OPEN ACCESS
Turkish Journal of Kinesiology

REVIEW ARTICLE

Heart rate of soccer referees during matches: A systematic review

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Received:
March 31, 2024

Accepted:
June 07, 2024

Online Published:
June 30, 2024

Keywords:
Football referee, heart rate, monitoring, soccer official, soccer referee.

Abstract

The physical demands of elite soccer players can affect the activity of the referees. During a competitive match, an elite soccer referee covers 9–13 km at 85–90% of the heart rate (HR). This systematic review aimed to scrutinize the scientific literature concerning HR values in football referees during matches. The search encompassed PubMed, Web of Science, MEDLINE, and Google Scholar databases up to April 24, 2023, alongside manual searches using specific keywords. Eligible studies included controlled observational trials involving soccer referees of various levels. Fifteen articles met the criteria, focusing on average heart rate (HRavg) and maximum heart rate (HRmax) during matches. The average HRavg among the sampled referees was 163.13 ± 8.89 bpm, with HRmax averaging 191.2 ± 7.01 bpm. HRavg ranged from 137.76 to 184.9 bpm, while HRmax ranged from 169.1 to 222 bpm. Despite variations in football competition levels, the monitored variables exhibited similar values across studies. These findings underscore the importance of HR monitoring for referee training and programming to ensure they can effectively manage the physical demands of matches at all levels of competition.

Introduction

The scientific interest in soccer has seen a notable increase, driven by the sport's growing dynamism. Starting from the 1990s, research, previously sporadic, has transitioned to a more systematic and frequent approach (Costa et al., 2010; Owoeye et al., 2020; Al Attar et al., 2021; Selmi et al., 2022). However, the majority of studies have predominantly focused on players, with fewer addressing the physical demands faced by football referees (Barbero-Álvarez et al., 2012; Bloß et al., 2020; Martin-Sanchez et al., 2022). Referees, integral to the game, experience notably high heart rates during matches (Dolanski et al., 2017). Their role in enforcing the rules ensures fair and decisive outcomes, underscoring their importance in validating game results (IFAB, 2018).

Soccer is recognized as an intermittent sport where aerobic metabolism plays a crucial role in energy production (Stølen et al., 2005; Field et al., 2022). Additionally, the anaerobic system is engaged during intense and explosive tasks such as tackling, heading, and kicking during matches (Hostrup & Bangsbo, 2023). The physical demands placed on elite soccer players also impact the performance of referees (Weston et al., 2012). Weston et al. (2007) were the pioneers in demonstrating a correlation between the match activity levels of elite soccer players and referees. Elite soccer referees cover distances ranging from 9 to 13 kilometers during a competitive match, maintaining a heart rate of 85–90% (Weston et al., 2012; Tessitore et al., 2007). Consequently, there is a need for increased research attention on soccer referees in general.

Previous studies have employed various parameters, such as total distance covered, distance traversed at different intensities (low, medium, high, and sprinting), and distance covered using different movement patterns (backward and sideward) per match, across various soccer leagues, to gauge the physical demands (external loads) placed on soccer referees during official matches (Castagna et al., 2007). Despite the abundance of data concerning external loads, less emphasis has been placed on assessing the internal load during official matches, including heart rate (HR) as a marker (Mallo et al., 2009; Weston et al., 2010; Martínez-Torremocha et al., 2023; Yousefian et al., 2023). HR monitoring methods could serve as valuable tools for determining the intensity range of referee endurance training (Costa et al., 2013). Consequently, HR monitoring facilitates the assessment of the workload

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To Cite: Stojanović, S., İlbak, İ., Lilić, A., & Kurhan, S. (2024). Heart rate of soccer referees during matches: A systematic review. *Turk J Kinesiol*, 10(2),131-137.**DOI:** 10.31459/turkjkin.1462145

referees experience during matches, thereby aiding in the development of training programs tailored to soccer referees based on such monitoring.

Football referees' average heart rate (HRavg), according to Catterall et al., (1993) reaches 165 beats per minute during games. Similar results were presented in in many studies (D'ottavio & Castagna, 2001; Ardigò, 2010; Vieira et al., 2010; Aoba et al., 2011; Costa et al., 2013; Yousefian et al., 2023) during matches. Some studies show even small increment to previously mentioned values (Martínez-Torremocha et al., 2023; Dolanski et al., 2017; Preissler et al., 2022) ranging from 170.25-184.9 bpm HVavg. These numbers fall between 85 and 90% of the maximum heart rate (Harley et al., 2001).

Best to our knowledge, there has been only one systematic review (Silva et al., 2019) analyzing the values of the HR of soccer referees during matches, and since that systematic review examined the literature up to 2017, the strength of this work lies in the fact that it will complement this topic with more recent scientific articles and the inclusion of other electronic databases. In this regard, the aim of this systematic review was to analyze in detail the relevant scientific literature that investigates heart rate values in football referees during matches.

Methods

Study Design

The literature review adhered to the PRISMA guidelines for systematic reviews and meta-analyses (Moher et al., 2009). A comprehensive search was conducted across electronic databases including PubMed, Web of Science, MEDLINE, and Google Scholar for articles published between 2001 and April 24, 2023. Employing descriptors aligned with DeC and MASH, we ensured exclusion of irrelevant terms unrelated to the research focus. These descriptors, including "heart rate," "heart rate monitoring," "pulse," "pulse rate," "soccer official," "soccer referee," "football referee," "monitoring," and "measuring," were meticulously chosen to maintain direct relevance to the study's objectives. It's notable that these terms were selected due to their prevalence in articles within the chosen databases, as neither DeCS nor MESH provided descriptors directly related to these terms or their potential synonyms. We combined three descriptors at once, consistently pairing a description of each study variable (HR_{avg}/HR_{max}) with a description pertinent to soccer referees until exhausting all possible combinations. Using the Population, Intervention, Comparator, and Outcome (PICO) criteria (see Table 1), potential studies were identified by evaluating their titles and abstracts for relevance. Subsequently, the selected studies underwent independent full-text review by two reviewers based on predefined inclusion and exclusion criteria.

Table 1
PICO Criteria.

Population	Soccer referees (elite, sub-elite, proffesional level)
Intervention	Measuring heart rate during the soccer game
Comparator	Observational group
Outcome	Heart rate during the soccer games in two diff. values – Average heart rate during the game (HR_{av}); Maximum heart rate during the soccer game (HR_{max})

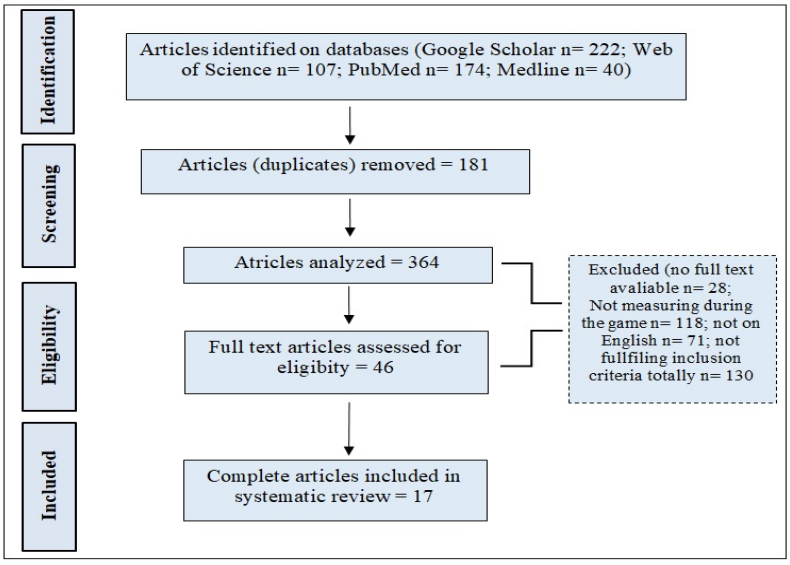

Figure 1. PRISMA flow chart of article selection process.

Table 2
Research findings (HR_{av} /HR_{max}).

Author/year	n	Competition	NoM	MD	Distance covered (km)	HR_{av}	HR_{max}
D'ottavio & Castagna (2001)	33	Serie A (Italy)	96	Polar electro HR monitor	11.49±0.98	163 ± 3	188.1
Krustrup & Bangsbo (2001)	27	1st and 2nd league Denmark	43	Polar electro HR monitor	10.07±0.13	162 ± 2	190.5
D'ottavio & Castagna (2001)	18	Serie A (Italy)	18	Polar electro HR monitor	11.49±0.98	163 ± 5	183.5
Helsen & Bultynck (2004)	17	Euro Cup 2000	31	Short-range radio telemetry	/	155±16	182.3
Weston et al. (2007)	19	Premier League (ENG)	254	Short-range radio telemetry	11.62±0.73	161.3 ± 6.2	191.4
Mallo et al. (2009)	12	World Cup U-17	12	Polar electro HR monitor	11.05±0.93	161 ± 8.9	187
Vieira et al. (2010)	12	Potiguar Championship 2009	21	Garmin® modelo Forerunner 405	10.50 ± 0.35	162.77 ± 7.44	182.2
Ardigò (2010)	6	ITA 6/7th Championship	20	Polar S610 + T31 belt transmitter	11.39±0.69	163 ± 8.1	201
Aoba et al. (2011)	14	J1 League	14	Wear Link 31C	12.02 ± 0.51	163 ± 16	183.5
Costa et al. (2013)	11	Campeonato Brasileiro Série A	35	Garmin® Forerunner 405	10.44 ± 0.27	166 ± 2.1	184
Dolanski et al. (2017)	20	1st Polish league	10	POLAR M400	10.27 ± 0.90	184.9 ± 17.1	201
Lima e Silva et al. (2020)	10	Campeonato Brasileiro Série A	10	OLAR GPS V800	/	160.90 ± 14.80	222
Dolanski et al. (2022)	14	America's Liberators/ Brazil's Cup	36	Garmin Forerunner 45/1	9.81± 0.63	170.25 ± 17.71	183.2
Ozaeta et al. (2022)	66	Division de Honor Spain	23	Polar Team System™	8.65± 0.74	137.76 ± 18.22	169.1
Martínez-Torremocha et al. (2023)	40	LaLiga (Spain)	29	Garmin heart rate band	10.4 ± 0.89	173 ± 13.1	192
Yousefian et al. (2023)	23	1st/2nd Portuguese	457	Telemetry - Polar HR monitor	9.43± 41.32	167.7 ± 3.41	189
Silva et al. (2023)	10	Campeonato Brasileiro Série A & B	10	Polar V800	10.89±0.69	162.41 ± 8.7	186.6

HR: Heart rate; NoM: Number of matches analyzed; MD: Measuring device; HR_{av} : Mean/average heart rate during game; HR_{max} : Maximum value of heart rate during game.

The inclusion criteria for the analyzed studies comprised:

a) Studies conducted with referees on soccer fields during matches,

b) Studies analyzing and/or quantifying heart rate (HR_{avg} + HR_{max}) during matches,

c) Articles published in the English language,

d) Articles available in full-text in scientific journals,

e) Articles published in specified databases.

The exclusion criteria included:

a) Studies focusing solely on heart rate among referees in activities or settings other than soccer matches on pitches,

b) Studies lacking complete information (full-text), conference articles, or articles not in English language,

c) Studies published before 2001.

The electronic database search yielded 541 potentially relevant articles, from which 44 underwent detailed assessment, resulting in the inclusion of 15 articles that met all inclusion and exclusion criteria. These studies collectively involved 352 participants, all professional-level soccer referees.

Results

In this section the basic parameters of the study are shown in the table (research findings), such as the

sample - number of respondents; comptetition, number of soccer games analyzed; measuring device for heart rate; distance covered, HR_{av}; HR_{max} (Table 2).

In total, 352 soccer refrees were analyzed in this systematic review. The studies analysed the referees during their performances in soccer matches, which overall, including the studies found, revealed an analysis of these referees in 1321 soccer matches. The analysed articles were displayed to address the variables of interest in this systematic review (Table 2.) The HRav of the articles found, meaning HRavg on sample included from previous research, was 163.13 ± 8.89 bpm and the average maximum values of HRmax were 191.2 ± 7.01 bpm. The range value of HRav was from 137.76-184.9 bpm, while the range for HRmax was from 169.1-222 bpm.

Discussion

Soccer referees' heart rates can be monitored more easily than those of players because they aren't involved in physical contact or other physically demanding tasks during games (tackling, heading, kicking, getting up from the ground, ecc.), making this a particularly easy measurments (Ohashi et al., 1985). The dynamic relationship between the two competing teams, static factors, motivation, and weather each have a significant impact on the movement intensity during matches, even though it is closely related to endurance. (Ohashi et al., 1985). Therefore, the referees require a sufficient level of physical fitness to go throughout a soccer game, and follow up actions from players from both teams (Aoba et al., 2011). The primary motor movements employed by referees are commonly identified as jogging and walking (Catterall et al., 2001; Bizzini et al., Dvorak, 2009; Preissler et al., 2021; Yousefian et al., 2023). However, it's widely acknowledged that the intensity of the game significantly influences these movements. Referees are required to execute highly irregular movements characterized by frequent and abrupt pace changes. While the aerobic system is the predominant energy producer, anaerobic interventions appear crucial for referee performance (Silva et al., 2019). Nonetheless, such research interventions are less frequent throughout a match.

Heart rate emerges as a pivotal factor in referees' performance. During play, HR_{max} typically averages 70-85% of the estimated HR_{max} (Krustrup & Bangsbo, 2001). Notably, Krustrup & Bangsbo (2001) observed that referees reached nearly 97% of their HR_{max} during a match, marking the highest recorded heart rate value. Similarly, players' heart rates during matches fluctuate between 80 and 90% of HR_{max} (Junior et al., 2002; Colosio et al., 2020; Gantois et al., 2022), mirroring the values observed in football referees. Consequently, the systematic review aimed to identify literature addressing the heart rate of soccer referees during matches.

The HRav of the articles found, meaning the average heart rate on the sample included in previous research, were 163.13 ± 8.89 bpm and the average maximum values of HR_{max} was 191.2 ± 7.01 bpm. The range value of HR_{av} was from 137.76-184.9 bpm, while the range for HR_{max} was from 169.1-222 bpm. Studies (D'ottavio & Castagna, 2001; Krustrup et al., 2001) from Italy's Serie A and 1st/2nd Denmark leagues showed almost identical data considering HR_{avg}, 163 ± 3; 162 ± 2; 163 ± 5 bpm, respectively. The maximum presented values were also similar = HR_{max} (188.1; 190.5; 183.5 bpm). Those results were in accordance with results from: Weston et al. (2007) in English Premier league (HR_{avg} = 161.3 ± 6.2 bpm; HR_{max} = 191.4 bpm); Mallo et al. (2009) in U-17 English league (HR_{avg} = 161 ± 6.2 bpm; HR_{max} = 187 bpm); Vieira et al. (2010) in Brazil Campeonato Potiguar (HR_{avg} = 162 ± 7.4 bpm; HR_{max} = 182.2 bpm); Aoba et al. (2011) in Japan J1 league (HR_{avg} = 163 ± 16 bpm; HR_{max} = 183.5 bpm); Costa et al. (2013) in Campeonato Brasileiro Série A (HR_{avg} = 166 ± 2.1 bpm; HR_{max} = 184 bpm); Yousefian et al. (2023) in 1st/2nd Portuguese league (HR_{avg} = 167.7 ± 3.41bpm; HR_{max} = 189 bpm); Ardigò (2010) in ITA 6/7th Championship (HR_{avg} = 163 ± 8.1bpm; HR_{max} = 201 bpm) and Lima e Silva et al. (2020) with 160.90 ± 14.80; Silva et al. (2023) with 162.41 bpm done in Campeonato Brasileiro Série A & B. Studies done in the 1st Polish league (Dolanski et al., 2017), America's Liberators/ Brazil's Cup (Preissler et al., 2022) and Spain's LaLiga (Martínez-Torremocha et al., 2023) showed a small increment in values of HR_{avg} (184.9 ± 17.1; 170.25 ± 17.71; 173 ± 13.1 bpm, respectively) but not in HR_{max} (201; 169.1; 192 bpm), which was in accordance with studies previously shown. There were 2 studies shown in Table 2 that displayed decrements of HR_{avg}. Helsen & Bultynck (2004) measured the HR of referees during the Euro Cup 2000. And the mean values of referees were HR_{avg}= 155±16 bpm and HR_{max}= 182.3 bpm. Lastly, Ozaeta et al. (2022) displayed an additional decrement in values of HR_{avg}= 137.76 bpm and HR_{max}= 169.1 bpm. Only Ozaeta et al. (2022) have shown smaller values, but the rest of the analyzed studies have shown similar results regarding HR_{max} values.

Looking at the presented results, it can be seen that the values of both monitored variables were very similar, although there were studies with different levels of football competition. HR may be considered as a valid measure of referees' workload during competitive matches (Foster, 1998; Schneider et al., 2018). Therefore, referees and training experts may find the measurement and subsequent analysis of HR to have practical implications for training monitoring, ensuring referees can handle the physical demands of their matches at all levels of competition. It is crucial to acknowledge that the demands placed on soccer referees differ substantially from match to match, as previously reported (Weston et al., 2010) . It is therefore possible that HR, which is potentially useful indicator of overall internal load, may not be sensitive enough to pick up on these variations in external load performed. This has significant implications for referee training programs and calls for additional study on this specific topic.

Conclusion

After detailed analization of 15 articles, it was seen that the HR_{av} of the articles found, meaning the HR_{avg} on the sample included in previous research, were 163.13 ± 8.89 bpm and the average maximum values of HR_{max} was 191.2 ± 7.01 bpm. The range value of HR_{av} was from 137.76-184.9 bpm, while the range for HR_{max} was from 169.1-221 bpm. In total, 352 soccer refrees were analyzed in this systematic review. Looking at the presented results, it can be seen that the values of both monitored variables were very similar, although there were studies with different levels of football competition. The measurement and subsequent analysis of HR can offer referees and training experts valuable insights for monitoring and programming training. This ensures that referees are adequately prepared to handle the physical demands of matches across all levels of competition. In order to properly train soccer referees, it is important to recognize that the physical demands placed on them can vary significantly from one game to another. As a result, heart rate, which can serve as an indicator of overall internal load, may not be sufficiently valid and reliable to detect changes in external load during play. This finding has important implications for the development of referee training programs, and implies the need for further research on this particular topic within the field of sports science.

Limitation of the Study

This study may have potential limitations. Firstly, it only included scientific studies published in English, overlooking potentially relevant research published in Spanish or other languages. Additionally, the inclusion criteria were restricted to scientific studies published in article format, potentially excluding valuable insights from other types of publications. Furthermore, the study only considered articles available in the Web of Science, Google Scholar, and PubMed databases, potentially omitting relevant studies from other sources.

Author's Contribution

Study Design: SS, İİ, AL; Data Collection: AL, SK ; Manuscript Preparation: SS, İİ, SK.

Ethical Approval

No ethical approval is required.

Funding

The authors declare that the study received no funding.

Conflict of interest

There is no conflict between the authors.

References

Al Attar, W. S. A., Faude, O., Bizzini, M., Alarifi, S., Alzahrani, H., Almalki, R. S., Banjar, R. G., & Sanders, R. H. (2021). The FIFA 11+ shoulder injury prevention program was effective in reducing upper extremity injuries among soccer goalkeepers: a randomized controlled trial. *Am J Sports Med,* 49(9), 2293-2300.

Aoba, Y., Yoshimura, M., Miyamory, T., & Suzuki, S. (2011). Assessment of soccer referee performance during games. *Football Science,* 8, 8-15.

Ardigò, L. P. (2010). Low-cost match analysis of Italian sixth and seventh division soccer refereeing. *J Strength Cond Res,* 24(9), 2532-2538.

Barbero-Álvarez, J., Boullosa, D. A., Nakamura, F. Y., Andrín, G., Castagna, C. (2012). Physical and physiological demands of field and assistant soccer referees during America's cup. *J Strength Cond Res,* 26(5), 1383-1388.

Bizzini, M., Junge, A., Bahr, R., Helsen, W., & Dvorak, J. (2009). Injuries and musculoskeletal complaints in referees and assistant referees selected for the 2006 FIFA World Cup: Retrospective and prospective survey. *Br J Sports Med,* 43, 490-497.

Bloß, N., Schorer, J., Loffing, F., & Büsch, D. (2020). Physical load and referees' decision-making in sports games: a scoping review. *Journal of Sports Science and Medicine,* 19(1), 149-157.

Castagna, C., Abt, G., & D'Ottavio, S. (2007). Physiological aspects of soccer refereeing performance and training. *Sports Medicine,* 37, 625-646.

Catterall, C., Reilly, T., Atkinson, G., & Coldwells, A. (1993). Analysis of the work rates and heart rates of association football referees. *Br J Sports Med,* 27(3), 193-196.

Colosio, A. L., Lievens, M., Pogliaghi, S., Bourgois, J. G., & Boone, J. (2020). Heart rate-index estimates aerobic metabolism in professional soccer players. *J Sci Med Sport,* 23(12), 1208-1214.

Costa, E. C., Vieira, C. M., Moreira, A., Ugrinowitsch, C., Castagna, C., & Aoki, M. S. (2013). Monitoring external and internal loads of brazilian soccer referees during official matches. *J Sci Med Sport,* 12(3), 559-564.

Costa, V. T. d., Ferreira, R. M., Penna, E. M., Costa, I. T. d., Noce, F., & Simim, M.A.d.M. (2010). Análise estresse psíquico em árbitros de futebol. *Rev Bras Cineantropom Hum,* 3(2), 2-16.

Dolanski, B., Szwarc, A., Heinig, B., & Sitek, M. (2017). Physical activity profile of the referee and the assistant referee during official football matches. *Balt J Health Phys A,* 9(3), 97-105.

Dottavio, S., & Castagna, C. (2001). Analysis of match activities in elite soccer referees during actual match play. *J Strength Cond Res,* 15(2), 167-171.

D'ottavio, S., & Castagna, C. (2001). Physiological load imposed on elite soccer referees during actual match play. *J Sport Med Phys Fit,* 41(1), 27-32.

Field, A., Naughton, R. J., Haines, M., Lui, S., Corr, L. D., Russell, M., Page, R. M., & Harper, L. D. (2022). The demands of the extra-time period of soccer: A systematic review. *J Sport Health Sci,* 11(3), 403-414.

Foster, C. (1998). Monitoring training in athletes with special reference to overtraining syndrome. *Med Sci Sports Exerc,* 30(7), 1164 – 1168.

Gantois, P., Piqueras-Sanchiz, F., Cid, M. J. F. A., Pino-Ortega, J., Castillo, D., & Nakamura, F.Y. (2022). The effects of different small-sided games configurations on heart rate, rating of perceived exertion, and running demands in professional soccer players. *Eur J Sport Sci,* 8, 1-9.

Harley, R., Tozer, K., & Doust, J. (2001). *An analysis of movement patterns and physiological strain in relation to optimal positioning of association football referees.* In: Spinks W, Reilly, T. and Murphy, A., eds, editor. Science and football IV. Routledge, London.

Helsen, W., & Bultynck, J. B. (2004). Physical and perceptual-cognitive demands of top-class refereeing in association football. *J Sport Sci,* 22(2), 179-89.

Hostrup, M., & Bangsbo, J. (2023). Performance adaptations to intensified training in top-level football. *Sports Med,* 53(3), 577-594.

IFAB (2018). Soccer laws illustrated: officially approved and recommended by The Referees' Committee of FIFA: with the laws of the game and decisions of the International Football Association Board: FIFA; 2017/2018. Retrieved from: https://www.theifab.com/

Junior, P. B., Lourenção, A., Ribeiro, L. F. P., Festuccia, W. T. L., & Neiva, C. M. (2002). Consumo máximo de oxigênio e limiar anaeróbio de jogadores de futebol: Comparação entre as diferentes posições. *Revista Brasileira de Medicina do Esporte,* 8(2), 32-36.

Krustrup, P., & Bangsbo, J. (2001). Physiological demands of top-class soccer refereeing in relation to physical capacity: effect of intense intermittent exercise training. *J Sport Sci, 19*(11), 881-891.

Lima e Silva, L., Neves, E., Silva, J., Alonso, L., Vale, R., & Nunes, R. (2020). The haemodynamic demand and the attributes related to the displacement of the soccer referees in the moments of decision/intervention during the matches. *Int J Perf Anal Spor,* 20(2), 219–230.

Mallo, J., Navarro, E., Aranda, J. M., & Helsen, W. F. (2009). Activity profile of top-class association football referees in relation to fitness-test performance and match standard. *J Sport Sci,* 27(1), 9-17.

Martínez-Torremocha, G., Martin-Sanchez, M. L., Garcia-Unanue, J., Felipe, J. L., Moreno-Pérez, V., Paredes-Hernández, V., Gallardo, L., & Sanchez-Sanchez, J. (2023). Physical demands on professional Spanish football referees during matches. *Sci Med Football,* 7(2), 139-145.

Martin-Sanchez, M.L., Oliva-Lozano, J.M, Garcia-Unanue, J., Felipe, J. L., Moreno-Pérez, V., Gallardo, L., & Sánchez-Sánchez, J. (2022). Physical demands in Spanish male and female elite football referees during the competition: a prospective observational study. *Sci Med Football,* 6(5), 566-571.

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). The PRISMA Group. Reprint-Preferred reporting items for systematic reviews and meta- analyses: The PRISMA statement. *Phys Ther,* 89, 873–880.

Ohashi, J., Togari, H., & Takii, T. (1991). The distance covered during matches of the world class soccer players (Japanese). *Arts and Sciences,* 25, 1-5.

Owoeye, O.B.A., VanderWey, M.J., & Pike, I. (2020). Reducing injuries in soccer (football): an umbrella review of best evidence across the epidemiological framework for prevention. *Sports Med-Open,* 26(1), 46.

Ozaeta, E., Fernández-Lasa, U., Martínez-Aldama, I., Cayero, R., & Castillo, D. (2022). Match physical and physiological response of amateur soccer referees: a comparison between halves and match periods. *Int J Environ Res Public Health,* 19(3), 1306.

Preissler, A. A., Schons, P., Costa, R. R., Reichert, T., Oliveira, H. B., De Vargas, G.D., Ribeiro, F.L., Brito, G.R., Zanella, J.C., Klein, L.M., Denadai, B.S., & Kruel, L.F. (2022). A comparison of the internal and external load demands imposed on professional soccer referees in FIFA's current model of physical test in relation to games. *J Sport Med Phys Fit,* 62(3), 308-316.

Preissler, A. A. B., Reichert, T., Schons, P., Costa, R. R., Delevatti, R. S., Denadai, B. S., & Kruel, L. F. M. (2021). External loads of elite soccer referees: a systematic review with meta-analysis. *Res Sports Med,* 11, 1-15.

Schneider, C., Hanakam, F., Wiewelhove, T., Döweling, A., Kellmann, M., Meyer, T., Pfeiffer, M., & Ferrauti, A. (2018). Heart rate monitoring in team sports-a conceptual framework for contextualizing heart rate measures for training and recovery prescription. *Front Physiol,* 31, 9639.

Selmi, O., Ouergui, I., Muscella, A., My, G., Marsigliante, S., Nobari, H., Suzuki, K., & Bouassida, A. (2022). Monitoring psychometric states of recovery to improve performance in soccer players: a brief review. *Int J Environ Res Public Health,* 19(15), 9385.

Silva, L. D. L., de Souza Vale, R. G., & Neves, E. B. (2023). Hemodynamic and motion demands of soccer referees: a comparison between series A and B of the State Championship of Rio de Janeiro, *Brazil. Archivos de Medicina del Deporte,* 40(4), 222-228.

Silva, L. L., Godoy, E. S., Neves, E. B., Vale, R., & Hall-López, J.A (2019). Heart rate and the distance performed by the soccer referees during matches: A systematic review. *Archivos de Medicina del Deporte,* 36(1), 36-42.

Stølen, T., , Chamari, K., , Castagna, C., & Wisløff, U. (2005) Physiology of soccer: an update. *Sports Med,* 35, 501-536.

Tessitore, A., Cortis, C., Meeusen, R., & Capranica, L. (2007). Power performance of soccer referees before, during and after official matches. *J Strength Cond Res,* 21*,* 1183–1187.

Vieira, C. M. A., Costa, E. C., & Aoki, M. S. (2010). Does the level of physical fitness affect the performance of the soccer referee? *Revista Brasileira de Educação Física e Esporte,* 24(4), 445-452.

Weston, M., Castagna, C., Impellizzeri, F.M., Bizzini, M., Williams, A. M., & Gregson, W. (2012) Science and medicine applied to soccer refereeing: an update. *Sports Med,* 42*,* 615-31.

Weston, M., Castagna, C., Impellizzeri, F. M., Rampinini, E., & Abt G. (2007). Analysis of physical match performance in English Premier League soccer referees with particular reference to first half and player work rates. *J Sci Med Sport,* 10(6), 390-397.

Weston, M., Castagna, C., Impellizzeri, F. M., Rampinini, E., & Breivik, S. (2010). Ageing and physical match performance in English Premier League soccer referees. *J Sci Med Sport,* 13*,* 96-100.

Yousefian, F., Zafar, A., Peres, P., Brito, J., Travassos, B., & Figueiredo, P. (2023). Intensity demands and peak performance of elite soccer referees during match play. *J Sci Med Sport,* 26(1), 58-62.