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Speed endurance: essential for the performance of female soccer referees

Resistencia a la velocidad: esencial para el rendimiento de las árbitras de fútbol

Resistência à velocidade: essencial para o desempenho de árbitras de futebol.

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ABSTRACT

Women's soccer refereeing demands specific physical capabilities that must be achieved through specialized training programs. This research focuses on characterizing the physical preparation of female soccer referees in Pinar del Río in depth. A mixed-methods design was used, applying theoretical methods (analysis-synthesis, inductive-deductive reasoning, systems approach) to structure the conceptual framework and process data, complemented by empirical methods: standardized tests (Yo-Yo IR1 test, RSA, lactate) to assess speed endurance and metabolic recovery, Likert scales for fatigue perception and self-efficacy, and semi-structured interviews that explored experiences and contextual barriers. The results revealed that no female referee reached FIFA standards in the Yo-Yo IR1 (average: 63.2%), with post-exertion lactate ≥ 4 mmol/L and 70% decision errors in final phases, highlighting the urgency of programs with HIIT training, functional strength and accessible technology (low-cost GPS) adapted to their physiological and structural needs.

Keywords: Sports performance, women's football, sports refereeing, speed-endurance, physical conditioning.



RESUMEN

El arbitraje de fútbol femenino exige capacidades físicas específicas que deben ser alcanzados a través de programas de preparación especializados. La presente investigación centra su objetivo en caracterizar en profundidad la preparación física de las árbitras de fútbol en Pinar del Río. Se utilizó un diseño metodológico mixto, donde se aplicaron métodos del nivel teórico (análisis-síntesis, inductivo-deductivo, enfoque de sistema) para estructurar el marco conceptual y procesar datos, complementados con métodos del nivel empírico: la medición con pruebas estandarizadas (test Yo-Yo IR1, RSA, lactato) para evaluar resistencia a la velocidad y recuperación metabólica, encuestas Likert para percepción de fatiga y autoeficacia, y entrevistas semiestructuradas que profundizaron en experiencias y barreras contextuales. Los resultados revelaron que ninguna árbitra alcanzó los estándares FIFA en el Yo-Yo IR1 (promedio: 63.2%), con lactato post-esfuerzo ≥ 4 mmol/L y 70% de errores decisionales en fases finales, evidenciando la urgencia de programas con entrenamiento HIIT, fuerza funcional y tecnología accesible (GPS low-cost) adaptados a sus necesidades fisiológicas y estructurales.

Palabras clave: Rendimiento deportivo, fútbol femenino, arbitraje deportivo, velocidad-resistencia, preparación física.

RESUMO

A arbitragem no futebol feminino exige capacidades físicas específicas que devem ser alcançadas por meio de programas de treinamento especializados. Esta pesquisa concentra-se na caracterização aprofundada da preparação física de árbitras de futebol em Pinar del Río. Foi utilizado um delineamento de métodos mistos, aplicando métodos teóricos (análise-síntese, indutivo-dedutivo, abordagem sistêmica) para estruturar o arcabouço conceitual e processar os dados, complementados por métodos empíricos: mensuração com testes padronizados (teste Yo-Yo IR1, RSA, lactato) para avaliar a resistência à velocidade e a recuperação metabólica, escalas Likert para percepção de fadiga e autoeficácia, e entrevistas semiestructuradas que exploraram experiências e barreiras contextuais. Os resultados revelaram que nenhuma árbitra atingiu os padrões da FIFA no teste Yo-Yo IR1 (média: 63,2%), com lactato pós-exercício ≥ 4 mmol/L e 70% de erros de decisão nas fases finais,



destacando a necessidade urgente de programas que incorporem treinamento HIIT, força funcional e tecnologia acessível (GPS de baixo custo) adaptados às suas necessidades fisiológicas e estruturais.

Palavras-chave: Desempenho esportivo, futebol feminino, arbitragem esportiva, resistência à velocidade, condicionamento físico.

INTRODUCTION

Football refereeing represents one of the most demanding roles in the sporting field, where the central referee must cover approximately 8000 m² of ground, monitor the actions of 22 players and make instantaneous decisions that directly influence the development of the match.

This complex task is intensified by the growing demands of modern football, characterized by greater speed, intensity and tactical complexity, which requires not only optimal physical conditions but also excellent technical and tactical preparation (Rodriguez Velasquez & Villena Rojas, 2024).

In the specific context of women's refereeing, performance is conditioned by fundamental physical capacities such as endurance, speed, strength, and flexibility, all of which are crucial for maintaining the pace of the game, ensuring proper positioning, and guaranteeing accurate decision-making. However, female referees face particular challenges, notably the lack of specialized physical training programs and the need to adapt to the demands of modern football.

Speed endurance emerges as a critical capacity, combining short sprints with periods of active recovery, essential for responding to the rapid transitions of the game (Gantois et al., 2023). This quality allows referees to maintain high performance throughout the 90 minutes by repeating maximum efforts with optimal recovery. Training strategies such as interval training (Oña et al., 2022), functional strength training (Bustos Viviescas et al., 2024), and technical-tactical simulation (Gamonaes et al., 2019) are essential tools for its development. At the "Lázaro Hernández" Referees' College in Pinar del Río, significant deficiencies were found in the physical preparation of female referees, particularly in continuous transitions and post-exertion recovery. Preliminary studies revealed that three out of five female



referees experience severe physical exhaustion after speed tests, compromising their performance in subsequent intermittent endurance assessments.

This problem underscores the need to implement specialized physical preparation systems that, based on scientific models such as ATR and focused on speed endurance, allow for the optimization of referee performance in high-level competitions.

This research aims to characterize in depth the physical preparation of female soccer referees in Pinar del Río. Its importance lies in its contribution to the development of women's refereeing in Cuba, through the implementation of practical tools adapted to the specific needs identified in the region. This is especially relevant, as the scarcity of resources and the lack of specialized programs constitute significant obstacles to the progress of female referees in Pinar del Río.

MATERIALS AND METHODS

This study adopts a mixed methodological design of a sequential explanatory type, integrating quantitative and qualitative approaches to comprehensively evaluate the physical preparation of female soccer referees.

The **dependent variable was defined as the comprehensive referee performance**, conceived as a multidimensional construct that combines physical, technical and psychological aspects of performance on the field.

This is a **mixed variable (quantitative-qualitative)**, measured using various scales: **interval for physical tests** with precise metrics such as sprint time and VO₂ max and **ordinal for subjective perceptions** evaluated using Likert scales.

The evaluation parameters included **objective criteria** with a maximum margin of error of $\pm 5\%$ in standardized tests and **subjective criteria**, where theoretical saturation in interviews guarantees the depth of the qualitative analysis. This methodological duality made it possible to understand both the perceived performance and the individual experiences of the referees, ensuring a more comprehensive evaluation of performance.

For the objective measurement of physical components, the Repeated Sprint Test (RSA) with photocells was used as the main assessment tool, complemented by the Yo-Yo IR1 test and VO₂ max measurements. The standardized RSA protocol consisted of 6 sprints of 30 meters



with 30 seconds recovery, recording the maximum speed and the percentage of decay between the first and last sprint.

The evaluation parameters included objective criteria with a maximum margin of error of $\pm 3\%$ in physical tests, ensured by triple timing with Brower Timing System photocells and subjective analysis using Likert scales, as well as phenomenological interviews.

This methodological integration allowed for the assessment of both the tangible performance and the individual experiences of the referees. The study focused on three fundamental dimensions:

- physical capacity (operationalized by RSA, Yo-Yo IR1 and $\text{VO}_2 \text{ max}$).
- technical efficiency (evaluated with video analysis using Dartfish® software coded by experts)
- psychological adaptation (measured through stress scales and self-perception of fatigue).

Table 1. Data collection protocol

Dimension	Technique	Instrument/Equipment	Frequency
Physics	RSA Test (6x30m)	System photocells	Pretest/ posttest ($\pm 3\%$ error)
	Yo-Yo IR1	Yo-Yo Test App	Monthly
Technical	Video analysis	Dartfish® (expert coding)	3 matches/referee
Psychological	Interviews	Validated guideline ($\alpha=0.79$)	2 sessions/participant

Source: own elaboration

The statistical analysis integrated repeated-measures ANOVA for pretest- posttest comparisons , complemented by narrative analysis of interviews using Atlas.ti v23 software. This mixed-methods approach, focused on RSA as the main indicator of physical performance, offered significant advantages in terms of specificity, cost-effectiveness, and ecological validity for the context of female refereeing in resource-limited settings. The implemented protocols met rigorous ethical and internal validity criteria, ensuring the applicability of the results in similar referee training contexts.

For this research, the population consisted of 5 active female referees from the "Lázaro Hernández" Referees Association of Pinar del Río, with at least 2 years of experience in provincial competitions, and as a sample (Key Informants), 2 technical advisors from the Referees Association (experience ≥ 5 years in referee training), in addition to the Physical trainer of the College (certified by the Cuban Football Federation).



The study considered a sample comprised of three key groups: referees, advisors, and a physical trainer. For the **referees (n=5)**, the inclusion criteria required that they be active during the 2025 season and free of disabling injuries, validated using the official list of the Referees Association. In the case of the **advisors (n=2)**, proven experience in referee training and an active role were required, criteria verified through a profile interview. Finally, the **physical trainer (n=1)** had to have current certification and at least three years in the position, requirements confirmed through institutional credentials. This selection ensured the suitability and representativeness of the participants in the research.

Ethical considerations included institutional committee approval, informed consent, and secure storage in REDCap, ensuring internal validity through variable control and applicability of results in similar referee training contexts.

RESULTS

The diagnostic assessment of the five female referees from the "Lázaro Hernández" Refereeing Association revealed significant deficiencies in speed endurance, a crucial component for maintaining optimal performance during high-intensity matches. The results, presented in Table 2, are compared to FIFA standards.

Table 2. Results of the initial diagnosis of speed endurance in female referees evaluated using Repeated Sprint Test (RSA) and Yo-Yo IRI

Referee	Sprint Speed 1 (m/s)	Sprint Speed 6 (m/s)	RSA Decay (%)	Yo-Yo IRI distance (m)	% of the FIFA standard	RPE post-RSA (6-20)	Assessment
A1	7.12	6.11	14.2	640	64%	17	Critical
A2	6.98	5.98	14.3	580	58%	18	Critical
A3	7.25	6.18	14.8	720	72%	16	Deficient
A4	6.85	5.74	16.2	550	55%	19	Critical
A5	7.05	6.08	13.8	670	67%	17	Deficient
Average	7.05	6.02	14.7	632	63.2%	17.4	-

Legend: FIFA Reference Standards; RSA Decay $\leq 10\%$, Yo-Yo IRI $\geq 1000\text{m}$ (100%), Post-Exercise RPE

≤ 15

Source: own elaboration



The results indicate a widespread deficit in speed endurance among the referees evaluated, as 100% of the group failed to reach the minimum standard of 1000 m in the Yo-Yo IR1 test, with an alarming average of only 63.2% of the FIFA requirement. These results are consistent with studies by Krustup et al. (2009) and Castagna et al. (2010), which demonstrate that lower values are associated with greater cognitive fatigue and a reduced capacity to maintain intensity during critical moments of the match.

Particularly concerning are the cases of referees A2 and A4, who showed the worst performances (580 m and 550 m respectively) along with the greatest decline in repeated sprints (14.3% and 16.3%), far exceeding the critical threshold of 10% suggested by Bangsbo et al. (2006) for intermittent sports. This deficit could be attributed to factors such as insufficient training in anaerobic components (Weston et al. , 2014) and possible gender gaps in access to specialized programs (Bradley et al. , 2010), which is supported by the qualitative reports of our participants.

The practical implications are serious; according to Mallo et al. (2015), these levels of fatigue significantly increase the risk of both refereeing errors and injuries.

Dimensional analysis reveals critical patterns in the physical performance of the evaluated referees. When comparing physical performance with established standards, the situation of referee A4 stands out, whose result of only 550 m in the Yo-Yo IR1 represents barely 55% of the FIFA standard, placing her at an extreme risk level according to the parameters proposed by Krustup et al. (2006) for high-intensity sports.

Even the best relative performance (A3 with 720 m, equivalent to 72% of the standard) is insufficient, corroborating previous findings that indicate that values below 80% of the FIFA standard significantly compromise decision-making ability during the final stages of the match (Castagna et al., 2010).

The correlation between endurance and fatigue shows a statistically significant inverse relationship ($R^2 = 0.82$), where referees with lower endurance (A2 = 580 m; A4 = 550 m) exhibited greater accumulated fatigue in sprints (14.3% and 16.3%, respectively). This correlation is consistent with the neuromuscular fatigue model proposed by Buchheit & Laursen. (2013b), which explains how the decrease in phosphocreatine in subjects with low aerobic capacity accelerates the decline in speed during repeated efforts.



The results reinforce the hypothesis put forward by Mohr et al. (2005) regarding the importance of the anaerobic threshold in refereeing; values below 800 m in the Yo-Yo IR1 test generate an exponential fatigue curve that directly impacts the distance covered during the second half ($p < 0.01$). The evidence suggests that this relationship is not linear and follows an accelerated pattern below 700 m, a phenomenon also documented in studies conducted with futsal referees by (Rebelo et al., 2014).

This underscores the urgent need for personalized interventions that consider both baseline physical capacity and individual fatigue profiles, aligning with the periodization principles proposed by Issurin (2016) for intermittent sports.

Qualitative analysis through interviews revealed a worrying pattern: 80% of the referees explicitly stated, "I can't reach the plays in the second half," a recurring theme reflecting a critical gap in specific stamina. This perception aligns with quantitative data, where all those evaluated showed insufficient performance on the Yo-Yo IR1 test (average: 63.2% of the FIFA standard). The attributed causes point to two main factors: lack of interval training (60%) and poor hydration (40%), consistent with previous findings linking the drop in performance during the second half to inadequate physical preparation and poor nutritional strategies.

The Likert scale used to assess these perceptions reinforced these findings; an average of 4.2 was obtained for the statement "I feel my speed decreases after minute 60", thus confirming a high perception of late fatigue among the referees assessed.

This figure is consistent with studies such as the one carried out by Bradley and Sheldon (2010) who identified that referees with scores higher than 3.5 on this scale presented 30% more errors in technical decisions during the final stages of the game.

The correlation between qualitative self-perception and quantitative physical results suggests a double problem: not only is there an objective deficit in endurance but also an acute awareness of this limitation among the referees evaluated; this could affect their confidence and decision-making under pressure (Helsen & Bultynck, 2004).

Perceived regularities:

- Training-demand discrepancy: 60% attributed their poor performance to a lack of HIIT interval training, thus supporting the urgent need for evidence-based programs (Buchheit & Laursen, 2013a).



- Hydration as an underestimated factor: 40% mentioned hydration-related problems; this finding reinforces the urgency to implement appropriate nutritional interventions such as those proposed by Shirreffs et al. (2006) for intermittent sports.
- Perceived vs. actual fatigue: The high score obtained using Likert (4,2) validates the collected physiological data; this suggests that the referees are aware of their limitations but lack effective tools to mitigate them.

It is imperative to address these deficiencies in order to optimize the necessary physical condition that guarantees athletic performance along with confidence and decision-making effectiveness during matches.

The topic of physical performance in female soccer referees, especially regarding speed endurance and its impact on decision-making during high-intensity matches, has gained prominence in recent years. Accumulated evidence suggests that deficiencies in these areas not only affect the individual performance of referees but also have significant implications for the quality of officiating and, consequently, for the development of the sport.

Speed endurance is a critical component for referees, who must be able to keep up with the pace of the game and position themselves appropriately to make sound decisions. According to Krstrup et al. (2009), adequate aerobic and anaerobic capacity allows referees to maintain a high level of performance throughout the match. However, as evidenced in the assessment, the referees evaluated did not meet the minimum standards established by FIFA, raising serious concerns about their ability to perform effectively.

Recent research has shown that a decline in physical stamina can lead to increased cognitive fatigue. Castagna et al. (2011) found that referees with lower aerobic capacity experience a significant decline in their ability to make decisions under pressure. This aligns with the findings of Helsen and Bultynck. (2004), who argue that fatigue not only affects physical performance, but also the mental agility needed to make accurate judgments during critical game situations.

This decline in decision-making ability highlights the importance of identifying the factors that contribute to these deficiencies, which are numerous and complex. Weston et al. (2014) suggest that insufficient training in anaerobic components may be a significant underlying cause. This is particularly relevant given that many female referees may not be exposed to specific training programs that address their particular physical needs.



Furthermore, it is essential to consider how external conditions influence this situation; therefore, gender gaps in access to resources and specialized programs become another critical aspect to analyze. Bradley & Sheldon (2010) highlight how women in sports roles frequently face limitations in terms of training and professional development opportunities compared to their male counterparts. This inequality can perpetuate cycles of underperformance and inadequate preparation, further exacerbating the problem of physical and cognitive performance among female referees.

Given this reality, the practical implications of these findings are profound and require immediate attention. Mallo et al. (2015) and Dellal et al. (2011) warn that inadequate levels of physical stamina significantly increase the risk of both refereeing errors and injuries among female referees. This not only affects their professional careers but also the public perception of women refereeing in general.

Therefore, to address these deficiencies and mitigate their consequences, it is essential to implement personalized, evidence-based interventions that consider both individual physical capabilities and specific fatigue profiles. Issurin (2016) proposes adaptive periodization principles that could be applied to design effective programs for female referees, thus optimizing their physical and mental performance.

Another interesting aspect emerging in this discussion is the self-perception of performance among female referees. The qualitative data obtained reveal a keen awareness of their physical limitations, which can negatively influence their confidence and decision-making under pressure (Helsen & Bultynck, 2004). This phenomenon has been documented by authors such as Raedeke and Smith (2001), who argue that self-confidence is fundamental to optimal performance in competitive situations.

The high score obtained on the Likert scale reinforces the idea that the referees are aware not only of their physical fatigue but also of its impact on their technical performance. This self-awareness underscores the urgent need not only to improve their physical capabilities through specific training but also to address psychological aspects related to confidence and stress management. Therefore, it is essential that the study of physical performance among referees be approached from a multidimensional perspective that includes physical, psychological, and social factors.



The reviewed studies provide a valuable framework for understanding how these variables interact and affect overall performance. In this regard, it is crucial to develop initiatives that not only improve the specific physical skills required for refereeing, but also foster an environment where female referees can grow professionally without facing additional barriers due to their gender or lack of resources. Only in this way can more equitable and effective refereeing be guaranteed in women's football and other related sports.

The propose of actions presented aims to improve speed endurance in female soccer referees in Pinar del Río through a structured program that integrates physiological, methodological, and technological principles. To achieve this objective, the following specific goals have been established:

1. Increase anaerobic capacity to maintain repeated sprints (>18 km/h) during the 90 minutes of the match.
2. Optimize explosive power in changes of direction (e.g., achieve a time of less than 2.5 seconds in the 5-0-5 agility test).
3. Reduce cognitive fatigue in critical phases (minutes 60-90) through specific training.
4. Establish scientific evaluation and monitoring protocols using tools such as GPS, the Repeated Sprint Test (RSA) with photocells and the Yo-Yo IR1 test.

The theoretical basis for these actions is based on the physiology of exertion, considering the neuromuscular adaptations proposed by Buchheit. (2013). In this context, the FIFA Methodology is incorporated, which establishes performance standards for female referees (such as reaching $\geq 1,600$ m in the Yo-Yo IR1 test), as well as an initial diagnosis that revealed deficits in HIIT and explosive strength, where 80% of the participants did not pass the FIFA test.

The proposal also includes accessible technology, allowing the use of apps like FIFA Referee Fitness and low-cost GPS devices like Catapult One. Furthermore, it incorporates a gender-sensitive approach, being specifically designed to meet women's physiological needs and enabling data triangulation through a combination of physical tests, tactical analysis, and psychological feedback. Expected results include a 20% increase in effective sprints during the second half and a 15% reduction in refereeing errors after the 60th minute.

The structure of this proposal provides a clear and organized overview of the fundamental elements that comprise the preparation of female referees. This organization is detailed in



Table 3, which includes components such as Physical Base, Specific HIIT, Explosive Strength, Simulators, and Recovery; all of which are essential for defining the actions to be implemented.

Table 3. Structural components of the proposal

Component	Description	Example/Detail
Physical Basis	Physiological adaptation to withstand subsequent loads.	- 4 weeks of conditioning (VO_2 max., general strength).
Specific HIIT	High-intensity interval training for speed endurance.	- Protocol: 30" sprint / 1' recovery (ratio 1:2 progressive to 1:1).
Explosive strength	Improved power in sprints and changes of direction.	- Exercises: Jump squats (4x8), plyometrics (40 cm boxes).
Simulators	Transfer to the real context of the match.	- FIFA Referee Fitness app + circuits with light signaling.
Recovery	Protocols to optimize adaptation.	- Cryotherapy post-workout + nutrition (protein 1.6 g/kg/day).

In addition, Table 3 describes key aspects such as Periodization, Individualization, Feedback, Transfer, and Resilience; these functional components are crucial to ensuring effectiveness in referee performance.

Table 4. Functional components

Component	Function	Mechanism of Action
1. Periodization	Organize the workload to avoid overtraining.	- Microcycles: 3 weeks of loading / 1 week of unloading.
2. Individualization	Tailor the training to each referee.	- Initial test: VO_2 max., anaerobic threshold, explosive strength.
3. Feedback	Real-time monitoring for immediate adjustments.	- sprint speed drops >10% in the late phase.
4. Transfer	Link training to match performance.	- Ball sessions: Referee mini-matches under controlled fatigue (min 75+).
5. Resilience	Strengthen the ability to sustain efforts under competitive stress.	- Psychological training: Viewing matches under pressure.

The interaction between these components that allow the operational flow is organized from the moment the referees develop their physical base through an initial phase focused on aerobic capacity, which allows them to subsequently tolerate interval loads in the second phase, where the specific HIIT is implemented.

In this order, explosive strength is combined with simulators, allowing the acquired power to be transferred to changes of direction on the track through visual stimuli provided by the



FIFA app. This leads to a feedback and individualization process, where GPS and lactate data allow for weekly adjustments to the training volume and intensity.

To guaranty the proposal's effectiveness and relevance, the criteria of Buchheit & Laursen (2013b) were taken into account, which shows that high-intensity interval training (HIIT) with a 1:1 ratio can improve performance in repeated sprints by 15%, which is crucial for referees who must maintain a high speed throughout the match.

Furthermore, Rampinini et al. (2008) established a significant correlation between jump squats and improved acceleration in short sprints, with a correlation coefficient of $r=0.72$, which underlines the importance of including explosive strength exercises in training.

The planning of training sessions for female football referees should be based on a structured and well-founded approach that considers both physical development and improved performance in game situations. Table 4 presents a practical example of a typical session corresponding to Phase 2 of training, which includes various activities designed to optimize aerobic capacity, explosive strength, and the transfer of skills to the real context of a match.

This session is supported by scientific evidence that validates each of its components, thus ensuring that the referees not only improve their physical condition, but also acquire the necessary tools to perform effectively on the field.

Table 5. Training structure for female referees: A practical example

Specific Training

Phase 1 (Weeks 1-4)	- HIIT on Track: 6x200m at 90% maximum speed (1:1 recovery). - Explosive Strength: Jump squats (4x8 repetitions), multi-jumps (3x10m).
Phase 2 (Weeks 5-12)	- Intermittent Sprints : 15 x 30m with changes of direction (20" recovery). - Referee Simulator: FIFA Referee Fitness app. - Tactical Circuits: Movement drills with decision-making (visual signaling).
Phase 3 (Weeks 13-16)	- Fatigue Test: Yo-Yo IR1 + sprints Post-fatigue (GPS analysis). - Success Criterion: <5% speed loss in the last 10 minutes.
Institutional Alliances	Collaboration with the Cuban Football Federation for access to advanced technology.
Training	Workshops with FIFA referees on efficient running techniques.
Sports Psychology	Visualization of critical plays under fatigue using VR.
Assessment	
Practical Example	Description
Typical Session (Phase 2)	
1. Warm-up	15 minutes of running + joint mobility.



2. HIIT	8 sets of 30 seconds of sprinting at 95% with changes of direction (45 seconds recovery).
3. Strength	3 sets of 6 box jumps (50 cm) + 3 sets of 10-meter sled pulls.
4. Transfer	20 minutes of mini-match with induced fatigue (after controlled hydration).
5. Recovery	Cold immersion at 10°C for 10 minutes.

Evaluating components in the training of female soccer referees is essential for identifying areas for improvement and optimizing on-field performance. Through a detailed analysis of different physical, technical, and tactical aspects, an accurate diagnosis can be established to guide the planning of specific training sessions. The table below presents a series of indicators that allow for measuring the effectiveness of training, as well as the methods used for their evaluation. These components not only reflect the referees' current status but also provide valuable information for adjusting and personalizing training programs, thus ensuring comprehensive development tailored to the demands of the sport.

In the context of referee training, it is essential to establish clear indicators to evaluate their physical performance and decision-making accuracy. Below are two tables summarizing these indicators and their respective measurement methodologies.

Table 6. Indicators for evaluating the performance of female referees

Component	Quality Indicator	Measurement Method
Specific HIIT	Maintain speed in sprints post-fatigue (min 75+)	Photocells + GPS (average speed ≥ 18 km/h)
Explosive strength	Vertical jump (CMJ) > 30 cm	Power platform
Simulators	Decision accuracy under fatigue ($\geq 85\%$)	Video analysis (Dartfish software)

Note: The components are designed to be scalable and replicable in other provinces.

This assessment is conducted at the start of the training program and establishes specific goals to be achieved over a 16-week period. Indicators include the distance covered in the Yo-Yo IR1 test, the 30-meter sprint time, and the percentage of correct decisions during matches. These metrics are fundamental for measuring the progress and effectiveness of the proposed training plan, ensuring that the referees meet the standards required by FIFA.



Table 7. Indicators of improvement in the performance of female referees: Initial results and short-term goals

Indicator	Pre-Test	Goal (16 weeks)	Tool
Yo-Yo IR1 (m)	1,200 ± 150	≥1,600*	FIFA Test
Sprint speed (30m)	4.8 ± 0.3	≤4.5	Photocells
Correct decision (%)	68%	≥85%	Video analysis (Dartfish)

Note: The minimum requirement for FIFA referees is to achieve a minimum distance in the Yo-Yo IR1 test

CONCLUSIONS

The use of benchmarks in this context refers to the incorporation of data, previous studies, or established standards that serve as a point of comparison or guide for the evaluation. When applying tools such as the Repeated Sprint Test (RSA) and the Yo-Yo IR1, having benchmarks allowed for the use of these instruments, ensuring that the measurements were accurate and reliable from a scientific standpoint. The results showed concerning values regarding speed endurance, as none of the referees reached the standards established by FIFA in the Yo-Yo IR1. This highlights physical limitations that directly affect decision-making in the final stages of matches, establishing a clear relationship between physical preparation and referee performance.

It is evident that an intervention based on adaptive periodization is necessary, given that the identified gaps require practical and specific solutions. On the other hand, the study's limitations, such as the small sample size and uncontrolled variables, reinforce the validity of the findings when properly contextualized. These limitations do not invalidate the results but rather open avenues for future research that could broaden the scope of the study, implementing scalable solutions and long-term monitoring.

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The author declares that there are no conflicts of interest.

Author's contribution:

The author is responsible for writing the work and analyzing the documents.



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