Mental and physical fatigue changes in elite u19 male football players: a comparison of microcycles with one match and two matches per week

Evaluación de la fatiga mental y física en futbolistas élite sub-19: Una comparación de microciclos para uno y dos partidos por semana

Authors

Francisco Tomás González-Fernández [1, 2]
Ana Filipa Silva [3]
Gabriel Delgado García [4]
Yarisel Quiñones-Rodríguez [1]
Luis Manuel Martínez-Aranda [5]
Alfonso Castillo-Rodríguez [2]

[1] University of Granada, Granada, Spain.
[2] University of Málaga, Malaga, Spain
[3] Polytechnic Institute of Coimbra, Coimbra, Portugal.
[4] Comillas Pontifical University, Palma de Mallorca, Spain
[5] Pablo de Olavide University, Seville, Spain

Corresponding author: Francisco Tomás González- Fernández
ftgonzalez@ugr.es

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Abstract

Introduction: The cognitive and mental demands placed on football players are considerable. Athletes must consistently maintain vigilance, execute swift decision-making, process incoming information efficiently, and regulate emotional responses effectively.
Objective: This study investigated the weekly fluctuations in Countermovement Jump (CMJ) performance, Rating of Perceived Exertion (RPE), mental fatigue (MF), and mental load (ML) in elite U19 football players across microcycles featuring single or double match weeks. Methodology: Eighteen elite male U19 football players from Spain participated during the 2024–2025 season. CMJ performance was assessed 30 minutes before and 20 minutes after each training session, while RPE, MF, and ML were evaluated following each session.
Results: Findings revealed an inverse relationship between players' RPE and pre-competition jump performance. Critically, during M2-Opt sessions, scheduled 48 hours prior to a match and often associated with double competition weeks, players reported significantly higher RPE and MF scores. This indicated elevated physical and mental demands on match day minus two (MD-2), coinciding with diminished jump performance. These fatigue levels were consistent with observed weekly microcycle fluctuations, highlighting MD-2.
Discussion: The significant influence of pre-match demands on physical and mental fatigue, culminating in impaired performance, underscores the necessity for coaches to meticulously manage training loads.
Conclusion: Prioritizing athlete recovery and strategically minimizing strenuous physical and mental stimuli in the days leading up to competition are crucial to optimize performance, mitigate injury risk, and ensure competitive readiness in elite youth football.

Keywords

Football; mental fatigue; mental load; mycrocicle, performance.

Resumen

Introducción: Las exigencias cognitivas y mentales que recaen sobre los jugadores de fútbol son considerables. Los atletas deben mantener una vigilancia constante, tomar decisiones rápidas, procesar la información entrante de manera eficiente y regular eficazmente sus respuestas emocionales.
Objetivo: Este estudio investigó las fluctuaciones semanales en el rendimiento del Salto con Contramovimiento (CMJ), la Percepción del Esfuerzo Percibido (RPE), la fatiga mental (MF) y la carga mental (ML) en jugadores de fútbol de élite sub-19 en microciclos semanales con uno o dos partidos.
Metodología: Dieciocho jugadores de fútbol de élite sub-19 participaron en presente estudio durante la temporada 2024-2025. El rendimiento del CMJ se evaluó 30 minutos antes y 20 minutos después de cada sesión de entrenamiento, mientras que el RPE, MF y ML se evaluaron después de cada sesión.
Resultados: Los hallazgos revelaron una relación inversa entre el RPE de los jugadores y el rendimiento del salto precompetición. Fundamentalmente, durante las sesiones M2-Opt, programadas 48 horas antes de un partido y a menudo asociadas con semanas de doble competición, los jugadores reportaron puntuaciones significativamente más altas de RPE y MF. Esto indicó demandas físicas y mentales elevadas en el día del partido menos dos (MD-2), coincidiendo con un rendimiento de salto disminuido. Estos niveles de fatiga fueron consistentes con las fluctuaciones semanales del microciclo, destacando MD-2 como un día particular de demanda.
Discusión: La importante influencia de las exigencias previas al partido en la fatiga física y mental, que resulta en un menor rendimiento, subraya la necesidad de que los entrenadores gestionen meticulosamente las cargas de entrenamiento.
Conclusión: Priorizar la recuperación de los atletas y minimizar estratégicamente los estímulos físicos y mentales en los días previos a la competición son cruciales para optimizar el rendimiento, minimizar las lesiones y garantizar la preparación competitiva.

Palabras clave

Carga mental; fatiga mental; fútbol; microciclo; rendimiento.

Introduction

Football is a multifaceted and intermittently challenging team sport that necessitates high levels of physical fitness, refined technical abilities, and astute tactical understanding from its players (konefal et al., 2019). Maintaining peak performance throughout an demanding season, characterized by intensive training regimens and a dense schedule of competitive matches, is paramount for the success of both individual athletes and their respective teams (Hostrup & Bangsbo, 2023). Consequently, the phenomenon of F, which encompasses both physical and cognitive dimensions, has garnered significant research interest in sports science. Historically, investigations primarily concentrated on neuromuscular and metabolic F, typically stemming from strenuous physical exertion. However, recent scholarly attention has broadened to acknowledge the substantial cognitive and emotional demands inherent in the sport, leading to an increased focus on MF and its resultant implications for performance (Smith et al., 2016, Gantois et al. 2020).

The cognitive and mental demands placed on football players are considerable. Athletes must consistently maintain vigilance, execute swift decision-making, process incoming information efficiently, and regulate emotional responses effectively (Smith et al., 2016, Habekost, Ovesen & Madsen, 2024). This sustained cognitive engagement can induce a psychobiological state termed MF, which manifests as both subjective feelings of exhaustion and objective impairments in cognitive functions, such as reaction time (Huijgen et al., 2015, Sun et al., 2022). Players experiencing MF frequently report a reduction in physical effort, an elevated perception of physical exertion, and a deterioration in technical skills, including shooting and passing accuracy, all of which can critically undermine competitive performance (Smith et al, 2017, Filipas et a., 2021).

Within the sphere of elite football, the competitive calendar typically features diverse microcycle structures, often marked by periods of fixture congestion (Julian, Page & Harper, 2021). A thorough understanding of how both mental and physical F evolve across these varied microcycles is crucial for optimizing athlete management and preventing injuries. Standard competitive microcycles usually involve a match on the weekend, followed by a structured week dedicated to recovery and training, which may incorporate high-intensity sessions (Greco et al, 2017). Significantly, studies indicate that the day immediately following a match (MD+1) is often cited by players as the most mentally taxing day of the week, highlighting the enduring cognitive strain associated with competitive play (Gantois et al., 2020, Huijgen et al., 2015).

The escalating intensity of competitions, compounded by both domestic and international obligations, frequently necessitates microcycles that include two competitive matches within a single week, often scheduled merely 72 hours apart. This compressed schedule intensifies both psychological and physical pressures, underscoring the imperative for strategic training load management practices (Greco et al, 2017, Russel et al., 2019). Prior research has identified fluctuations in MF across different segments of the competitive season, pointing to notable variations in F levels associated with distinct phases, such as the regular season compared to playoff contexts. Nevertheless, comprehensive data contrasting the acute dynamics of mental and physical F in specific microcycles, particularly those defined by varying match densities among elite youth football players, remain sparse (Nédélec et al., 2012, Van Cutsem et al., 2017).

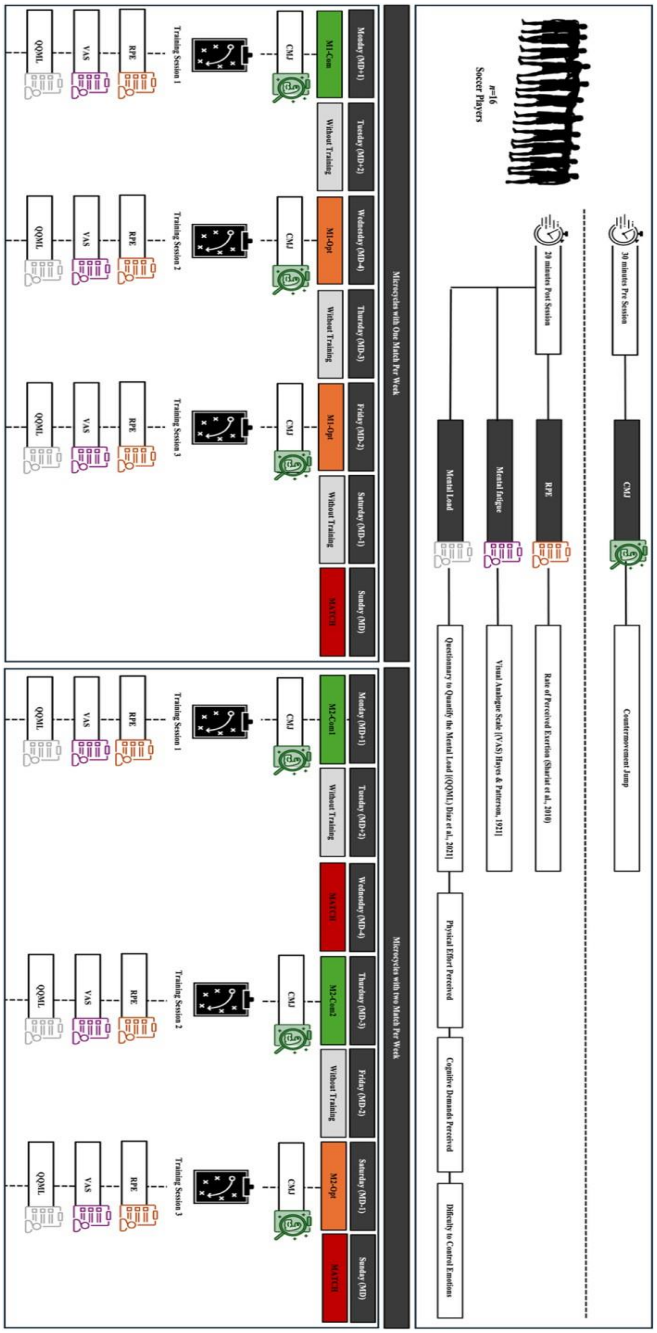
The elite youth football demographic encounters particular challenges as they navigate substantial training demands, competitive pressures, and the physiological intricacies linked to ongoing maturation (González-Fernández et al., 2025). These young athletes experience stressors akin to those in professional environments while concurrently managing rapid growth and cognitive development. This necessitates targeted research to gain a deeper understanding of their recovery and adaptation processes subsequent to consecutive match exposure (Van Cutsen et al., 2017). Considering these points, the current study aims to enhance our understanding of the dynamics of mental and PF among elite Under-19 male (U19) football players across microcycles that differ in match density. The primary objective is to systematically compare the evolution of CMJ, ratio RPE, MF and ML in microcycles featuring either one or two matches per week. Through this analysis, the research intends to generate ecologically valid empirical data to inform evidence-based strategies for training periodization, recovery protocols, and holistic F management. Ultimately, the findings aspire to furnish actionable insights for coaches and sports

practitioners, thereby assisting in optimizing performance and mitigating F-related risks during periods of intense fixture schedules.

Method

This study employed a randomized cross-over design with a descriptive approach to evaluate fluctuations in neuromuscular performance, perceived exertion, muscle fatigue, and lactate levels across microcycles characterized by either one or two matches per week. The primary objective was to monitor athlete well-being during two critical periods within the season (see Figure 1 for an illustrative timeline), facilitating a comparative analysis of microcycles with differing match frequencies.

Figure 1. Schematic Representation of both microcycles.



This research included eighteen elite U19 male football players (mean age: 17.69 ± 0.60 years; mean body weight: 73.11 ± 1.53 kg; mean height: 180.26 ± 5.10 cm) recruited from Melilla, Spain. Given the regional context (estimated population of 80,000–90,000 residents, National Institute of Statistics), the limited squad size necessitated a high player utilization rate. Consequently, all eighteen outfield players were required to participate in each match due to intense competition demands. While total individual match minutes were not comprehensively logged for every player, adherence to the minimum inclusion criterion of 30 minutes of playtime per match was confirmed for all participants. Participants were selected based on the following inclusion criteria: (i) consistent participation, defined as playing a minimum of 60 minutes in each scheduled session; and (ii) complete submission of all jump and questionnaires daily throughout the designated data collection period. Data were meticulously collected on a daily basis over the course of the study. Prior to commencing data collection, a thorough explanation of the study's objectives and procedures was provided to parents/legal guardians (as participants were minors) and representatives from the territorial football federation. Formal written informed consent was subsequently obtained from all necessary parties. An a priori sample size calculation was performed using G*Power software www.gpower.hhu.de; accessed on January 4, 2026This calculation aimed to achieve a statistical power of 0.95 and a significance level (α) of 0.05, informed by effect sizes derived from previous research and similar studies (González-Fernández, et al., 2025). All participants were treated in strict accordance with the ethical guidelines of the American Psychological Association (APA), ensuring the confidentiality and anonymity of their responses. The research protocol adhered to the principles outlined in the 1964 Declaration of Helsinki and received formal approval from the Research Ethics Committee of the University of Granada (Protocol n° 4712/CEIH/2024).

Measures

Countermovement Jump

The CMJ test was conducted using a Chronojump-Boscosystem® contact platform (de Blas et al., 2012), known for its high reliability in measuring jump height. Following a warm-up, participants performed three maximal jumps, 20 seconds apart, adhering to specific technique instructions. The highest jump (cm) was recorded. For comprehensive details, see González-Fernández et al., 2023.

Questionnaire of Mental Load

Athletes' self-reported physical and mental load was assessed using the QQML. This tool evaluates RPE, cognitive demands, and emotional control difficulty on a 0-10 Likert scale, with 10 representing maximum effort or difficulty. For comprehensive details, consult Diaz-García et al., 2021.

Visual Analogue Scale

A 100 mm VAS, a validated instrument in football studies (Badin et al., 2016, Smith et al, 2017, Smith et al, 2016). Participants rated their perceived session motivation (0-100) post-training, with scores subsequently converted to a 0-10 scale for data consistency. For comprehensive methodological details, see Rubio-Morales et al., 2023

Procedure

The study design was meticulously structured prior to microcycle preparation, commencing with a comprehensive analysis of the entire training calendar. This pre-planning aimed to evaluate the evolution of CMJ, RPE, MF, and ML. CMJ performance was assessed 30 minutes before and 20 minutes after each training session. Data for RPE, MF, and ML questionnaires were collected digitally via Google Forms, allowing athletes to complete surveys on their mobile devices during designated evaluation periods. This ensured accurate, real-time data capture and streamlined subsequent analysis. All responses were organized in a Microsoft Excel® spreadsheet for statistical evaluation. While players underwent familiarization with the questionnaires in preceding training sessions, only data collected during the two designated microcycle periods were included in the final analysis, aligning with the study's specific objectives.

Statistical analysis

The analyses were conducted using JAMOVI and R Studio. As a descriptive step, a correlation matrix was calculated utilizing Kendall's Tau-B coefficient to explore the relationships among the psychological variables. To compare fatigue levels reported across sessions of different typologies, a non- parametric repeated measures MANOVA was performed in R. This analysis employed the pamatric Bootstrap option and included Tukey's multivariate post-hoc tests. The model considered the session as the independent variable and the various fatigue scales as dependent variables. The use of MANOVA is advantageous because it accounts for the covariance structure among the included variables, thus enabling the detection of multivariate response patterns while reducing the likelihood of committing a Type I error. Additionally, non-parametric repeated measures ANOVAs, specifically Friedman's ANOVA, were conducted to examine differences within each fatigue scale across sessions. Post-hoc comparisons were carried out using Durbin's test to identify specific differences between sessions in each of the fatigue measures.

Results

The non-parametric repeated measures MANOVA was conducted to examine differences in subjective fatigue across various session types, revealing statistically significant variations (Wald-Type Statistic = 142.413; degrees of freedom = 20; $p < 0.001$). Subsequent multivariate post-hoc analyses indicated significant differences between session M2-Opt and both sessions M1-Com and M2-Com1, as well as between M2-Com1 and M2-Com2. Notably, session M2-Opt appears to be the most distinct from the other sessions in terms of perceived exertion, consistently registering the highest scores across all subjective fatigue measures. Similarly, session M1-Com also demonstrates a high level of intensity, as evidenced by elevated values in all subjective effort metrics. These findings suggest that certain sessions elicit higher levels of perceived fatigue, with M2-Opt standing out as particularly demanding in this regard.

Table 1. Repeated measures MANOVA post hoc analysis (p values of the pairwise comparisons)

Microcicle	M1-Com	M1-Opt	M2-Com1	M2-Com2	M2-Opt
M1-Com	-				
M1-Opt	0.987	-			
M2-Com1	0.831	0.646	-		
M2-Com2	0.339	0.725	0.047	-	
M2-Opt	0.005	0.055	< 0.001	0.573	-

Note: The M1-Com refers to a recovery session (+1) conducted after a microcycle featuring a single weekly game. The M1-Opt corresponds to an optimization session (-2) during a microcycle with two games per week, aimed at enhancing performance. The M2- Com1 indicates a recovery session (+1) performed after the first match within a microcycle that includes two games. Similarly, the M2- Com2 designates a recovery session (+1) executed following the second game of the same microcycle. The M1-Opt also refers to an optimization session (-2) within a microcycle with two weekly games, tailored to improve certain performance aspects amid increased match loads.

Regarding mental fatigue, statistical analysis indicated significant differences across the various session types ($\chi^2 = 26.80$; df = 4; $p < 0.001$). Specifically, the session with the highest mental load was M2-Opt, which demonstrated statistically significant higher scores ($p < 0.001$) compared to all other sessions. Similarly, emotional fatigue also showed notable variations among the session categories ($\chi^2 = 23.11$; df = 4; $p < 0.001$). The sessions M1-Com and M2-Opt recorded the highest scores, reflecting greater levels of emotional fatigue. Post-hoc analyses revealed significant differences between M1-Com and all other sessions ($p > 0.01$, except with M2-Opt, where $p = 0.167$), as well as between M2-Opt and the remaining sessions ($p < 0.001$).Furthermore, analysis of relationship fatigue yielded a χ^2 value of 32.20 with degrees of freedom equal to 4, and a p-value below 0.001, indicating substantial differences between session types. Once again, the sessions M1-Com and M2-Opt obtained the highest scores, suggesting higher perceived fatigue levels. Conversely, the lowest scores were observed in the sessions M2-Com1, M1-Opt, and M2-Com2, in that order. This pattern consistently underscores that sessions M1- Com and M2-Opt are associated with heightened fatigue across various dimensions, while others elicit comparatively lower fatigue responses (See Figure 2,3, and 4 for more information).

Figure 2. Evolution of MF Scores across mycrocicles

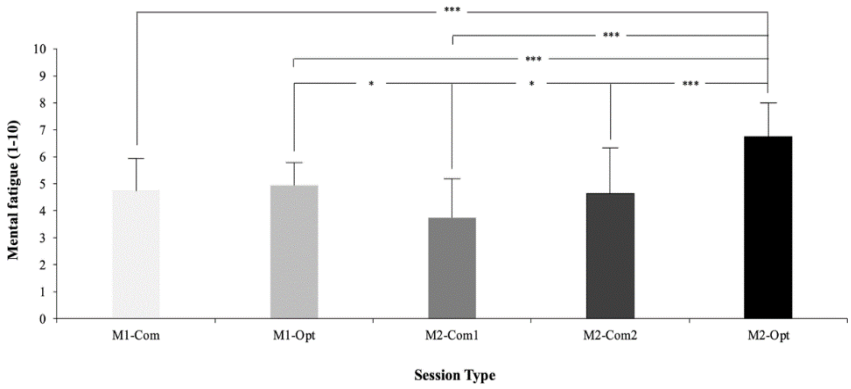


Figure 3. Evolution of Emotional F Scores across mycrocicles

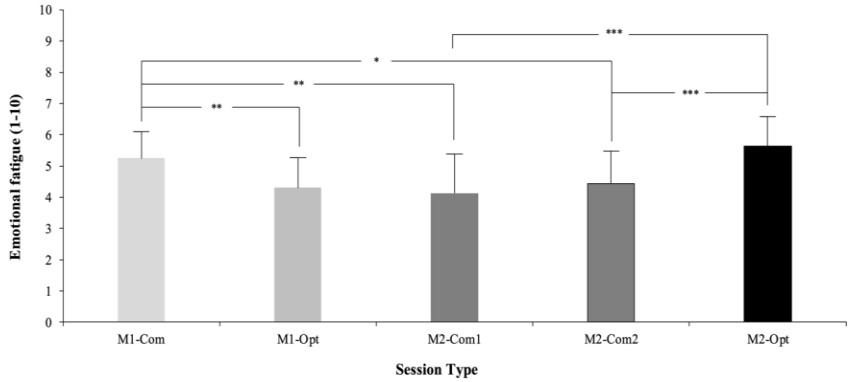
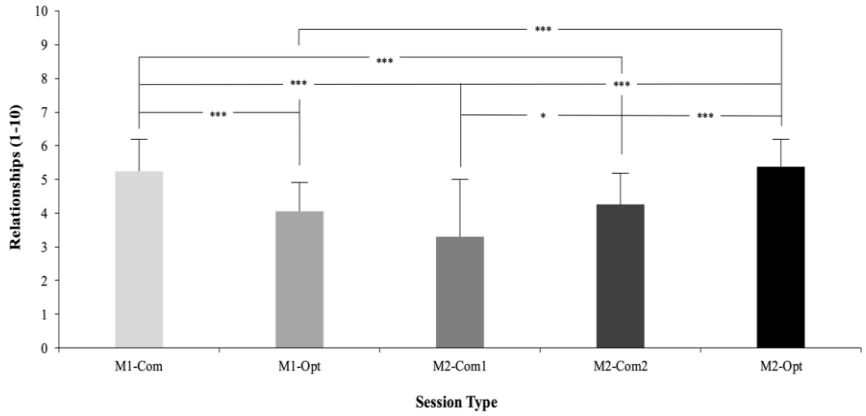


Figure 4. Evolution between variables (relationships) across mycrocicles.



Finally, both the Rate of Perceived Exertion (RPE) and the Rating of Perceived Workload (VAE) demonstrated significant differences across the various session types ($\chi^2 = 23.70$; df = 4; $p < 0.001$ for RPE, and $\chi^2 = 31$; df = 4; $p < 0.001$ for VAE). The pairwise comparisons revealed that the results for these two variables were quite similar, indicating consistent perceptions of exertion and workload among participants. Notably, the sessions M2-Com2 and M2-Opt yielded the highest scores in both metrics, reflecting greater perceived effort and workload during these periods. These sessions showed significant differences when compared to M1-Com1, M2-Com1, and M1-Opt, which registered the lowest values ($p < 0.01$), suggesting that the athletes perceived these sessions as less demanding.

Regarding the Countermovement Jump (CMJ) performance, there were also statistically significant differences between sessions ($\chi^2 = 49.12$; df = 4; $p < 0.001$). The session where athletes achieved the highest CMJ was M2-Opt, indicative of better explosive performance, whereas the lowest was observed during M2-Com1. Further analysis confirmed significant differences between these sessions, highlighting the impact of session type and timing within the microcycle on neuromuscular performance. Such findings emphasize the influence of training load and recovery strategies on explosive capabilities, as well as the importance of tailoring training and recovery to optimize performance outcomes.

Figure 5. Evolution of RPE Scores across mycrocicles

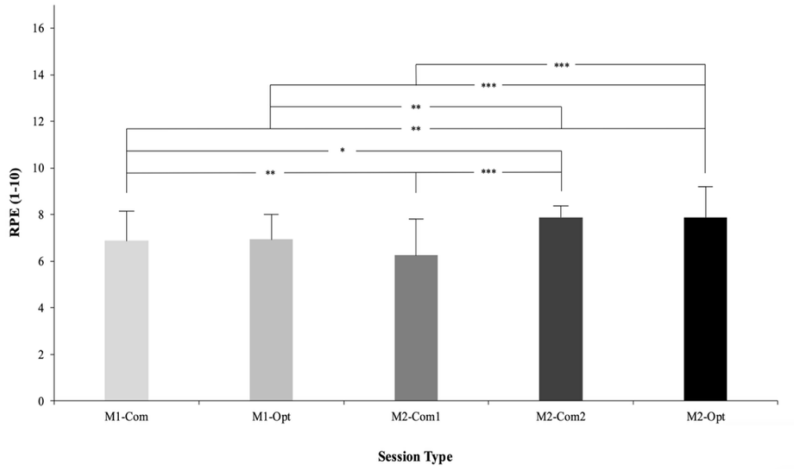


Figure 6. Evolution of VAE Scores across mycrocicles.

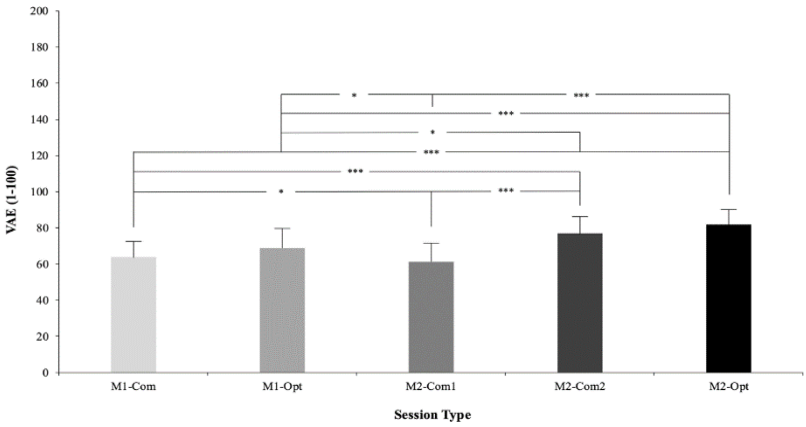
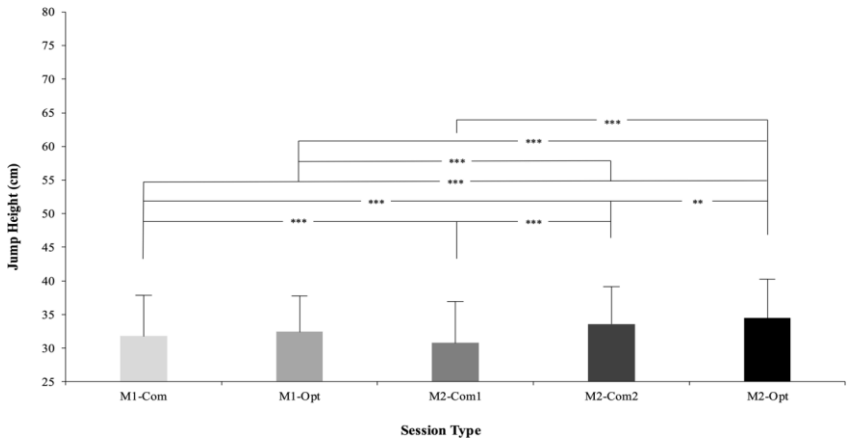


Figure 7. Evolution of jump height across mycrocicles.



Discussion

The main objective of this study was to examine the influence of perceived upcoming match demands on the MF of elite U19 football players throughout the training microcycle. The results showed that players' RPE was inversely related to jump performance (assessed through CMJ tests conducted prior to competition). Conversely, during the M2-Opt sessions involving double competition matches, players reported higher RPE and VAS scores compared to other sessions, indicating greater task demands within this training day. Emotional and MF were assessed after each session. This information is highly relevant, as elite youth football players exhibited greater physical (as assessed by RPE) and mental (as assessed by VAS) F during the M2-Opt session. This optimization session takes place 48 hours before the match, meaning that on MD-2 (match day minus two), players experience higher levels of F compared to the rest of the week. This finding is consistent with the study by Díaz-García et al. (2023), which determined that MD-3 and MD-4 sessions are the most mentally demanding training days of the week. They also found significant differences compared to MD-1 and MD+1 sessions, leading to the conclusion that F levels fluctuate throughout the weekly microcycle.

Several factors influence performance in football (Coutinho et al., 2018). Among them, training load, determined by the interaction between volume, intensity, and recovery periods (Castillo- Rodríguez et al., 2020), is a key determinant of players' F status. Excessive or poorly managed training loads may negatively affect performance (Silva et al., 2018) increase the likelihood of injury, and, at the elite level, even determine the outcome of competitive matches. It is therefore imperative that training sessions in the days preceding competition avoid stimuli that may exacerbate physical or MF (Thompson et al., 2019). Similarly, introducing new or complex tasks that impose additional perceptual, cognitive, or motor demands on the player's central nervous system is not recommended, as these may compromise readiness and neuromuscular efficiency before match play. This information holds significant scientific and professional relevance. From a practical standpoint, injuries or performance decrements can have considerable financial implications for football clubs, including salary expenses during rehabilitation periods. Moreover, such incidents may contribute to poorer competitive results and, in extreme cases, relegation to lower divisions, with substantial socio-economic repercussions for the organization (Castillo-Rodríguez et al., 2023). Furthermore, it was observed that the perception of EF, assessed through the session RPE after training sessions, with most values approaching 8 (a high- intensity workload) on the validated Borg CR-10 scale (Borg, 1998). suggests that elite youth players experience limited recovery time throughout the training week. This restricted recovery window makes it difficult to conduct purely conditioning-oriented sessions aimed at improving physical fitness. In both one-match and two-match microcycles, midweek sessions serve as opportunities for players to recover from the physical and mental demands of competition and to reach subsequent matches in optimal condition. These sessions also allow for the development of both physical and tactical objectives established by the coaching staff (Guerrero-Calderón et al., 2021). The tactical component, however, imposes an additional layer ML, as it involves continuous perceptual–cognitive processing within dynamic game contexts. Players are required to adhere to predefined structural patterns and execute preplanned responses, particularly in defensive roles, or conversely, to maintain minimal F levels in order to sustain high cognitive flexibility and creative decision-making during offensive phases, thereby enhancing goal-scoring opportunities (Castillo-Rodríguez et al., 2018).

Elite football coaches routinely design training tasks that impose significant ML on players (Alarcón et al., 2018). Therefore, they should be familiar with effective strategies to mitigate such mental demands prior to competitive matches (Díaz-García et al., 2023), including the use of ergogenic aids such as caffeine or creatine (Proost et al., 2022). The substantial cognitive and emotional pressures inherent to competitive football can induce MF, which in turn may impair player performance. Although awareness of MF in sport has increased in recent years, a deeper understanding of the specific psychological challenges faced by football players remains necessary.

Strenght and limitations

This study presents several limitations. First, the sample size was restricted to a single squad in order to obtain detailed information about how each training session affected the players, which limits the

research to a case-study design. This constraint opens opportunities for future researchers to replicate the same training sessions across different elite teams, thereby enabling broader generalization of the results. Secondly, the study relied on self-reported data collected through questionnaires, which may be subject to social desirability bias and introduce uncertainty regarding the reliability of the responses. Future investigations are therefore encouraged to complement perceptual data with objective physiological or biochemical measures, such as blood samples or other physiological indicators, to enhance the robustness and validity of the findings.

Conclusions

This study underscored the significant influence of perceived upcoming match demands on the mental fatigue experienced by elite U19 football players across their training microcycle. Our findings revealed that M2-Opt sessions, conducted 48 hours prior to competition, resulted in elevated RPE and mental (VAS) fatigue, concomitantly correlating with diminished jump performance. This indicates that critical pre-match training days contribute substantially to player fatigue, aligning with the observed weekly fluctuations in load. Consequently, these results emphasize the imperative for coaches to meticulously manage training loads. Prioritizing athlete recovery and minimizing excessive physical or mental stimuli in the days preceding matches are crucial strategies to optimize performance, mitigate injury risk, and ensure competitive readiness in elite youth football.

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References

Alarcón, F., Castillo-Díaz, A., Madinabeitia, I., Castillo-Rodríguez, A., & Cárdenas, D. (2018). Mental workload impairs the pass precision in soccer players. Revista de psicología del deporte. 27(2), 155-164.

Borg, G. (1998). *Borg's perceived exertion and pain scales.* Human Kinetics.

Badin, O. O., Smith, M. R., Conte, D., & Coutts, A. J. (2016). Mental Fatigue: Impairment of Technical Performance in Small-Sided Soccer Games. *International journal of sports physiology and performance*, *11*(8), 1100–1105. https://doi.org/10.1123/ijspp.2015-0710

Díaz-García J, Filipas L, La Torre A, Gómez-Rivera J, Rubio-Morales A, García-Calvo T. (2023). Mental fatigue changes from regular season to play-offs in semiprofessional soccer: A comparison by training days. *Scandinavian Journal of Medical Science Sports.*33(5):712-724. https://doi.org/10.1111/sms.14301

Castillo-Rodríguez, A., Alejo-Moya, E. J., Figueiredo, A., Onetti-Onetti, W., & González-Fernández, F. T. (2023). Influence of physical fitness on decision-making of soccer referees throughout the match. *Heliyon*, *9*(9), e19702. https://doi.org/10.1016/j.heliyon.2023.e19702

Castillo-Rodríguez, A., Cano-Cáceres, F. J., Figueiredo, A., & Fernández-García, J. C. (2020). Train Like You Compete? Physical and Physiological Responses on Semi-Professional Soccer Players. *International journal of environmental research and public health*, *17*(3), 756. https://doi.org/10.3390/ijerph17030756

Castillo-Rodríguez, A., Madinabeitia, I., Castillo-Díaz, A., Cárdenas, D., & Alarcón, F. (2018). The impulsivity determines the role performed by futsal players. *Revista de Psicologia del Deporte*. 27(2), 181-188.

Coutinho, D., Gonçalves, B., Wong, D. P., Travassos, B., Coutts, A. J., & Sampaio, J. (2018). Exploring the effects of mental and muscular fatigue in soccer players' performance. *Human movement science*, *58*, 287–296. https://doi.org/10.1016/j.humov.2018.03.004

de Blas X, Padullés JM, López del Amo JL, et al (2012). Creation and validation of chronojump- boscosystem: a free tool to measure vertical jumps. *Revista Internacional de Ciencias del Deporte*. 30: 334–356

Filipas, L., Borghi, S., La Torre, A., & Smith, M. R. (2021). Effects of mental fatigue on soccer-specific performance in young players. *Science & medicine in football*, *5*(2), 150–157. https://doi.org/10.1080/24733938.2020.1823012

Gantois, P., Caputo Ferreira, M. E., Lima-Junior, D., Nakamura, F. Y., Batista, G. R., Fonseca, F. S., & Fortes, L. S. (2020). Effects of mental fatigue on passing decision-making performance in professional soccer athletes. *European journal of sport science*, *20*(4), 534–543. https://doi.org/10.1080/17461391.2019.1656781

Guerrero-Calderón, B., Owen, A., Morcillo, J. A., & Castillo-Rodríguez, A. (2021). How does the mid-season coach change affect physical performance on top soccer players?. *Physiology & behavior*, *232*, 113328. https://doi.org/10.1016/j.physbeh.2021.113328

González-Fernández, F. T., Clemente, F. M., Rodríguez-García, L., & Castillo-Rodriguez, A. (2023). Effects of 16-weeks of strength training on jump height and anthropometric variables in U19 semi- professional male soccer players. *International Journal of Sports Science & Coaching*, *19*(4), 1641-1650. https://doi.org/10.1177/17479541231210093

González-Fernández, F. T., Martínez-Aranda, L. M., Sanz-Matesanz, M., Quiñones-Rodríguez, Y., & Castillo-Rodríguez, A. (2025). Impact of Four-Match Congestion on the Well-Being of Under-16 Male Soccer Players. *Sports (Basel, Switzerland)*, *13*(7), 209. https://doi.org/10.3390/sports13070209

Greco, G., Tambolini, R., Ambruosi, P., & Fischetti, F. (2017). Matchday +1 Fatigue in Soccer: What Affects It? *Journal of Physical Education and Sport. 2027;* 17(4), 280-287. https://doi.org/10.7752/jpes.2017.04280

Habekost, T., Ovesen, J., & Madsen, J. B. (2024). Cognition in elite soccer players: a general model. *Frontiers in psychology*, *15*, 1477262. https://doi.org/10.3389/fpsyg.2024.1477262

Hostrup, M., & Bangsbo, J. (2023). Performance Adaptations to Intensified Training in Top-Level Football. *Sports medicine (Auckland, N.Z.)*, *53*(3), 577–594. https://doi.org/10.1007/s40279- 022-01791-z

Huijgen, B. C., Leemhuis, S., Kok, N. M., Verburgh, L., Oosterlaan, J., Elferink-Gemser, M. T., & Visscher, C. (2015). Cognitive Functions in Elite and Sub-Elite Youth Soccer Players Aged 13 to 17 Years. *PloS one*, *10*(12), e0144580. https://doi.org/10.1371/journal.pone.0144580

Julian, R., Page, R. M., & Harper, L. D. (2021). The Effect of Fixture Congestion on Performance During Professional Male Soccer Match-Play: A Systematic Critical Review with Meta-Analysis. *Sports medicine (Auckland, N.Z.)*, *51*(2), 255–273. https://doi.org/10.1007/s40279-020-01359-9

Konefał, M., Chmura, P., Kowalczuk, E., Figueiredo, A. J., Sarmento, H., Rokita, A., Chmura, J., & Andrzejewski, M. (2019). Modeling of relationships between physical and technical activities and match outcome in elite German soccer players. *The Journal of sports medicine and physical fitness*, *59*(5), 752–759. https://doi.org/10.23736/S0022-4707.18.08506-7

Nédélec, M., McCall, A., Carling, C., Legall, F., Berthoin, S., & Dupont, G. (2012). Recovery in soccer: part I - post-match fatigue and time course of recovery. *Sports medicine (Auckland, N.Z.)*, *42*(12), 997– 1015. https://doi.org/10.2165/11635270-000000000-00000

Rubio-Morales, A., Díaz-García, J., Harper, L. D., & García-Calvo, T. (2024). The influence of the perceived requirements of the next match and motivation on the mental fatigue of soccer players. *Scandinavian journal of medicine & science in sports*, *34*(2), e14580. https://doi.org/10.1111/sms.14580

Russell, S., Jenkins, D., Rynne, S., Halson, S. L., & Kelly, V. (2019). What is mental fatigue in elite sport? Perceptions from athletes and staff. *European journal of sport science*, *19*(10), 1367–1376. https://doi.org/10.1080/17461391.2019.1618397

Silva, J. R., Rumpf, M. C., Hertzog, M., Castagna, C., Farooq, A., Girard, O., & Hader, K. (2018). Acute and Residual Soccer Match-Related Fatigue: A Systematic Review and Meta-analysis. *Sports medicine (Auckland, N.Z.)*, *48*(3), 539–583. https://doi.org/10.1007/s40279-017-0798-8

Smith, M. R., Coutts, A. J., Merlini, M., Deprez, D., Lenoir, M., & Marcora, S. M. (2016). Mental Fatigue Impairs Soccer-Specific Physical and Technical Performance. *Medicine and science in sports and exercise*, *48*(2), 267–276. https://doi.org/10.1249/MSS.0000000000000762

Smith, M.R., Fransen, J., Deprez, D., Lenoir, M., Coutts A.J. (2017). Impact of mental fatigue on speed and accuracy components of soccer-specific skills. *Science Medical Football.* 1(1):48-52. https://doi.org/10.1080/02640414.2016.1252850

Smith, M. R., Zeuwts, L., Lenoir, M., Hens, N., De Jong, L. M., & Coutts, A. J. (2016). Mental fatigue impairs soccer-specific decision-making skill. *Journal of sports sciences*, *34*(14), 1297–1304. https://doi.org/10.1080/02640414.2016.1156241

Sun, H., Soh, K. G., & Xu, X. (2022). Nature Scenes Counter Mental Fatigue-Induced Performance Decrements in Soccer Decision-Making. *Frontiers in psychology*, *13*, 877844. https://doi.org/10.3389/fpsyg.2022.877844

Thompson, C. J., Fransen, J., Skorski, S., Smith, M. R., Meyer, T., Barrett, S., & Coutts, A. J. (2019). Mental Fatigue in Football: Is it Time to Shift the Goalposts? An Evaluation of the Current Methodology. *Sports medicine (Auckland, N.Z.)*, *49*(2), 177–183. https://doi.org/10.1007/s40279-018-1016-z

Proost, M., Habay, J., De Wachter, J., De Pauw, K., Rattray, B., Meeusen, R., Roelands, B., & Van Cutsem, J. (2022). How to Tackle Mental Fatigue: A Systematic Review of Potential Countermeasures and Their Underlying Mechanisms. *Sports medicine (Auckland, N.Z.)*, *52*(9), 2129–2158. https://doi.org/10.1007/s40279-022-01678-z

Van Cutsem, J., Marcora, S., De Pauw, K., Bailey, S., Meeusen, R., & Roelands, B. (2017). The Effects of Mental Fatigue on Physical Performance: A Systematic Review. *Sports medicine (Auckland, N.Z.)*, *47*(8), 1569–1588. https://doi.org/10.1007/s40279-016-0672-0

Authors and translators' details:

Francisco Tomás González Fernández	ftgonzalez@ugr.es	Author
Ana Filipa Silva	anafilsilva@gmail.com	Author
Gabriel Delgado García	gdelgado@cesag.org	Author
Yarisel Quiñones Rodríguez	yariselqr@gmail.com	Author
Luis Manuel Martínez Aranda	lmmarara@upo.es	Author
Alfonso Castillo Rodríguez	ac@uma.es	Author