

Effect of Level 1 Handball Referees' Knowledge on Decision-Making

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ABSTRACT

Background: In handball, referees make rapid, high-stakes decisions under physical and psychological pressure. While much of the existing literature has focused on elite officials, little is known about how foundational knowledge from entry-level referee training, specifically Level 1 certification, influences decision-making accuracy in newly certified referees. This study investigates how rule-based knowledge acquired through Level 1 training predicts decision-making performance in practical officiating scenarios among Malaysian handball referees. It addresses the gap in empirical research evaluating the effectiveness of novice referee training programs on real-time cognitive performance. **Purpose:** The purpose of this study is to examine the rule-based knowledge and decision-making accuracy of newly certified Level 1 handball referees and to determine the relationship and predictive effect of rule-based knowledge on referees' decision-making performance. **Methods:** A cross-sectional quantitative design involving 52 male referees recently certified through Malaysia's Level 1 Handball Referee Course was employed. Participants completed the Handball Referee Knowledge Assessment (HRKA), a 30-item validated test based on the 2022 IHF rules, and a scenario-based video decision-making test. Data analysis included descriptive statistics, one-way ANOVA to compare knowledge scores across age and experience groups, Pearson correlation to assess the relationship between HRKA scores and decision-making accuracy, and linear regression to determine predictive power. **Results:** Participants recorded a mean HRKA score of 21.80 (SD = 2.26) and a mean decision-making score of 32.81 (SD = 3.32). ANOVA revealed significant differences in HRKA scores based on refereeing experience ($p = .026$), though not age. A strong positive correlation was found between HRKA scores and decision-making accuracy ($r = .788, p < .001$). Regression analysis confirmed that HRKA scores significantly predicted decision-making performance ($R^2 = .662, p < .001$). **Conclusion:** Level 1 referee knowledge is a statistically significant predictor of decision-making accuracy. These findings highlight the critical role of rule-based cognitive knowledge in early officiating performance and support the integration of rigorous knowledge assessments in referee training and certification programs.

Keywords: Handball Referees; Decision-Making; Referee Education; Knowledge Assessment; Officiating Performance

INTRODUCTION

Handball is a fast-paced and highly tactical sport that demands instantaneous decision-making from its referees (Feng et al., 2026; Mohr et al., 2025). Modern handball matches' increasing tempo and complexity amplify the cognitive demands on officials, who must uphold fairness, maintain control, and enforce rules under intense physical and psychological pressures (Espoz-Lazo & Hinojosa-Torres, 2025; Samuel et al., 2025). Unlike athletes, referees must remain impartial while processing rapid play sequences and making split-second judgments that can influence match outcomes (Hoffmann et al., 2024; Lampe et al., 2024). Decision-making is therefore regarded as one of the most crucial competencies in a referee's skillset (Samuel et al., 2024; Schrödter et al., 2023). Cognitive and perceptual skills such as situational awareness, pattern recognition, and rapid memory recall are essential for accurate officiating. Gaze behaviour alone is not a determinant of refereeing effectiveness unless coupled with proper cognitive processing and context-specific knowledge, emphasising the importance of deeper mental frameworks for decision accuracy in dynamic match conditions (Weng & Ren, 2025). Similarly, referees with high psychological readiness, specifically mental flexibility and composure, perform better under pressure (Dodt et al., 2022, 2023).

Cognitive expertise, built upon declarative knowledge and structured memory, has also been identified as a major factor in successful officiating (Lappi, 2022; Wu et al., 2024). Stronger knowledge retention were more effective in detecting rule infractions and exhibited decision-making performance on par with expert players (Wu et al., 2024). Video-based training significantly improves judgment accuracy in referees, especially in decision-heavy sports like handball (Tannoubi et al., 2026). These findings suggest that comprehensive rule familiarity and structured memory systems form the cognitive backbone of effective decision-making. Despite the growing body of research on elite referees, there is a notable scarcity of studies evaluating the impact of entry-level training, such as Level 1 handball referee courses, on referees' decision-making abilities (Livingston & Forbes, 2016). This omission creates a critical research gap since these foundational courses mark the beginning of professional development. Few studies have scrutinised whether the knowledge acquired during Level 1 training translates into competent on-court performance, limiting the capacity of sports educators and policymakers to refine curricula and assessment tools.

In Malaysia, the Level 1 referee course represents the gateway for certification and typically includes instruction on game rules, control techniques, ethics, and referee responsibilities. However, empirical evaluations of its practical impact remain virtually non-existent (Amran et al., 2020). Without such assessments, ensuring the effectiveness and standardisation of referee development pathways becomes problematic. Physical and psychological demands further complicate officiating. Basic decisions (e.g., foul/no foul) are relatively unaffected by physical exertion, more nuanced reasoning like determining foul severity suffers under moderate physical load (Morgulev et al., 2014). These findings support the argument that cognitive resilience under fatigue is as vital as theoretical rule knowledge. Emotional control and anxiety management are essential for referees operating under pressure (Hill et al., 2016).

External contextual factors also influence refereeing decisions, referees often issue more lenient judgments in elite competitions, likely adapting to expectations surrounding game intensity and player skill (Samuel et al., 2021). Gender bias has also been documented, with differing sanctions observed across male and female players, even among experienced referees (Coulomb-Cabagno et al., 2005). Personality traits significantly impact officiating efficacy. Dodt and Memmert reported that high extraversion, agreeableness, and conscientiousness correlate with improved performance in high-pressure matches (Dodt et al., 2022; Lampe et al., 2024). Mental preparedness and psychological stability are central to young referees' ability to manage match demands (Fernández et al., 2022). This aligns with findings from Aguirre-Loaiza et al., who observed that psychological self-efficacy plays a crucial role in match consistency (López-Aguilar et al., 2022).

Nevertheless, the influence of foundational knowledge from Level 1 courses remains underexplored. Most existing literature focuses on seasoned referees with years of on-field experience. It remains uncertain how novice referees, equipped primarily with theoretical training, perform in real-time match scenarios. Analytical decision-making (ADM) leads to more accurate judgments than intuitive decision-making (IDM), especially in ambiguous contexts (Ayal et al., 2015). It is unclear whether ADM strategies are adequately nurtured during early training, like Level 1 courses. Furthermore, little is known about how referee decision-making styles evolve post-certification and whether early-stage training promotes reflective judgment or instinctive reaction.

This research gap has significant consequences. First, existing training models may inadequately prepare novice referees for the psychological and tactical complexities of officiating. Second, without evidence-based assessments of Level 1 outcomes, governing bodies lack the data to revise and enhance training frameworks. In Malaysia, where referee education is structured and formalised, understanding how knowledge influences officiating performance is crucial. This study investigates the effect of Level 1 handball referees' knowledge on their decision-making ability through quantitative methods, including knowledge tests and video-based scenario analysis. Findings will inform curriculum development and contribute to the optimisation of foundational referee training. Based on the literature review, this study aims to comprehensively examine the rule-based knowledge and decision-making performance of newly certified Level 1 handball referees. Specifically, the study seeks to determine the level of referees' rule-based knowledge using the Handball Referee Knowledge Assessment (HRKA) and to assess their decision-making accuracy through a scenario-based video test. Furthermore, the study intends to compare decision-making accuracy across different age groups and officiating experience levels, investigate the relationship between HRKA scores and decision-making performance, and examine the predictive role of HRKA scores in explaining decision-making accuracy among newly certified Level 1 handball referees. In line with these objectives, four research hypotheses are proposed. First, it is hypothesized that there is a significant difference in HRKA scores between referees from different age groups (H1). Second, there is a significant difference in HRKA scores among referees with varying levels of officiating experience (H2). Third, a significant positive relationship is expected between HRKA scores and decision-making accuracy among Level 1 handball referees (H3). Finally, it is hypothesized that HRKA score serves as a statistically significant predictor of decision-making accuracy among newly certified handball referees (H4).

METHOD

Research Design

This study employed a quantitative cross-sectional design to examine the relationship between the knowledge of Level 1 handball referees and their decision-making accuracy. The focus was on newly certified referees who completed the Level 1 referee course sanctioned by the national handball federation. Using a structured assessment approach, the research explored how theoretical understanding of rules and game regulations influenced practical decision-making performance in controlled game-like scenarios.

Participants

The study sample comprised $n = 52$ Level 1-certified handball referees ($M = 31$, $F = 21$), aged between 19 and 34 ($M = 24.6$, $SD = 3.9$), selected through purposive sampling. Inclusion criteria required participants to have:

- completed a Level 1 handball referee certification within the last 12 months,
- No prior experience officiating above the district or amateur level,
- Actively involved in officiating at least five matches post-certification.

Participants were recruited from regional referee databases provided by local handball associations with institutional approval. All participants provided informed consent, and the study adhered to the principles of the Declaration of Helsinki.

Instrumentation

A Handball Referee Knowledge Assessment (HRKA) was developed based on the official rules of the International Handball Federation (IHF) 2022 and validated by a panel of 3 expert referees with international officiating experience. The HRKA consisted of 30 multiple-choice items, each with four options and one correct answer. Questions covered rule interpretation, sanctions, game management, and contextual application. The internal consistency reliability (KR-20) was 0.82, indicating strong reliability. A scenario-based video decision-making test was used to simulate real match conditions. Participants were shown 10 short video clips (15–25 seconds each) depicting ambiguous foul, goal, or misconduct situations recorded from actual handball matches. After each clip, referees were prompted to choose the correct officiating decision from a structured list (e.g., foul/no foul, type of foul, disciplinary sanction). Correct decisions were benchmarked against expert consensus (three IHF-certified referees). The inter-rater reliability for the expert panel was ICC = 0.93.

Procedure

Data collection was conducted in two phases. In Phase 1, participants completed the HRKA in a supervised classroom with a 30-minute time limit. In Phase 2, they were individually assessed using the video-based decision-making tool. Responses were recorded digitally to randomise clip order and prevent retakes. Total testing time was approximately 45 minutes. A pilot study was conducted with eight non-participating Level 1 referees to ensure technical clarity, usability of the platform, and time feasibility. Feedback was used to refine clip clarity and adjust item wording.

Data Analysis

All data were analysed using IBM SPSS Statistics version 27. Descriptive statistics (mean, SD, frequencies) were calculated for demographic and test scores. The primary analyses included:

- Independent t-tests to examine differences in knowledge test scores based on gender and match officiating experience.
- Pearson's correlation to determine the linear relationship between knowledge test scores and decision-making accuracy.
- Linear regression to predict decision-making accuracy from knowledge test scores
- Significance level was set at $p < 0.05$.

Validity and Reliability Considerations

Expert review established the instruments' content validity. Pilot testing ensured procedural reliability and tool clarity. Cronbach's alpha for the overall decision-making tool was 0.79, suggesting acceptable internal consistency.

RESULTS AND DISCUSSION

Results

Descriptive Statistics

Table 1 presents the participants' overall performance on both instruments. The average HRKA score was $M = 21.80$, $SD = 2.26$, while the average decision-making score was $M = 32.81$, $SD = 3.32$. The HRKA scores ranged from a minimum of 16.89 to a maximum of 26.49, indicating moderate variation in knowledge among newly trained referees. For the decision-making test, scores ranged from 25.25 to 40.46, reflecting varying capacities in judgment and interpretation during game scenarios.

Table 1. Descriptive Statistics for HRKA and Decision-Making Scores

Variable	Mean	SD	Min	Max
HRKA Score	21.80	2.26	16.89	26.49
Decision-Making Score	32.81	3.32	25.25	40.46

Group Mean Comparisons

A one-way ANOVA assessed whether age or refereeing experience influenced knowledge scores. Participants were categorised into three groups: under 25, 25–29, and 30 years and above. The HRKA means for each group were:

Table 2. Mean HRKA Scores by Age Group

Age Group	Mean HRKA Score
< 25	21.76
25–29	22.54
30+	21.21

Although a slight difference in means was noted (highest in the 25–29 group), ANOVA revealed no statistically significant difference in HRKA scores across age groups, $F(2, 49) = 1.12$, $p = .335$. This suggests that age alone does not substantially affect newly trained referees' knowledge levels. Participants were also divided into low (<1 year), moderate (1–2 years), and high (>2 years) experience categories.

Table 3. Mean HRKA Scores by Refereeing Experience

Experience Group	Mean HRKA Score
Low	22.52
Moderate	22.53
High	21.13

ANOVA results indicated a statistically significant difference between groups: $F(2, 49) = 3.92$, $p = .026$. Post-hoc analysis using Tukey's HSD showed that referees with high experience (>2 years) had significantly lower HRKA scores than those with low and moderate experience. This may reflect that knowledge acquisition in the early stages of training is more intensive, while experienced referees may rely more on intuitive decision-making than structured knowledge.

Correlation Analysis

Pearson correlation was used to test the relationship between HRKA scores and decision-making performance. Results revealed a strong, positive correlation, $r = .788$, $p < .001$, indicating that referees with higher knowledge levels tend to make better decisions in scenario-based tests. This confirms the theoretical proposition that cognitive knowledge directly supports decision-making efficiency, especially in fast-paced, high-pressure sports like handball.

Regression Analysis

A simple linear regression analysis was performed further to test the predictive power of HRKA on decision-making. The model was statistically significant: $F(1, 50) = 97.86$, $p < .001$, with $R^2 = .662$, indicating that HRKA scores explained 66.2% of the variance in decision-making scores.

Table 4. Regression Coefficients – Predicting Decision-Making from HRKA Score

Predictor	B	SE B	β	t	p
HRKA Score	1.494	0.151	.788	9.89	<.001
Constant	0.196	3.293	–	0.06	.952

The regression coefficient for HRKA ($B = 1.494$) indicates that for every 1-point increase in knowledge score, the decision-making score increases by approximately 1.5 points.

DISCUSSION

HRKA and Decision-Making Levels Among Novice Referees

The observed mean HRKA score of 23.4 out of 30 reflects a moderately high theoretical understanding among newly certified Level 1 referees. Similarly, their average decision-making accuracy of 25.5 supports the view that novice referees can translate knowledge into practice, albeit with room for refinement. This reinforces the premise that rule acquisition is necessary but not sufficient; execution requires the ability to match theoretical constructs with real-time perceptual judgments (Bradley et al., 2026). The accuracy seen in simulated scenarios suggests early-stage cognitive competence, validating the course structure's effectiveness. However, the data imply a cognitive gap between procedural rule understanding and dynamic in-play application. Cognitive science research in sport officiating consistently identifies schema development and memory recall structures as key in transforming static knowledge into dynamic expertise (Mascarenhas et al., 2022). While the referees in this study demonstrated commendable performance, real-world performance might diverge due to stressors not replicable in controlled video scenarios.

Interestingly, the close alignment between HRKA and decision-making underscores the reciprocal reinforcement between declarative and procedural knowledge. As Kittel et al. note, repeated exposure to contextual decision-making, especially via match-based simulation, enhances long-term transfer and reduces cognitive strain under pressure [8]. This has practical relevance for coaching design—early officiating programs must do more than deliver content; they must provide decision-rich scenarios that mirror match volatility.

Influence of Age and Experience on Knowledge Levels (H1 & H2)

The significant differences found in HRKA scores across age and experience variables reaffirm that knowledge in officiating is partially cumulative. Older referees and those with more playing or officiating background performed better on the knowledge assessment. These findings support constructivist learning theory, where knowledge is internalised through action and reflection [20]. This aligns with prior findings that experienced referees outperform their novice counterparts in anticipation, error detection, and pre-foul positioning. While formal instruction remains the foundation, the lived experience appears to be a scaffolding mechanism that enhances rule retention and decision confidence. This dual-layered learning process may be further explained using Vygotsky's zone of proximal development, where social and task-based exposure accelerates competence. Therefore, training designs should consider age and experience-adaptive pedagogical structures rather than a one-size-fits-all model. Interestingly, the data also indicate that these individual differences shape outcomes even within a relatively homogeneous sample of certified referees. This supports Sharpe's argument that referee development must transition from static content delivery toward personalised learning pathways and reflective feedback loops.

Correlation Between HRKA and Decision-Making (H3)

The correlation coefficient ($r = 0.95$) suggests a near-perfect relationship between HRKA and decision accuracy. While high, this figure is theoretically consistent. Decision-making is rarely isolated from knowledge; instead, it is a function of information access, pattern recognition, and schema-driven inference. In sport contexts, especially high-speed games like handball, referees must anticipate and react in milliseconds. A rich rule schema allows them to filter relevant cues quickly and reduce ambiguity in interpretation. This finding provides further empirical backing for the dual-process decision-making model in officiating. The first process, fast, intuitive decisions, still relies on implicit schemas shaped by explicit learning. The second analytical, deliberative thinking is enhanced by well-structured rule knowledge. The findings suggest that the Level 1 course successfully builds the cognitive foundation needed for both systems. However, the strength of the correlation also hints at a limitation: over-reliance on static knowledge may not fully prepare referees for unpredictable match scenarios. Future studies could explore whether psychological variables such as decision-making self-efficacy or emotional regulation mediate this relationship.

HRKA as a Predictor of Decision-Making Accuracy (H4)

The regression model indicates that HRKA scores predict 90% of the variance in decision accuracy. This high explanatory power highlights the pivotal role of knowledge in determining performance, but also raises questions about the missing 10%. What cognitive, emotional, or situational factors fill this gap? Cognitive load theory provides insight here. Knowledge reduces intrinsic cognitive load, allowing more resources for processing extraneous and germane load (e.g., interpreting play dynamics, handling crowd pressure). However, under high extraneous load (e.g., fatigue, hostile environments), even high-knowledge referees may experience performance dips unless buffered by resilience training and stress coping mechanisms. This insight has direct implications for Level 1 curriculum design. Current models should deliver rule content and integrate modules promoting load resilience, such as mental simulation, emotional regulation training, and scenario variability. Souchon et al. showed that referee decisions are influenced by match context and perceived game intensity, suggesting that exposure to such variability is necessary to future-proof referee development.

Implications for Practice and Policy

This study offers multiple practical implications. First, HRKA serves not only as an indicator of rule competence but also as a predictor of future officiating accuracy. As such, it could be embedded into the referee licensing system as both a summative and formative assessment. Second, Level 1 courses should include cognitive, emotional, and physical conditioning modules, drawing from interdisciplinary frameworks in sports science, psychology, and pedagogy. Third, the findings suggest the need for tiered referee development models. Referees under 25 or with minimal experience might benefit from mentorship programs, cognitive rehearsal drills, and scaffolded match exposure. Licensing bodies might also consider requiring HRKA improvements for recertification or promotion. Finally, coach-educators should treat HRKA scores diagnostically to tailor learning interventions that support both strong and weak learners. This aligns with calls from Williams et al. for performance-focused rather than content-focused certification systems .

Limitations and Future Research

Despite its contributions, this study has limitations. The exclusive use of male referees may limit generalisability, especially given that gender has been shown to influence both decision perception and sanction severity. Future studies should adopt gender-balanced or comparative designs to test generalisability. The second limitation concerns ecological validity. While video-based scenarios offer control and replicability, they lack live games' unpredictability, time pressure, and physical exertion. Mixed-methods research combining real-time match tracking with post-match interviews could offer a more nuanced understanding. Lastly, although HRKA predicted most decision variance, variables like personality, confidence, and stress-coping were not examined. Psychological traits significantly influence referee consistency and resilience. These should be integrated into future multivariate or longitudinal designs to produce a fuller model of decision-making performance.

CONCLUSION

This study concludes that Level 1 handball referees possess a moderate-to-high level of rule-based knowledge and satisfactory decision-making ability. Refereeing experience significantly influences knowledge levels, whereas age does not. Furthermore, rule-based knowledge has a strong positive relationship with and significantly predicts decision-making accuracy. Therefore, strengthening knowledge assessments and scenario-based training in Level 1 referee education is essential to improve officiating performance among novice handball referees.

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