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The Impact of Video-Based Training on Football Referees' Decision-Making Skills: A Systematic Review And Meta Analysis

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ADMINISTRATIVE INFORMATION

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Review Stage at time of this submission - Formal screening of search results against eligibility criteria.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 12 December 2024 and was last updated on 12 December 2024.

INTRODUCTION

Review question / Objective Review Question/Objective: Does video-based decision-making training improve the decision-making accuracy of soccer referees compared to no training, as measured by video-based judgment tasks?

PICOS Framework:

Population (P): Soccer referees aged 18 and above, both male and female, with varying levels of experience and expertise.

Intervention (I): Video-based decision-making training programs with defined frequency and duration.

Comparison (C): Control groups without decision-making training.

Outcome (O): Decision-making accuracy, measured as the number or proportion of correct judgments in video-based decision-making tasks.

Study Design (S): Randomized Controlled Trials (RCTs).

Rationale Decision-making is a critical skill for soccer referees, whose judgments directly influence the fairness and flow of a match. On average, a professional soccer referee makes 200–250 decisions during a single game, and any errors can significantly affect player performance and match outcomes. As soccer continues to evolve with faster-paced transitions and intense physical and psychological demands, referees face increasing challenges in maintaining high decision-making accuracy.

Traditional methods for improving referees' decision-making skills primarily focus on theoretical education, such as rule learning, or practical training through game experiences. However, these approaches have limitations. Frequent workshops or replicating live match scenarios can be time-consuming, resource-

intensive, and difficult to organize. Consequently, there is a pressing need for innovative, efficient, and practical training methods that allow referees to repeatedly practice and refine their decision-making skills outside the game environment.

Video-based decision-making training has emerged as a promising alternative. By simulating match scenarios through video clips, referees can practice judgment tasks in controlled environments, gaining exposure to diverse game situations. This method is convenient, cost-effective, and adaptable, offering a scalable solution to the constraints of traditional training. Studies have demonstrated that video-based training can enhance athletes' decision-making skills across sports, including soccer, rugby, and basketball. However, its effectiveness for soccer referees remains a subject of debate, with some researchers citing limited improvements due to ecological validity concerns, such as the lack of first-person perspectives or the exclusion of real-match contextual factors like crowd noise and physical exertion.

Despite these mixed findings, video training has potential as a supplementary tool for referees, especially with advancements like virtual reality (VR) and immersive simulation. However, no high-standard systematic review or meta-analysis has comprehensively evaluated its effectiveness in improving soccer referees' decision-making skills. This study aims to fill this gap by synthesizing existing evidence, quantifying the training's overall impact, and identifying its limitations. The findings will provide valuable insights for optimizing referee training programs and guiding future research on innovative training methods. By addressing the limitations of current studies and exploring practical applications, this research contributes to improving the performance and professionalism of soccer referees, ultimately enhancing the quality and fairness of soccer matches.

Condition being studied This study is currently in the preparatory stage, with clearly defined research objectives and plans. The research aims to evaluate the impact of video-based decision-making training on soccer referees' decision-making abilities through systematic review and meta-analysis. The research plan includes:

1. Verifying whether video training can significantly improve referees' decision-making accuracy;
2. Exploring its applicability and potential limitations;
3. Providing scientific evidence for optimizing referee training programs.

The research question is constructed based on the PICOS framework, providing a clear direction for subsequent study design. The research framework

is preliminarily planned according to the PRISMA statement, covering scientific steps such as search strategies, inclusion criteria, data extraction methods, and bias risk assessment. Additionally, CMA software is proposed for data analysis.

The research team consists of experts in referee decision-making and statistical analysis, with the professional knowledge and technical skills necessary to conduct systematic reviews and meta-analyses. Some members have practical experience in projects related to referee training, providing background support for the effectiveness of interventions. The team members have experience publishing high-quality academic articles and participating in relevant international academic conferences, ensuring the academic rigor of this study.

This study is in the application phase, and the research team has already raised initial research funding to support the project's progress. The preliminary budget includes expenses for database subscriptions, statistical analysis software licenses, and personnel costs. The research team plans to secure additional funding through university research grants and related academic funding programs to ensure the study proceeds as planned.

METHODS

Search strategy A systematic search was conducted in four electronic databases (EBSCO, PubMed, Scopus, SPORTDiscus, and Web of Science). The search algorithm included all possible keyword combinations from the following groups: ("video" OR "video training" OR "video intervention") AND ("soccer referees" OR "football referees") AND ("decision" OR "decision making" OR "judgment"). Additionally, a manual search of the reference lists of included articles was performed to identify relevant publications. Only peer-reviewed English-language research articles were included in the search.

Participant or population The study population includes soccer referees aged 18 years and above. Participants encompass a diverse range of individuals with varying levels of expertise, from novice referees to experienced professionals officiating at semi-professional or professional levels.

Inclusion criteria specify healthy referees actively involved in officiating soccer matches, with no restrictions on gender. The intervention group comprises referees who underwent video-based decision-making training, while the control group includes referees who received no decision-making training or alternative forms of intervention.

Exclusion criteria include referees with insufficient experience in officiating soccer games, studies involving interventions unrelated to video-based training (e.g., rule learning, physical training), or referees unable to participate due to health or availability constraints.

The focus on soccer referees as a specific population aims to address their unique decision-making demands and evaluate the applicability and effectiveness of video-based training in enhancing their judgment accuracy during match officiation.

Intervention The intervention evaluated in this study is video-based decision-making training. This approach involves presenting referees with edited or simulated match scenarios through video clips, requiring them to perform decision-making tasks such as identifying fouls, offsides, or other rule violations. The training content is typically based on critical events from real matches, including static and dynamic situations, to enhance referees' decision-making accuracy in complex match environments.

Comparator The control group includes referees who either received no decision-making training or underwent alternative interventions (e.g., rule learning or standard training).

Study designs to be included Randomized Controlled Trials, RCTs.

Eligibility criteria The eligibility criteria for this study are defined based on the PICOS framework:

Inclusion Criteria:

1. Population:

Studies involving soccer referees aged 18 years or above, of any gender, with varying levels of experience (e.g., novice, semi-professional, professional).

2. Intervention:

Studies implementing video-based decision-making training programs with defined frequency and duration.

Training should involve decision-making tasks such as identifying fouls, offsides, or other game events using video simulations.

3. Comparator:

Studies with a control group that did not receive decision-making training or underwent alternative interventions (e.g., rule learning, standard training).

4. Outcomes:

Studies reporting quantitative measures of decision-making accuracy, such as the number or percentage of correct judgments in video-based tasks.

5. Study Design:

Randomized Controlled Trials (RCTs) or other high-quality experimental designs (e.g., pretest-posttest designs).

Exclusion Criteria:

1. Studies involving interventions unrelated to video-based training (e.g., physical fitness training, psychological interventions).

2. Studies without control groups or insufficient methodological rigor.

3. Non-English or non-Chinese publications that lack accessible full texts.

4. Descriptive studies, systematic reviews, or meta-analyses.

5. Studies not reporting relevant quantitative outcomes.

This systematic review aims to ensure the inclusion of studies that directly address the research objectives, providing robust evidence for the effectiveness of video-based training on referees' decision-making skills.

Information sources Comprehensive searches will be conducted in the following databases: PubMed, Web of Science, Scopus, EBSCO.

These databases will be searched for peer-reviewed studies relevant to video-based decision-making training for soccer referees.

Main outcome(s) The primary outcome of this review is the decision-making accuracy of soccer referees, measured as the number or proportion of correct judgments in video-based decision-making tasks. Decision-making accuracy will be assessed through pretest-posttest comparisons or between-group differences in randomized controlled trials (RCTs). Effect sizes (e.g., Hedge's *g* or Cohen's *d*) will be used to quantify the impact of video-based training interventions.

Additional outcome(s) Timing will be captured based on intervention duration and follow-up assessments where available. Secondary outcomes, such as training feasibility or participant satisfaction, may also be analyzed if reported in the included studies.

Quality assessment / Risk of bias analysis The quality assessment and risk of bias analysis for this review will be conducted using the Cochrane Risk of Bias 2.0 (RoB 2) tool, which evaluates bias across the following five domains:

1. Bias arising from the randomization process:

2. Bias due to deviations from intended interventions:

3. Bias due to missing outcome data:

4. Bias in measurement of the outcome:
5. Bias in selection of the reported result.

Strategy of data synthesis The data synthesis for this review will follow a structured approach:

1. Data Extraction and Organization:

Relevant data, including study characteristics (e.g., sample size, intervention type, duration) and outcome measures (e.g., decision-making accuracy), will be extracted using a standardized template.

All extracted data will be organized in tabular form for consistency and clarity.

2. Quantitative Synthesis:

A meta-analysis will be conducted using Comprehensive Meta-Analysis (CMA) 3.0 software to calculate pooled effect sizes (e.g., Hedge's g) for the impact of video-based training on decision-making accuracy.

A random-effects model will be employed to account for between-study heterogeneity.

3. Heterogeneity Assessment:

Statistical heterogeneity will be evaluated using the I^2 statistic and Q-test.

Subgroup analyses (e.g., by intervention duration, referee experience level) will be conducted to explore sources of heterogeneity.

4. Sensitivity Analysis:

A leave-one-out analysis will be performed to assess the robustness of pooled results by excluding one study at a time.

5. Publication Bias:

Funnel plots and Egger's test will be used to assess the potential for publication bias.

6. Qualitative Synthesis:

If quantitative synthesis is not feasible for some studies due to significant methodological differences, findings will be narratively summarized to provide contextual insights.

Subgroup analysis Subgroup analyses will be conducted to explore potential sources of heterogeneity and provide deeper insights into the effectiveness of video-based decision-making training for soccer referees. The planned subgroup analyses include:

1. Intervention Characteristics:

Frequency of Training: Weekly sessions (e.g., 1 session/week vs. 3 sessions/week).

Duration of Training: Short-term (<2 weeks) vs. long-term (≥ 2 weeks).

2. Participant Characteristics:

Experience Level: Novice vs. semi-professional vs. professional referees.

Gender: Male vs. female referees (if sufficient data are available).

Subgroup differences will be tested statistically where possible, and findings will be interpreted cautiously to account for multiple comparisons.

Sensitivity analysis A leave-one-out analysis will be performed to assess the robustness of pooled results by excluding one study at a time.

Language restriction No.

Country(ies) involved China.

Other relevant information No

Keywords Video-Based Training; decision-making skills; Football Referees; Meta-Analysis.

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