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DEFENSIVE SYSTEMS IN HANDBALL: A NARRATIVE REVIEW OF TACTICAL AWARENESS

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ABSTRACT:

This narrative review explores the role of tactical awareness in defensive systems in handball, addressing the literature's emphasis on offense. It synthesizes studies from major databases on defensive formations, perceptual-cognitive processes, and training methods to understand defensive effectiveness holistically. Findings show that success depends not only on structures but on players' perception, anticipation, and response to dynamic situations. Open systems like the 3:2:1 enable proactive pressure and ball recovery but create spatial gaps, while closed systems ensure stability under numerical equality. Tactical awareness, via perception–action coupling, supports real-time decisions and adaptive positioning. Team cognition, through shared mental models, boosts coordination and collective defense. Non-linear pedagogy, including small-sided games, effectively develops these skills. Limitations include inconsistent definitions, absent standardized tools, and reliance on observational designs. Overall, tactical awareness drives defensive performance; integrated training and rigorous research are needed to advance theory and practice.

KEYWORDS: *Handball defense; Tactical awareness; Defensive systems; Perceptual-cognitive skills; Decision-making; Team cognition; Perception–action coupling; Game-based training.*

1. INTRODUCTION:

Defensive systems are a critical, yet understudied, component of handball strategy. Existing literature disproportionately favors offensive aspects, likely due to the inherent complexity in categorizing defensive actions (Salas et al., 2019). Nevertheless, a comprehensive understanding of defensive tactical awareness is crucial for optimal team performance, as defensive phases are integral to regaining possession and impeding opponent progression (Barreira et al., 2021). This review synthesizes existing knowledge on defensive systems in handball, exploring the nuanced interplay between individual player actions and collective tactical responses that contribute to effective spatial protection and opponent containment. This includes the emergent properties of self-organization within defensive units, where individual anticipatory movements and shared interpretations of offensive intentions coalesce into coordinated systemic responses (Espoz-Lazo et al., 2025). Although research in other team sports, such as basketball, has begun leveraging machine learning to analyze defensive strategies and player deviations (Santana et al., 2015), handball match analysis has primarily relied on traditional observational methods to examine technical and tactical aspects (Prieto et al., 2015). Accordingly, this review consolidates the current understanding of defensive tactical awareness in handball, with a focus on how coaches organize and plan the teaching of defensive content—fundamental for developing robust team defenses (Granero et al., 2024). Such pedagogical approaches are vital for transferring learning from theoretical frameworks to specific in-game contexts, thereby integrating individual defensive skills into cohesive team strategies (Espoz-Lazo et al., 2023). Handball's dynamic nature, marked by rapid transitions and high-intensity actions, demands a sophisticated grasp of defensive spatial organization and player-specific roles to counteract diverse offensive formations (Karcher & Buchheit, 2014; Manchado et al., 2020). This entails examining how defensive systems adapt to varying offensive schemes and player movements through continuous adjustments in positioning and communication. For example, the efficacy of a 3:3 defensive system—particularly in youth categories—depends on its ability to adapt to offensive transformations via coordinated individual and group tactical responses (Leonardo & Krahenbühl, 2018). The complexity of these actions is compounded by the continuous co-adaptation required to opponent and teammate movements, akin to dynamic tactical behaviors in other invasion sports (Pizarro et al., 2020). Specifically, analyses of defensive soccer behavior reveal recurring tactical patterns: a first defender applies pressure while teammates concentrate in the same zone to provide cover or close space, facilitating successful ball recovery (Fernandes et al., 2021). This interplay highlights the importance of interpersonal

coordination and shared mental models within defensive units (Fernandes et al., 2021), enabling synchronized movements and anticipatory positioning to counter offensive threats. Accordingly, this narrative review delves into the underlying cognitive processes that facilitate these coordinated defensive actions, exploring how players develop the perceptual-cognitive skills essential for rapid decision-making in dynamic scenarios.

Tactical awareness is the ability to anticipate offensive plays and position effectively—is paramount for successful defensive outcomes (Leonardo & Krahenbühl, 2018). It involves not only individual responsibilities but also comprehension of the collective defensive structure and its responses to offensive stimuli (Vogel & Schack, 2023). This is especially critical in high-speed, dynamic sports like handball, where defenders must exhibit exceptional speed, movement, and coordination to cover rapidly shifting threats (Jamel & Majeed, 2024). Identifying game-specific patterns and initiating appropriate motor responses is thus a key aspect of defensive decision-making (Magnaguagno et al., 2023). Sophisticated cognitive processes—such as attention, spatial perception, and anticipation—allow defenders to interpret contextual information and execute increasingly effective responses (Granero et al., 2024).

Despite the acknowledged importance of defensive tactical awareness, empirical research on handball defenders' decision-making processes—particularly when out of possession—remains limited (Janssen et al., 2023). This gap is striking, given that expert players demonstrate superior decision-making by integrating multiple elements, including game score, opponent and teammate actions, and ball trajectory (Bonnet et al., 2020). Moreover, experts exhibit distinct gaze behaviors, with fewer but longer fixations that enable efficient processing of crucial visual information in handball's dynamic environment (Bonnet et al., 2020; Vater, 2024). These findings underscore the need to investigate how perceptual-cognitive skills interact to drive superior defensive performance (Magnaguagno et al., 2023). Thus, this review examines the perceptual and cognitive abilities underpinning expert defensive performance, including anticipating opponents' intentions and making rapid decisions under time pressure (Magnaguagno & Beck, 2025).

This review systematically synthesizes empirical evidence on defensive tactical awareness in handball, focusing on the perceptual-cognitive skills and decision-making processes of elite defenders (Ashford et al., 2021). It critically evaluates existing methodologies for assessing these skills and identifies gaps warranting future investigation.

2. METHODOLOGY

This narrative review synthesizes existing literature on defensive systems and tactical awareness in handball. Relevant studies were identified through a comprehensive search of prominent academic databases, including PubMed, Scopus, Web of Science, and Google Scholar. Keywords included "handball defense," "tactical awareness handball," "defensive systems handball," "collective defense invasion sports," "decision-making," and "game intelligence."

Inclusion Criteria:

Studies were included if they:

- Involved competitive handball players.
- Addressed defensive tactics or systems, cognition, perception-action coupling, tactical awareness, or decision-making.
- Comprised peer-reviewed articles, reviews, or theoretical papers.
- Given the narrative nature of this review, emphasis was placed on conceptual integration rather than systematic quantification.

Exclusion Criteria:

***Studies* were excluded if they:**

- Were non-English.
- Pertained to irrelevant sports.
- Lacked relevance to defense or tactical awareness.
- Approach to Analysis

In lieu of statistical analysis, the literature was handled through thematic synthesis, conceptual analysis, and interpretive integration to consolidate key themes and insights.

Nature of the Review:

As a narrative review, this work prioritizes interpretive synthesis and conceptual depth to provide a cohesive overview of defensive tactical awareness in handball, underscoring academic rigor and transparency in its scope.

3. RESULTS:

The following sections outline the key thematic findings from the synthesized literature, highlighting the multifaceted aspects of defensive tactical awareness in handball. These encompass perceptual-cognitive skills and visual search strategies that support effective

defensive tactics in dynamic team sports (Alemanno et al., 2025; Triggs et al., 2025), as well as the influence of team mental models and shared knowledge on defensive synchronization and performance (Eldadi & Tenenbaum, 2025). Overall, the reviewed studies reveal three main themes: defensive formations and their effectiveness, cognitive and perceptual mechanisms, and training implications for tactical development.

Defensive Formations and Efficiency:

Open defensive formations excel at creating numerical advantages by limiting attackers' space and time, forcing passes or turnovers farther from the goal. In contrast, closed formations prove more effective in situations of numerical equality, as they keep possession in peripheral areas—though they concede more goals overall. Ultimately, the optimal defensive system depends on contextual factors, team characteristics, and numerical situations; opponent-oriented setups like the 3:2:1 enhance coordination but often leave the flanks exposed.

Cognitive and Perceptual Processes:

Tactical awareness relies on layered cognitive processes that enable players to perceive actions, anticipate moves, and make decisions—skills that are especially pronounced in elite athletes. Key elements include perception-action integration, close marking, timely support defense, and a proactive stance to block intrusions. Elite defenders demonstrate superior pattern recognition through synchronized movement and communication.

Training Implications:

Non-linear pedagogical methods, such as small-sided games, effectively promote defensive behaviors like line-of-progression defense and collective adjustments, outperforming traditional linear drills. Tactical exercises further enhance these skills by emphasizing anticipation and individual marking, which transfer well to competition. For youth players, training should start with basic principles before introducing zonal complexities.

These themes position tactical awareness as pivotal to defensive success, evolving from individual cognition to collective adaptability. This adaptability stems from team cognition, where shared mental models and mutual understanding of roles, positions, and interaction patterns enable implicit coordination under time pressure (Eldadi & Tenenbaum, 2025). Such shared knowledge promotes a proactive defensive posture, allowing players to anticipate offensive plays and respond cohesively (Lex et al., 2015, p. 15). Ultimately, this collective

intelligence helps defenders foresee opponent movements, synchronize actions, and optimize space control while reducing vulnerabilities (Pizarro et al., 2020, p. 8).

4. DISCUSSION:

This narrative review synthesizes evidence on handball defensive systems through the prism of tactical awareness, underscoring its multifaceted role across structural, cognitive, and training domains. The findings reveal that defensive effectiveness extends beyond system choice, hinging on players' perceptual-cognitive skills and team-level organization.

◈ Defensive Systems and Contextual Effectiveness:

No single defensive formation is universally superior; effectiveness varies by context. Open systems like the 3:2:1 disrupt offensive rhythm by compressing attackers' time and space, fostering turnovers and early interceptions. This approach aligns with modern proactive, pressure-based strategies.

Yet these systems create vulnerabilities, especially on the wings, reflecting a trade-off between aggression and coverage. Closed systems, by comparison, provide stability and suit numerical parity by prioritizing compactness. This contrast emphasizes adapting structures dynamically to match conditions, team strengths, and evolving play—challenging static models in favor of situational flexibility.

◈ Cognitive and Perceptual Foundations of Tactical Awareness

A key insight is tactical awareness as a core driver of defensive performance. Elite defenders leverage advanced perceptual-cognitive skills to anticipate actions, detect patterns, and intervene decisively.

This aligns with perception-action coupling, where decisions arise from ongoing environmental-motor interactions. Behaviors like help defense, positioning, and interceptions thus form part of this integrated cycle, rather than isolated events.

Hierarchical cognitive processing further enables experts to handle information efficiently under duress, distinguishing them from novices and highlighting the need for cognitive alongside physical and technical training.

◈ Team Cognition and Collective Defensive Organization

Individual skills alone fall short; team cognition is vital for defensive cohesion. Shared mental models allow implicit coordination, minimizing reliance on verbal cues and enabling swift, unified responses to threats.

This is crucial in intricate systems demanding interdependent roles and movements. Anticipating teammates' actions bolsters unity and proactivity.

However, handball-specific empirical measures of team cognition remain scarce, often drawing from theory or other sports—calling for targeted research.

◈ Training Approaches and Tactical Development

Non-linear, game-based training outperforms linear methods in cultivating tactical awareness. Small-sided games and scenario drills replicate match demands, sharpening decisions and adaptability.

Traditional repetitive drills limit perceptual-cognitive growth, underscoring the need for ecologically valid approaches that blend perception, choice, and action.

For youth, progressive models—starting with fundamentals before zonal tactics—build cognitive foundations, in line with skill acquisition principles.

◈ Critical Evaluation of Existing Literature

Valuable though the literature is, limitations persist. Standardized tactical awareness tools are lacking, causing measurement inconsistencies. Many studies use observational or cross-sectional designs, restricting causal insights.

Vague definitions of terms like "tactical awareness" and "team cognition" hinder cross-study comparisons, urging methodological rigor ahead.

◈ Implications for Practice and Research

In practice, coaches should integrate cognitive, perceptual, and physical training to foster tactical awareness, emphasising communication, anticipation, and flexibility to drive individual and team gains.

Research priorities include:

- Validated assessment tools
- Longitudinal and intervention studies
- Individual-team cognition interplay

- Tech like motion tracking and analytics

In sum, tactical awareness anchors defensive success in handball, linking individual cognition to team dynamics. Systems thrive when players perceive, interpret, and respond fluidly to game flux, a process that demands holistic training and analysis. Future investigations should therefore prioritize developing robust methodologies to quantify the subtle interplay between individual perceptual-cognitive abilities and emergent collective behaviors within dynamic defensive systems.

CONCLUSION:

This narrative review underscores the pivotal role of tactical awareness in determining the efficacy of defensive configurations in handball. The integration of pertinent literature indicates that defensive proficiency transcends mere structural arrangements of formations, depending instead on the interplay between players' individual perceptual-cognitive competencies and team-based synchronization. Although defensive setups such as open and closed systems confer unique tactical benefits, their utility remains contingent upon contextual factors, including match scenarios, player numerics, and team attributes.

A primary revelation from this synthesis is that tactical awareness serves as the mediating process linking defensive architecture to on-field results. Through mechanisms such as anticipation, judgment formation, and perception-action synthesis, athletes can dynamically adjust their spatial alignment and reactions. Furthermore, the cultivation of common mental representations among team members supports synchronized defensive actions, promoting nonverbal interplay and adaptive responses amid competitive pressures.

The results also accentuate the value of ecologically sound training paradigms for advancing tactical awareness. Nonlinear, game-oriented instructional strategies prove especially potent in nurturing judgment, spatial cognition, and collective harmony, whereas conventional linear repetitions often fail to meet the perceptual-cognitive exigencies of contemporary handball defense. A staged developmental pathway holds particular promise for young players, laying essential tactical groundwork before introducing sophisticated systems.

Notwithstanding these insights, the review delineates persistent shortcomings in the scholarly corpus, including the absence of standardised evaluative instruments, definitional ambiguities, and reliance on descriptive methodologies. These deficiencies highlight the imperative for more stringent, prospective, and discipline-tailored inquiries to elucidate the nexus of personal cognition and group defensive processes.

Ultimately, tactical awareness stands as a cornerstone of defensive prowess in handball, forging a connection between solitary proficiency and ensemble execution. Prospective scholarship and coaching methodologies must thus embrace a holistic framework that integrates cognitive, perceptual, and tactical facets with physical and technical conditioning. This orientation promises to bolster defensive potency and advance more versatile and astute defensive frameworks in modern handball.

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