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Review

Incidence of injuries per 1000 hours of refereeing or training in soccer referees: A mini-review

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ABSTRACT

Soccer referees, same as players, face intense physical exertion, exposing them to a high risk of injury. However, to date, no review has been conducted that synthesizes the injury incidence rate per 1000 h of exposure. Therefore, the purpose of this mini-review was to systematically examine the literature on the incidence of injury per 1000 h of exposure related to refereeing and training in soccer referees. A search was conducted in PubMed, Web of Science and ScienceDirect, resulting in the identification of 299 articles, of which 5 met the established inclusion criteria. The quality of the selected studies was assessed using the checklists provided by SIGN. In total, a group of 625 soccer referees was analyzed. The injury incidence rate during refereeing was found to be 14.43 injuries per 1000 h of exposure, while for training it was 8.59 injuries per 1000 h of exposure.

Introduction

As a highly competitive team sport, soccer demands that athletes possess a wide range of physical skills, ranging from the ability to perform quick changes of direction to explosive jumps, repeated sprints, and remarkable endurance, among other skills. Improving these aspects is crucial to enhance performance during the game.[1] However, due to the intense physical demands in both training and competitive matches, injuries are a recurrent problem among soccer players.[2] Considering this reality and given that the amount of exposure may influence the development of more injuries, several reviews have elucidated the injury incidence rate per 1000 h of exposure in soccer players.[3,4]

On the other hand, referees, like players, must possess exceptional physical qualities, as they are also submitted to considerable physical exertion. In fact, it has been shown that referees can cover distances of up to 12 kms and run at speeds in excess of 18 kms per hour.[5] It is therefore not surprising that they also suffer a high number of injuries, mainly to the lower limbs[6]. However, to date, there is no review that compiles and synthesizes the injury incidence rate per 1000 h of exposure, implying a lack of knowledge about injury risk in relation to exposure time in soccer referees. That being said, the objective of this mini-review is to systematically examine the literature on the incidence of injury per 1000 h of exposure related to refereeing and training in soccer referees.

Methods

Search strategy and procedure

A systematic search for original studies (prospective cohort studies and randomized controlled trials) was carried out with a deadline of February 28, 2024, using the PubMed, Web of Science and ScienceDirect databases. For this purpose, the following search terms were used: Epidemiology, Epidemiologic, Epidemiological, Epidemiological, Incidence, Prevalence, Injury, Injuries, Injured and Soccer referees. These terms were combined in the following search equation: ((((((“Epidemiology”) OR (“Epidemiologic”)) OR (“Epidemiological”)) OR (“Incidence”)) OR (((“Prevalence”)))) AND (((“Injury”) OR (“Injuries”))) OR (“Injured”)))) AND (Soccer Referees). Detailed search history in each of the databases used, along with the number of records identified, is provided in the supplementary material.

Criteria for the evaluation of studies for this review

Prospective cohort studies and clinical trials were selected to reduce recall bias inherent in retrospective studies. No language

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restrictions were imposed in order to avoid linguistic bias and to collect more information on the incidence of injury per 1000 h of exposure, either during training or refereeing, or in both contexts. The target population considered was eleven-a-side soccer referees, regardless of gender.

Identification of studies and data extraction

For article selection, first, the preliminary manuscripts obtained during the searches in each database were uploaded to the collaborative web application Rayyan[7]. Then, two reviewers conducted an independent selection after analyzing the title and abstract of each found text. Subsequently, the reviewers conducted a second independent selection process after reading the full texts that had been selected in the first phase. During these two stages of selection, in the event of discrepancies between the reviewers, a third reviewer was involved to facilitate reaching a consensus and reaching an agreement.

Once the texts that were included in this review were selected, the following data were extracted from each of them: title, authors, year of publication, journal of publication, type of study, follow-up period, injury definition, population, total injuries and injury incidence rate per 1000 h of exposure during training, refereeing or both, with their respective confidence intervals when available. These data were extracted by two reviewers independently and stored in an Excel spreadsheet. Subsequently, the extracted data were cross-checked to verify the accuracy of the extraction. In case of discrepancies, a third reviewer intervened to verify the information and reach a consensus on the final data.

Quality of studies

The quality of the studies was assessed using the cohort study checklist and the clinical trial checklist provided by the Scottish Intercollegiate Guidelines Network (SIGN)[8]. The application of these scales to the texts selected in this review was performed by two investigators. If disagreements appeared, a third reviewer intervened to facilitate consensus.

Synthesis of results

The results are presented both qualitatively and quantitatively, using tables and figures that provide a visual representation of the data collected and the results obtained. The injury incidence rate per thousand hours of exposure during refereeing, training or both activities, together with their respective 95% confidence intervals, were used to estimate the overall incidence rate by meta-analysis. In cases where the studies did not provide the confidence intervals and the raw data did not allow their calculation, it was necessary to contact the authors of the articles via e-mail and the social network for researchers ResearchGate[9], requesting the missing data. The I2-squared statistic was used to determine heterogeneity among the included studies, and the random-effects model was used.

Result

Study selection characteristics

Initially, 299 manuscripts were identified. After eliminating duplicates, the number was reduced to 266. Afterwards, a review of titles and abstracts was conducted, resulting in the selection of 13 articles for comprehensive review.[6,10–21] During this process, 7 articles were excluded due to their retrospective nature,[6,17–21] as well as an additional one that lacked specific data relevant to soccer referees.[11] This left a total of 5 articles for final selection and synthesis.[13,15,17–18,21] A flowchart that visually summarizes the search and article selection process is presented in Fig. 1.

Data analysis and description of the studies

An analysis was conducted involving a total of 625 referees, of whom 621 were men and only 4 were women. The age range of the referees was between 27 and 40 years. In terms of study designs, 4 prospective cohort studies[13,15,17,18] and 1 randomized clinical trial[21] were identified. A notable aspect across the studies was the consistency in the definition of injury used, as all 5 studies adopted the definition provided by the consensus on injury definitions and data collection procedures in soccer studies.[22] The characteristics of the studies are detailed in Table 1.

Quality of studies

After evaluating the quality of the studies, it was determined that the clinical trial reached an acceptable level. However, regarding the prospective cohort studies, it was found that two met the criteria for acceptable quality, while the other two exhibited significant deficiencies and were rated as low quality. The main deficiencies were related to the lack of consideration of the probability that some eligible subjects already had the outcome at the time of enrollment, the absence of blinding or acknowledgment of it when it was impossible to implement, suggesting that knowledge of exposure status could have biased the outcome assessment and identification of key confounding factors. A detailed summary of the quality assessment of the studies included in this review is provided in Table 2.

Incidence of injuries per 1000 h of exposure

One study reported the incidence rate of injuries per thousand exposure hours during refereeing and training[21]. However, it did not provide confidence intervals or the necessary data to calculate them, so it could not be included in the overall analysis. This study stood out among the others as a clinical trial, in which the FIFA 11+ program was used as a preventive measure for injuries. It was observed that the control group, which did not implement the program, had an incidence rate of 1.45 injuries per 1000 exposure hours, while the group that followed the program twice a week showed an injury incidence rate of 0.50 injuries per 1000 exposure hours.

Another cohort study also did not provide the necessary confidence intervals for the overall analysis.[15] In this study, the injury rate during refereeing was 37.8 injuries per 1000 exposure hours, and for training, it was 39.9 injuries per 1000 exposure hours. It is important to note that attempts were made to contact the authors of these two studies, but no response was received.

Regarding the studies in which it was possible to obtain confidence intervals, weighted estimates revealed that the incidence rate of injuries is higher during refereeing matches, at 14.43 injuries per 1000 exposure hours, compared to training, which was 8.59 injuries per 1000 exposure hours. The overall weighted incidence rate of injuries during both refereeing and training was 11.66 injuries per 1000 exposure hours (Fig. 2).

Discussion

The present review, to the best of our knowledge, represents the first compendium synthesizing available information on the incidence rate of injuries in soccer referees per 1000 h of exposure. The compiled data reveal that the incidence rate of injuries per 1000 h of exposure is notably higher during refereeing activities than during soccer referee training sessions. These findings align with previous discoveries in soccer players, such as those documented by Robles-Palazón et al.,[3] where an incidence rate of 14.43 injuries/1000 h of

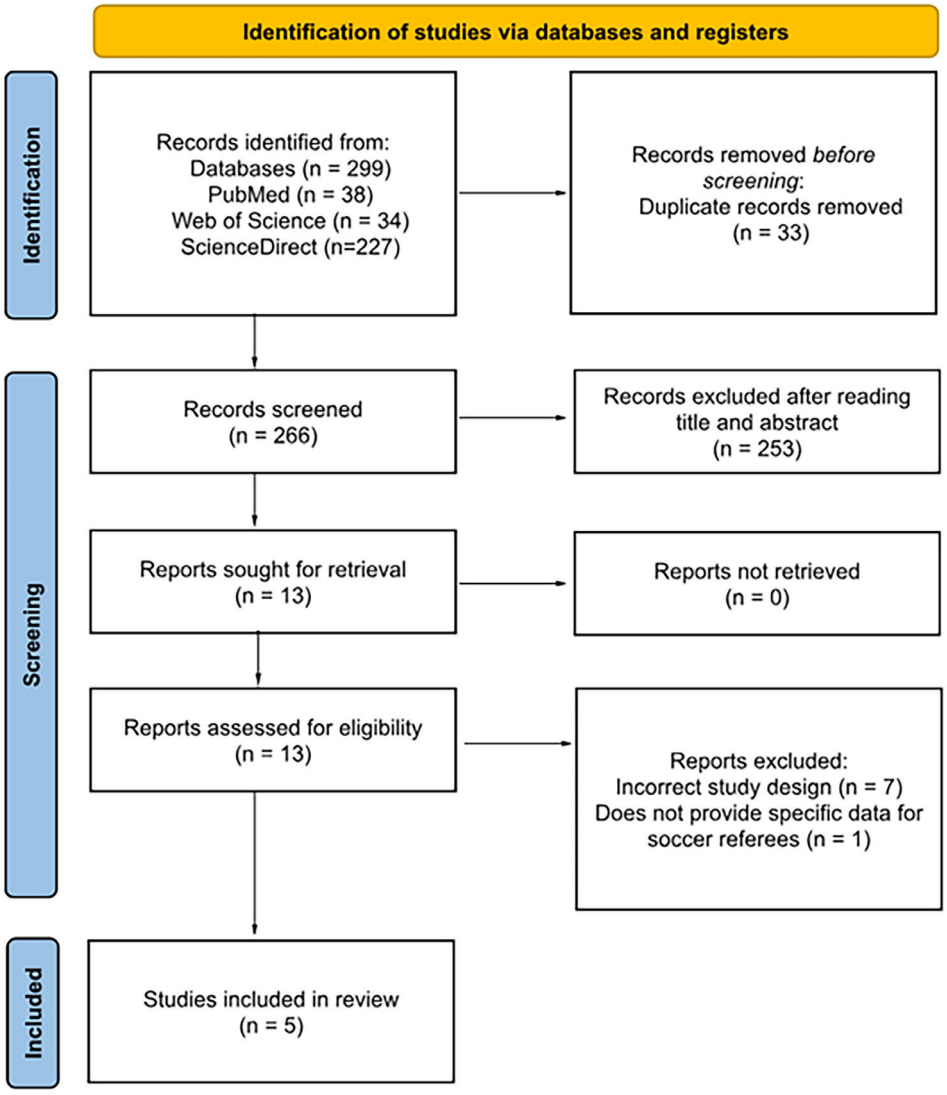

Fig 1. PRISMA flow diagram suggested by Page et al.,[26].

exposure was observed during matches for men and 14.97 injuries/1000 h of exposure for women, whereas during training, the rate significantly dropped to 2.77 injuries/1000 h of exposure for men and 2.62 injuries/1000 h of exposure for women. Similarly, Owoeye et al.'s umbrella review[4] found similar data in elite soccer players, with rates during matches ranging from 9.5 to 48.7 injuries/1000 h of exposure and during training from 3.7 to 11.4 injuries/1000 h of exposure.

These findings from the literature, in contrast with those of this study, are likely due to the fact that during competition, not only is maximum physical performance demanded of football players and referees, but multiple external factors also challenge cognitive performance and can increase the number of injuries.[23] Therefore, it is imperative to integrate preventive measures, such as the FIFA 11+ program for referees, which one of the studies included in this review found to be highly effective.[21] However, this program focuses on

Table 1
Characteristics of the included studies.

First Author Year	Journal	Design	Population	Follow-up period
Wilson et al. 2012[13]	Irish Medical Journal	Prospective Cohort	n: 31 professional referees [27 male and 4 female (33.2 ± 6.2 years)]	1 year
Vieira et al. 2019[15]	Revista Brasileira de Medicina do Esporte	Prospective Cohort	n: 257 male professional referees (32,9 ± 5,0 years)	3 years
Kordi et al. 2013[17]	Sports Health	Prospective Cohort	n: 74 male professional referees [(30 main referees (37.30 ± 3.20 years) y 44 assistant referees (36.30 ± 4.30 years)]	1 year
Bizzini et al. 2009[18]	British Journal of Sports Medicine	Prospective Cohort	n: 63 male professional referees [(21 main referees (37.30 ± 3.20 years) y 42 assistant referees (37.30 ± 3.20 years)]	1 month
Al Attar et al. 2021[21]	Scandinavian Journal of Medicine & Science in Sports	Randomized Controlled Trial	Experimental group= *n*: 100 male amateur referees (31.6 ± 4.1 years) Control group= *n*: 100 male amateur referees (31.6 ± 4.1 years)	6 months

Table 2
Quality of the studies using the SIGN checklists.

Studies	*Items*															
	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.10	1.11	1.12	1.13	1.14	2.1	2.2
Wilson et al.[13]		NA	NA	X	0%	NA		NA	X				X		Acceptable	
Vieira et al.[15]		NA	NA	X	0%	NA		NA	X				X	X	Low quality	
Kordi et al.[17]		NA	NA	X	1.3%	NA		NA	X		X		X	X	Low quality	
Bizzini et al.[18]		NA	NA	X	4.54%	NA		NA	X				X	X	Acceptable	X
Clinical Trial Checklist provided by SIGN																
Studies	*Items*															
	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9		1.10		2.1		2.2	
Al Attar et al.[21]			X	X				3.5%			NA		Acceptable			

Note = ✔: Compliant; X: Does not comply; NA: Not applicable. The percentages shown in item 1.5 and 1.8 correspond to the percentage of subjects who abandoned the study before it ended.

exercises for the lower limbs and does not include exercises for other parts of the body. This aspect is crucial because, according to Kordi et al.[17] and Bizzini et al.,[18] while upper limb and trunk injuries are less frequent, they still occur. In one year, 4.35% of injuries to main referees involve hands and wrists, and 2.17% involve the head. Among assistant referees, 3.57% of total injuries affect hands and wrists.[17]

Therefore, it is essential to conduct more research in this field to validate and establish injury prevention protocols that encompass all potential risk areas for referees. Since, as far as is known, the FIFA program is the only one available for referees, it may be necessary to consider alternatives in some situations.

Finally, considering that the incidence rate of injuries per 1000 h of exposure is higher during matches, it is fundamental that decision-makers at local, national, and international levels reinforce warm-up programs to prevent injuries before each soccer match, and implement all necessary preventive measures to reduce the number of injuries during refereeing.

Limitations

It is crucial to acknowledge the limitations of this review. Firstly, it is evident that this field of study has not yet been deeply explored, which limits the analyses presented due to a scarcity of data from primary studies. Furthermore, there is significant heterogeneity among the included studies, necessitating a cautious interpretation of the presented data. This statistical heterogeneity, along with observable differences in incidence rates, may be explained by the specific contexts in which the studies were conducted, where the pace of play in each league and competition could exert greater demands on referees and result in more injuries. For instance, a higher injury rate was evident among referees officiating in the 2006 FIFA World Cup compared to those in the Irish professional league,[13,18] suggesting that dynamics within each setting could pose varying risks to referees.

Moreover, it is important to note that due to underrepresentation, findings may be limited to male referees and cannot be extrapolated to female referees, as only four women were included in the analysis. Additionally, while the data obtained in the meta-analysis pertain to studies conducted on professional referees, providing clarity on incidence rates among them, the sole study on amateur referees was conducted by Attar et al.,[21] who implemented the FIFA 11+ referees program for preventive measures. Therefore, these data are not generalizable to amateur referees, and the reported incidence rate of injuries is likely influenced by various confounding variables inherent to the study context where an intervention was applied.

Furthermore, it is relevant to point out that while some studies presented combined data for main referees and assistant referees, others presented them separately, indicating a disparity in injury incidence rates during refereeing, with higher rates in main referees than in assistants.[17,18] This difference could be explained by the greater distances covered and the higher physical demands during the game by main referees.[24] Additionally, there is still a lack of data on injury rates during fitness assessment tests, where the level of physical demand is also considerably high.[25]

In light of the above, it is imperative that researchers address the epidemiology of injuries in soccer referees more rigorously, given the existing imbalance between the study of players and the refereeing body. This will enable a more comprehensive understanding of the

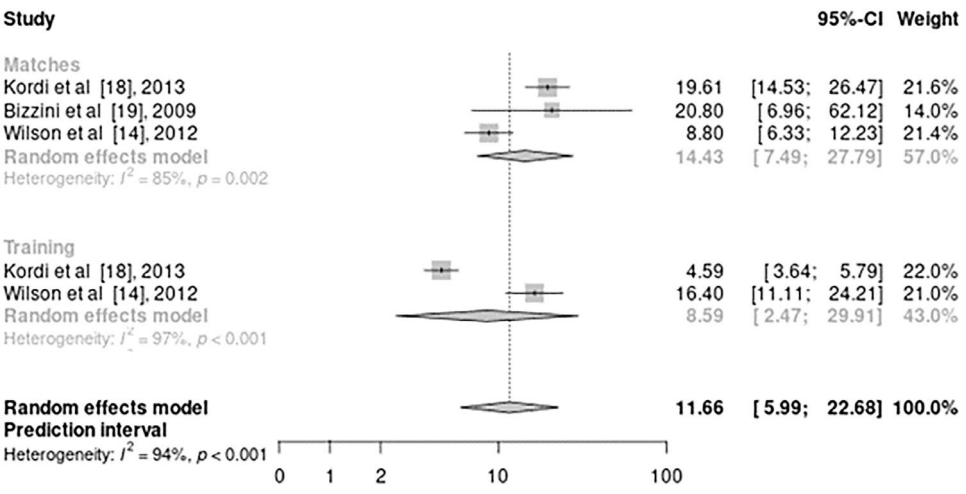

Fig 2. Estimation of the incidence of injuries per 1000 h of exposure related to refereeing and training in soccer referees.

issue and facilitate the implementation of appropriate preventive measures, in an area where studies on injury prevention are also scarce.[21,26]

Conclusion

Injuries among soccer referees are a recurring issue that warrants attention. Studies have shown that referees are more likely to sustain injuries during matches than during training sessions, with an injury incidence rate of 14.43 injuries per 1000 h of officiating compared to 8.59 injuries per 1000 h of training. Therefore, it is crucial to implement preventive measures and educational programs to reduce the incidence rate of injuries among referees. An example of such a program is the FIFA 11+ for referees, which is especially recommended before matches, as this is when the highest number of injuries occur.

Statements

- That it is an original work.
- That it has not been previously published in whole or in part.
- That it is not under evaluation in any other publication.
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- That the fact of being accepted for publication implies that all authorship rights are transferred.
- That there was not and will not be any economic benefit for the preparation of this manuscript.
- That there was no source of funding for the development of the manuscript.

Conflicts of interest

That there are no conflicts of interest

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Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.apunsm.2024.100455.

References

1. Beato M, Bianchi M, Coratella G, Merlini M, Drust B. Effects of plyometric and directional training on speed and jump performance in elite youth soccer players. *J Strength Cond Res*. 2018;32(2):289–296. https://doi.org/10.1519/jsc.0000000000002371.
2. Mandorino M, Figueiredo AJ, Gjaka M, Tessitore A. Injury incidence and risk factors in youth soccer players: a systematic literature review. Part I: epidemiological analysis. *Biol Sport*. 2023;40(1):3–25. https://doi.org/10.5114/biolsport.2023.109961.
3. Robles-Palazón FJ, López-Valenciano A, De Ste Croix M, et al. Epidemiology of injuries in male and female youth football players: a systematic review and meta-analysis. *J Sport Health Sci*. 2022;11(6):681–695. https://doi.org/10.1016/j.jshs.2021.10.002.
4. Owoeye OBA, VanderWey MJ, Pike I. Reducing injuries in soccer (football): an umbrella review of best evidence across the epidemiological framework for prevention. *Sports Med Open*. 2020;6(1):46. https://doi.org/10.1186/s40798-020-00274-7.
5. Castagna C, Abt G, D'Ottavio S. Activity profile of international-level soccer referees during competitive matches. *J Strength Cond Res*. 2004;18(3):486–490. https://doi.org/10.1519/00124278-200408000-00016.
6. Gabrilo G, Ostojic M, Idrizovic K, Novosel B, Sekulic D. A retrospective survey on injuries in Croatian football/soccer referees. *BMC Musculoskelet Disord*. 2013;14(1). https://doi.org/10.1186/1471-2474-14-88.
7. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan—a web and mobile app for systematic reviews. *Syst Rev*. 2016;5(1). https://doi.org/10.1186/s13643-016-0384-4.
8. The Scottish Intercollegiate Guidelines Network (SIGN) website www.sign.ac.uk.
9. García-Peñalvo FJ. ResearchGate. Salamanca. *España: Grupo GRIAL*. 2020. https://doi.org/10.5281/zenodo.3841998. https://youtu.be/7YrUJznBr0I.
10. Bizzini M, Junge A, Bahr R, Dvorak J. Injuries of football referees: a representative survey of Swiss referees officiating at all levels of play. *Scand J Med Sci Sports*. 2011;21(1):42–47. https://doi.org/10.1111/j.1600-0838.2009.01003.x.
11. Dvorak J, Junge A, Grimm K, Kirkendall D. Medical report from the 2006 FIFA World Cup Germany. *Br J Sports Med*. 2007;41(9):578–581. https://doi.org/10.1136/bjsm.2006.034579.
12. Epidemiology and history of knee injury and its impact on activity limitation among football premier league professional referees. *J Inj Violence Res*. 2018;10(1). https://doi.org/10.5249/jivr.v10i1.963.
13. Wilson F, Byrne A, Gissane C. A prospective study of injury and activity profile in elite soccer referees and assistant referees. *Ir Med J*. 2011;104(10):295–297.
14. Szymski D, Opitz S, Pfeifer C, et al. High injury rates and weak injury prevention strategies in football referees at all levels of play. *Scand J Med Sci Sports*. 2022;32(2):391–401. https://doi.org/10.1111/sms.14083.
15. Vieira PR, Alonso AC, Ingham SJM, Oliveira ASB, Schmidt B, Fallopa F. Incidence of musculoskeletal injuries in soccer referees: a three-year study. *Rev Brasil Med Esporte*. 2019;25(3):258–262. https://doi.org/10.1590/1517-86922019250318 2833.
16. Moen C, Andersen TE, Clarsen B, Madsen-Kaarød G, Dalen-Lorentsen T. Prevalence and burden of health problems in top-level football referees. *Sci Med Footb*. 2023;7(2):131–138. https://doi.org/10.1080/24733938.2022.2055782.
17. Kordi R, Chitsaz A, Rostami M, Mostafavi R, Ghadimi M. Incidence, nature, and pattern of injuries to referees in a premier football (soccer) league: a prospective study: a prospective study. *Sports Health*. 2013;5(5):438–441. https://doi.org/10.1177/1941738113481428.
18. Bizzini M, Junge A, Bahr R, Helsen W, Dvorak J. Injuries and musculoskeletal complaints in referees and assistant referees selected for the 2006 FIFA World Cup: retrospective and prospective survey. *Br J Sports Med*. 2009;43(7):490–497. https://doi.org/10.1136/bjsm.2008.048314.
19. Matute-Llorente Á, Sanchez-Sanchez J, Castagna C, Casajus JA. Injuries of a Spanish top-level sample of football referees. A retrospective study. *Apunts Sports Med*. 2020;55(208):146–152. https://doi.org/10.1016/j.apunsm.2020.07.001.
20. Bizzini M, Junge A, Bahr R, et al. Injuries and musculoskeletal complaints in referees-a complete survey in the top divisions of the swiss football league. *Clin J Sport Med*. 2009;19(2):95–100.
21. Al Attar WSA, Bizzini M, Alkabkabi F, et al. Effectiveness of the FIFA 11+ Referees Injury Prevention Program in reducing injury rates in male amateur soccer referees. *Scand J Med Sci Sports*. 2021;31(9):1774–1781. https://doi.org/10.1111/sms.13983.
22. Fuller CW, Ekstrand J, Junge A, et al. Consensus statement on injury definitions and data collection procedures in studies of football (soccer) injuries. *Scand J Med Sci Sports*. 2006;16(2):83–92. https://doi.org/10.1111/j.1600-0838.2006.00528.x.
23. Chaaban CR, Turner JA, Padua DA. Think outside the box: incorporating secondary cognitive tasks into return to sport testing after ACL reconstruction. *Front Sports Act Living*. 2023;4. https://doi.org/10.3389/fspor.2022.1089882.
24. Krustrup P, Helsen W, Randers MB, et al. Activity profile and physical demands of football referees and assistant referees in international games. *J Sports Sci*. 2009;27(11):1167–1176. https://doi.org/10.1080/02640410903220310.
25. Fédération Internationale de Football Association. *Refer Fitness Tests*. 2020.
26. Al Attar WSA, Shamrani N, Al Kabkabi F, Ghulam H. Implementation of the FIFA 11 referees injury prevention program among soccer referees. *J Phys Educ Sport*. 2021;21(3):1367–1375.