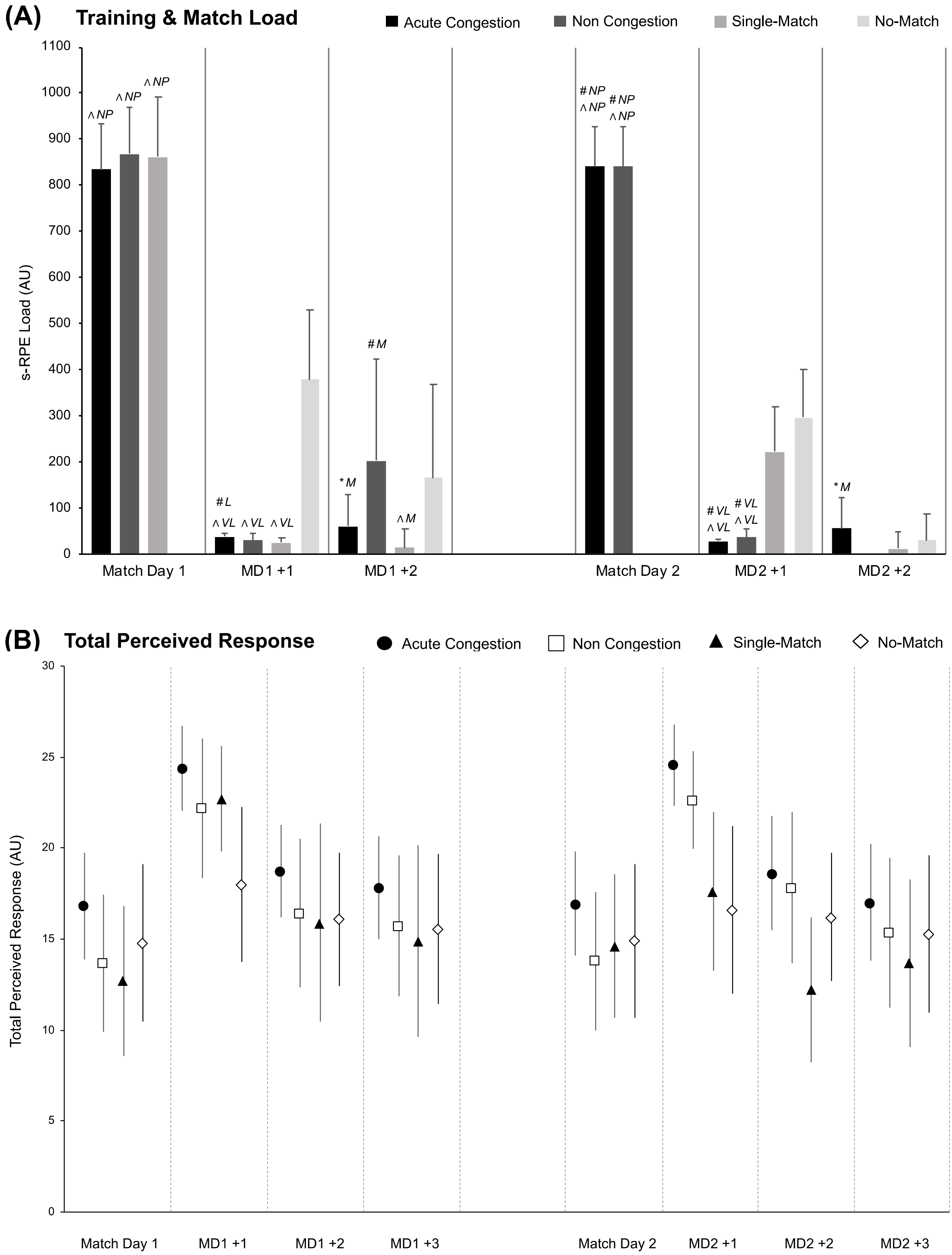

Figure 1. Internal (s-RPE) training/match load (Figure A) and total perceived response profiles (Figure B) for Acute Congestion, Non-Congestion, Single-Match, and No-Match microcycles. Note: Higher perceived response scores represent a worsened status.
*Denotes a significant difference from NC, #Denotes a significant difference from SM, ^Denotes a significant difference from NM; $p \leq 0.05$. Effect size abbreviations: *S* = small, *M* = Moderate, *L* = large, *VL* = very large, *NP* = nearly perfect.

Table 1. Sub-scale perceived response profiles for Acute-Congestion, Non-Congestion, Single-Match, and No-Match microcycles.

	MD1	MD1 +1	MD1 +2	MD1 +3	MD2	MD2 +1	MD2 +2	MD2 +3
Fatigue								
Acute-Congestion	3.4 ± 0.8	5.2 ± 0.5 ^L	4.1 ± 0.8 ^M	3.7 ± 0.8 ^M	3.6 ± 0.6 *M $^{\#}$L ^M	5.2 ± 0.4 $^{\#}$VL ^VL	4.3 ± 0.6 $^{\#}$VL ^L	3.7 ± 0.8 ^M
Non-Congestion	2.6 ± 1.2	4.9 ± 1.0 ^L	3.7 ± 1.1	3.2 ± 1.2	2.7 ± 1.1	4.9 ± 0.9 $^{\#}$L ^L	4.0 ± 1.0 $^{\#}$L ^M	3.3 ± 1.1
Single-Match	2.3 ± 1.3	4.4 ± 1.4	3.2 ± 1.6	2.8 ± 1.4	2.2 ± 1.1	2.6 ± 1.5	1.9 ± 1.3	2.3 ± 1.4
No-Match	2.7 ± 1.3	3.1 ± 1.3	3.0 ± 1.3	2.8 ± 1.3	2.7 ± 1.2	2.8 ± 1.3	2.9 ± 1.3	2.7 ± 1.3
Muscle Soreness								
Acute-Congestion	3.6 ± 0.8	5.0 ± 0.7 ^L	4.2 ± 0.5 ^M	3.7 ± 0.8	3.6 ± 0.7 $^{\#}$L ^M	5.1 ± 0.4 $^{\#}$VL ^VL	4.4 ± 0.7 $^{\#}$VL ^L	3.7 ± 0.8 $^{\#}$L ^M
Non-Congestion	2.7 ± 1.2	4.8 ± 0.8 ^L	3.9 ± 1.1	3.4 ± 1.1	2.9 ± 1.1	4.9 ± 0.8 $^{\#}$VL ^VL	4.2 ± 1.0 $^{\#}$L ^M	3.4 ± 1.2
Single-Match	2.7 ± 1.2	4.8 ± 0.8 ^L	4.2 ± 1.1	3.3 ± 1.2	2.6 ± 0.8	2.7 ± 1.1	2.4 ± 1.1	2.5 ± 1.0
No-Match	3.0 ± 1.3	3.3 ± 1.2	3.2 ± 1.2	3.0 ± 1.1	2.8 ± 1.1	2.7 ± 1.3	3.2 ± 1.0	2.8 ± 1.1
Psychological Status								
Acute-Congestion	2.7 ± 1.0	3.1 ± 1.0	2.9 ± 1.0	2.7 ± 0.9	2.7 ± 0.9	3.2 ± 1.0	3.0 ± 0.9	2.6 ± 1.0
Non-Congestion	2.3 ± 0.8	2.5 ± 1.0	2.3 ± 0.7	2.3 ± 0.8	2.3 ± 0.7	2.6 ± 1.1	2.5 ± 0.9	2.3 ± 0.8
Single-Match	2.1 ± 1.0	2.8 ± 1.0	2.4 ± 1.1	2.2 ± 0.9	2.5 ± 1.2	2.7 ± 0.9	2.4 ± 0.9	2.3 ± 0.9
No-Match	2.5 ± 1.2	3.0 ± 1.1	1.9 ± 1.2	2.9 ± 1.2	2.7 ± 1.2	3.0 ± 1.3	3.2 ± 1.2	2.8 ± 1.1
Sleep Quality								
Acute-Congestion	3.2 ± 0.8	4.9 ± 0.9 ^L	3.4 ± 1.0	3.4 ± 0.9	3.2 ± 0.9	4.9 ± 1.3 ^L	3.1 ± 1.3	3.2 ± 0.9
Non-Congestion	2.8 ± 0.9	4.4 ± 1.2	2.9 ± 1.4	2.9 ± 1.2	2.7 ± 1.0	4.4 ± 1.0 ^M	3.2 ± 1.6	2.7 ± 1.2
Single-Match	2.7 ± 0.9	4.5 ± 0.9	2.8 ± 1.6	3.0 ± 1.3	3.3 ± 1.1	4.2 ± 1.0	2.6 ± 0.9	2.8 ± 1.2
No-Match	3.0 ± 1.1	3.7 ± 1.1	3.3 ± 0.8	3.2 ± 0.9	3.2 ± 1.0	3.3 ± 1.0	3.4 ± 0.8	3.2 ± 1.0
Sleep Duration								
Acute-Congestion	3.9 ± 0.9 $^{\#}$M	6.2 ± 0.6 ^M	4.1 ± 1.0	4.4 ± 0.9 ^M	3.8 ± 0.9	6.1 ± 0.8 ^L	3.8 ± 1.4	3.8 ± 1.0
Non-Congestion	3.2 ± 1.0	5.5 ± 1.3	3.5 ± 1.2	3.9 ± 1.4	3.2 ± 1.0	5.8 ± 0.8 ^M	3.9 ± 1.6	3.6 ± 1.4
Single-Match	2.9 ± 0.9	6.2 ± 0.4 ^M	3.3 ± 1.6	3.6 ± 1.4	4.0 ± 1.2	5.4 ± 1.0	2.9 ± 1.2	3.8 ± 1.2
No-Match	3.6 ± 0.8	5.0 ± 1.4	3.7 ± 0.8	3.7 ± 0.8	3.6 ± 0.8	4.7 ± 1.2	3.6 ± 1.0	3.8 ± 1.1

MD1, Match Day 1; MD2, Match Day 2

*Denotes a significant difference from NC, $^{\#}$Denotes a significant difference from SM, ^Denotes a significant difference from NM; $p \leq 0.05$.

Effect size abbreviations: ^{S} = small, ^{M} = Moderate, ^{L} = large, ^{VL} = very large

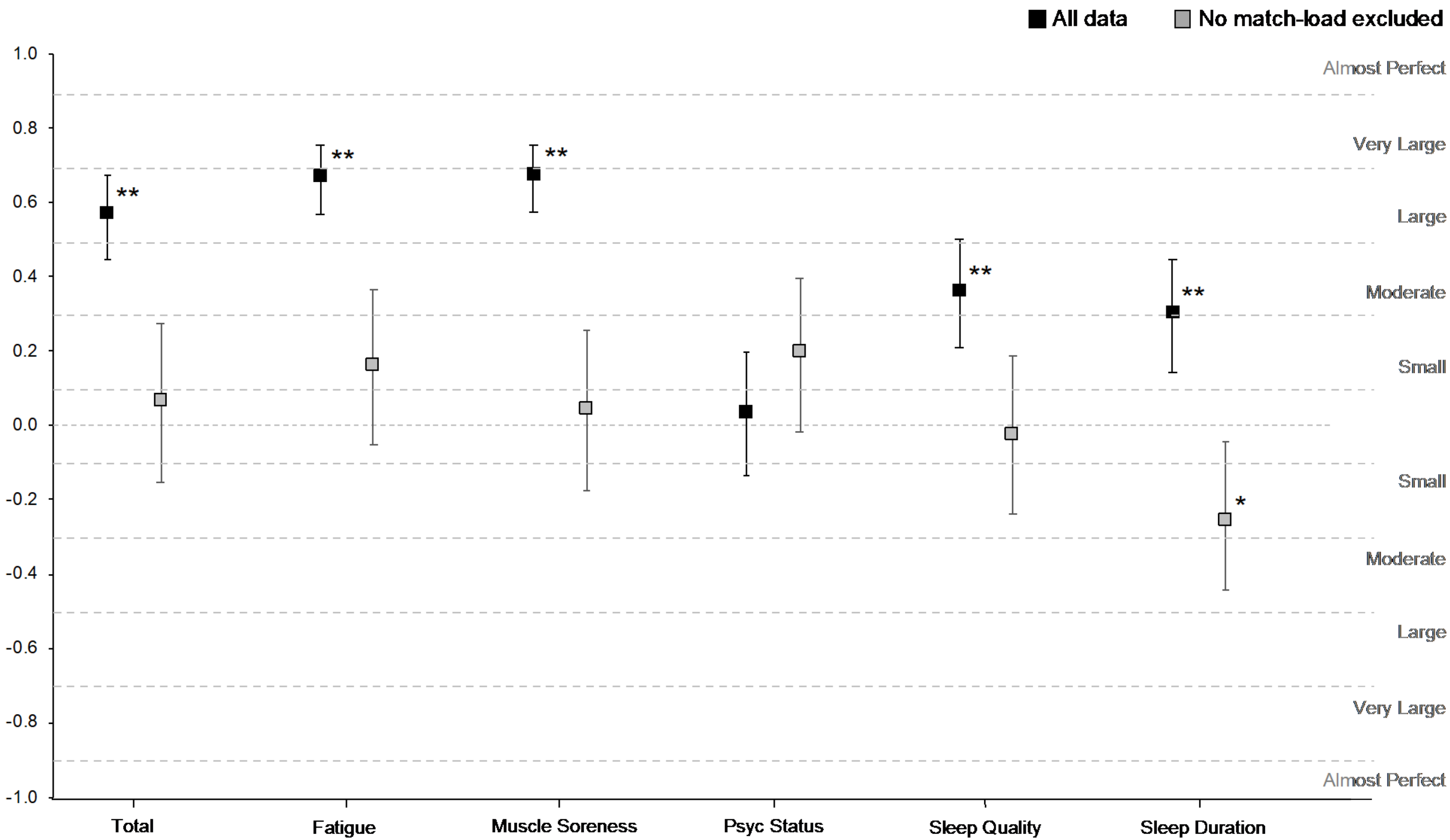

Figure 2. Correlation coefficients (r_s) between s-RPE match load and post-match MD-1 perceived response items, plotted as means ± 95% CI for all data (black squares) and no-match load data excluded (grey squares).
*correlation is significant (p<0.05)
**correlation is significant (p<0.001)