



Multidimensional determinants of decision making in judo: a systematic review

Determinantes multidimensionales de la toma de decisiones en el judo: una revisión sistemática

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Abstract

Introduction: Decision-making in judo is a critical skill, shaped by multiple physiological, contextual, technical, and psychological factors that interact in highly unpredictable and tactically demanding environments.

Objetivo: This systematic review aimed to analyze the main determinants of decision-making in judo, synthesize the methodological designs used, and discuss the associated practical and research implications.

Methodology: The Scopus and Web of Science databases were searched according to PRISMA guidelines, yielding 4 eligible studies.

Results: Evidence shows that decision-making in combat is strongly influenced by variables such as tournament phase, weight category, rapid weight loss, and the opponent's technical style. Lighter athletes exhibit greater technical diversity and faster decision-making, while heavier categories prioritize strength and ground control. Strategies such as pacing and intensity adjustments depending on the competitive moment emerge as central tactical determinants. Rapid weight loss has been shown to compromise executive function, negatively impacting attention and reaction time. Despite advances in observational analyses, there remains a lack of experimental studies integrating neurocognitive and psychophysiological metrics.

Conclusions: The conclusion is that decision-making in judo should be trained in representative contexts that simulate the cognitive, technical, and emotional pressures of real competition, promoting an integrated approach between technical training, physical preparation, and mental regulation.

Keywords

Cognitive factors; combat sports; contextual factors; structural factors; tactical performance.

Resumen

Introducción: La toma de decisiones en judo es una habilidad crucial, determinada por múltiples factores fisiológicos, contextuales, técnicos y psicológicos que interactúan en entornos altamente impredecibles y tácticamente exigentes.

Objetivo: Esta revisión sistemática tuvo como objetivo analizar los principales determinantes de la toma de decisiones en judo, sintetizar los diseños metodológicos utilizados y discutir las implicaciones prácticas y de investigación asociadas.

Metodología: Siguiendo las directrices PRISMA, se consultaron las bases de datos Scopus y Web of Science, identificando 4 estudios elegibles.

Resultados: La evidencia muestra que la toma de decisiones en combate está fuertemente influenciada por variables como la fase del torneo, la categoría de peso, la pérdida rápida de peso y el estilo técnico del oponente. Los atletas de menor peso muestran una mayor diversidad técnica y una toma de decisiones más rápida, mientras que las categorías de mayor peso priorizan la fuerza y el control del terreno. Estrategias como el ajuste del ritmo y la intensidad según el momento competitivo emergen como determinantes tácticos centrales. Se ha demostrado que la pérdida rápida de peso compromete la función ejecutiva, impactando negativamente la atención y el tiempo de reacción. A pesar de los avances en los análisis observacionales, aún faltan estudios experimentales que integren métricas neurocognitivas y psicofisiológicas.

Conclusiones: La conclusión es que la toma de decisiones en judo debe entrenarse en contextos representativos que simulen las presiones cognitivas, técnicas y emocionales de la competición real, promoviendo un enfoque integrado entre el entrenamiento técnico, la preparación física y la regulación mental.

Palabras clave

Deportes de combate; factores cognitivos; factores contextuales; factores estructurales; rendimiento táctico.

Introduction

Decision-making is a cross-cutting skill in high-performance sports, especially critical in opposition and direct confrontation sports such as judo. The uniqueness of this sport lies in the combination of physical, technical, strategic, and cognitive demands in a highly dynamic, uncertain, and opponent-dependent environment, where the opponent's actions constantly influence the athlete's motor choices.

In this context, the ability to make effective and timely decisions represents not only a competitive advantage but also a criterion of sporting excellence. Making the right decision at the right time can determine the difference between victory and defeat, and this skill is influenced by multiple factors that go beyond technical aptitude and physical preparation. Pedro and Durbin (2001) and Pieter and Heijmans (1997) report that elite combat sports competitions require athletes to demonstrate rapid and efficient motor responses, high levels of attention, self-control, consistency, and high power.

Combat situations in judo and other related disciplines confront competitors with consecutive changes in demands and stimuli in extremely short time intervals, centered between 100 and 200 milliseconds (Blumenstein et al., 2005), leading to extreme fluctuations in emotional and mental states during matches. Judokas are required to demonstrate high decision-making and neuromotor proficiency in a context where the movements executed by the competitor vary in difficulty, primarily by performing high-speed throws (300-500 milliseconds) (Blumenstein et al., 2005) with or without rotation, dislocations, chokes, and immobilizations, coordinated with the opponent's actions, without losing balance and spatial awareness.

Judo requires athletes to rapidly process information about body positioning, opponent movement patterns, changes in the rhythm of the fight, and regulatory and temporal constraints. These decisions are often made under conditions of fatigue, competitive stress, and psychological pressure (Anshel and Payne, 2006; Rushall, 2003), making understanding their determinants a priority for coaches, athletes, and researchers.

Some studies (Dopico-Calvo et al., 2024; Fortes et al., 2016; Miarka et al., 2018) have suggested that decision-making in judo does not result from a linear sequence between perception and action, but from a functional relationship between environment, task, and organism, as advocated by Gibson's (1979) direct perception theory and the ecological approach to motor learning (Araújo, Davids, & Passos, 2007). In this framework, the athlete does not simply react to stimuli, but regulates their actions based on the affordances offered by the competitive context, and these opportunities for action (affordances) are modulated by individual, environmental, and task-related constraints (Renshaw et al., 2019).

Among the factors influencing combat decision-making, contextual, physiological, technical-tactical, and cognitive variables stand out. The literature shows that the tournament stage in which the combat takes place influences the athlete's tactical approach, with more conservative decisions observed in the final stages, where risk is minimized and efficiency is prioritized (Miarka et al., 2018). Penalties (shido), in turn, introduce an additional strategic dimension, forcing the athlete to adjust their behavior based on the risk of disqualification or the opponent's point advantage (Balci & Ceylan, 2020; Ceylan & Balci, 2021). Effort management throughout the combat, or pacing strategy, has been studied as a mechanism of tactical regulation, indicating that experienced athletes modulate the intensity of their actions depending on the competitive stage and the opponent's profile (Miarka et al., 2018; Dopico-Calvo et al., 2024).

Another determining factor in judo decision-making is weight category. Studies show that lighter athletes tend to make faster decisions, exhibit greater technical diversity, and rely on close-range and counterattack strategies, while heavier judokas adopt more direct styles based on strength, positional dominance, and ground actions (Soto et al., 2020; Barreto et al., 2022). These differences are often associated with the athletes' morpho-functional profile, mobility level, and the type of technique favoured in each weight category. The athlete's gender has also been identified as an influential factor, with studies indicating greater tactical variability and frequency of technical actions among female athletes, especially in the early stages of tournaments (Miarka et al., 2016; Batista et al., 2022).

Competitive pressure, previous experience, knowledge of the opponent, and emotional management also play a fundamental role in technical-tactical decisions. More experienced judokas tend to

demonstrate greater adaptability and the ability to read the fight, constantly adjusting their strategy in response to their opponent's actions (Agostinho & Franchini, 2021; Dopico-Calvo et al., 2023). Additionally, research has shown that experienced and more successful judokas carried out their technical elements bilaterally and with greater symmetry of execution (Šimenko & Hadžić, 2022). These technical-tactical adaptability is particularly evident in situations where the regulation time of the fight is extended, such as golden score, where the decision to attack or maintain defense can determine the outcome of the fight. In these moments, indicators of fatigue, risk tolerance, and emotional competence become even more relevant, requiring a balance between aggression and control.

From a physiological perspective, rapid weight loss (RWL), a common practice in judo competitions, has been associated with temporary cognitive deficits that compromise reaction time, attention, and decision-making effectiveness (Fortes et al., 2016). These effects are concerning, especially considering that judo requires split-second decisions and high neuromuscular demands. Athletes who do not undergo aggressive weight loss processes tend to perform better in decision-making tasks, suggesting the need to rethink weight management strategies and promote more sustainable and integrated approaches between physiological and cognitive perspectives (Agostinho et al., 2021; Kashiwagura et al., 2021).

The literature has also focused on the most frequent technical-tactical patterns according to the phase of the fight. Temporal analyses reveal that, in the initial stages, athletes tend to test their opponent, adopting lower-risk decisions. In contrast, in the final 30 seconds and in periods of stalemate, the propensity for offensive decisions increases, mainly in response to emotional and temporal stimuli (Dopico-Calvo et al., 2023). These decisions are often based on previously established patterns, revealing the importance of specific training for competitive situations with limited time, score pressure, and simulated opponents. Using methods such as Markov chains has made it possible to identify sequential patterns of actions, revealing the predictability of particular strategies and the importance of tactical anticipation (Miarka et al., 2016; Soto et al., 2020). Markov chains are mathematical models used to describe systems that transition between states probabilistically, where the next state depends solely on the current state and not on the path taken to reach it.

However, despite the growing number of studies on this topic, there is considerable methodological dispersion, with a predominance of observational analyses and a scarcity of experimental studies that directly measure neurocognitive variables. There is also a lack of standardized instruments to accurately assess decision-making capacity in the context of judo, and studies using technologies such as EEG, eye-tracking, or heart rate variability (HRV) to monitor attention, cognitive load, or emotional response are rare. These methodological gaps limit the applicability of the data for training and hinder the clear identification of casual relationships between physiological, cognitive, and behavioral variables (Fortes et al., 2016; Kons et al., 2022).

In practical terms, understanding the determinants of decision-making in judo is essential to designing more effective training strategies that are not limited to technical repetition but also include the simulation of real combat contexts, with tactical variability, temporal constraints, and scenarios of emotional pressure. Situational training, combined with video analysis and real-time feedback, can be a promising avenue for developing decision-making skills. Additionally, integrating exercises that stimulate perception, anticipation, and pattern reading, adjusted for weight category and competitive level, can enhance a more effective transfer to the competitive context. Coach training should also include components on cognition, stress management, and attention and decision-making regulation strategies, aiming for a more holistic and integrated approach.

This systematic review is justified by the growing need to consolidate existing knowledge on decision-making in judo, systematizing the factors that influence it and evaluating the methodological quality of available studies. Given the diversity of approaches and the growing importance attributed to this domain in income and educational contexts, it is pertinent to critically review the recent specific literature on the topic, identifying consistent patterns, gaps, and emerging trends. Furthermore, this review seeks to translate scientific findings into practical implications for training and strategic performance planning in judo, taking into account the specific demands of the sport.

In this sense, the objectives of this study were: (1) to conduct a systematic review of decision-making in judo, filtering indicators such as objectives, methodological designs, and main results; (2) to reflect on



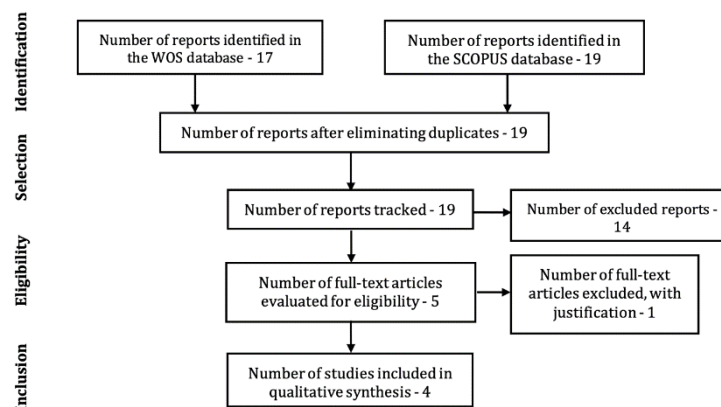
the limitations of existing studies, as well as the practical implications for training and competition, highlighting perspectives for future research; and (3) to identify the determining factors of decision-making in judo according to the current scientific literature.

Method

To ensure the methodological rigour of this study, two experienced researchers in the field of sports sciences were involved, each with more than twenty-five years of professional engagement in judo. The PRISMA methodology (Page et al., 2021) was used to search the Web of Science and Scopus databases for the period of May 2025, introducing the keywords "judo" and "decision-making."

After applying the PRISMA method (Figure 1), 19 articles were selected from the articles listed after filtering for duplication between the Web of Science and Scopus databases. Of these 19 articles, after screening based on title, keywords, and abstract, only 5 met the eligibility criteria. Fourteen articles were excluded because their subject matter and conclusions did not specifically focus on decision-making in judo. Based on full-text analysis of the 5 selected articles, we decided to exclude 1 article. This study focused on the coaches' perspective regarding the importance of the information blocks that constitute the basis of tactical knowledge at different stages of long-term development in modern Olympic combat sports. This study, as it did not directly observe the performance or execution of judokas and the results did not focus exclusively on judo, but rather on a mix of modalities, we chose to eliminate it, with 4 being the number of studies included in the qualitative synthesis.

Figure 1. Flowchart demonstrating the PRISMA methodology for systematic review



Article eligibility was determined based on the Participants, Intervention, Comparison, Outcomes, and Study Design (PICOS) criteria (Higgins et al., 2022) for the title, abstract, keywords, and/or full text of articles, in English or Portuguese, allowing for a systematic and structured approach (Table 1).

Studies involving judo athletes in a combat context, whether in real or simulated situations, were considered. The interventions analyzed included pacing and decision-making strategies during combat, effort-pause relationships, and the effects of frequency and duration of actions on performance, as well as the impact of victory or defeat on competitive decision-making and the effects of rapid weight loss on performance. Comparisons made across studies included variables such as gender, weight categories, bout phases, competition phases, and competitive level.

Table 1. Study eligibility according to the PICOS method

PICOS	Detail
Participants	Judo athletes during combat in real or simulated competition.
Interventions	Analysis of pacing strategies during combat, effort-pause relationship, impact of frequency and duration of actions on performance. Impact of victory and defeat on decision-making in competition. Impact of rapid weight loss on performance.
Comparisons	Comparison between genders, weight categories, combat phases, competition phases and competitive level

The results considered focused on concrete contributions to judo training and competition. Finally, studies with different methodological designs were included, namely, observational, descriptive, double-blind crossover, randomized and non-randomized studies.

Results

Based on the analysis of the articles included in the qualitative synthesis, we present a summary of the main analytical indicators we used for the four articles.

Fortes et al. (2016) designed a quasi-experimental study to analyze the effect of rapid weight loss on decision-making performance in judokas. They used a sample of 39 male judoka competitors randomly divided into two groups (EG=20; CG=19). Forty-eight hours before the start of the experiment and 48 hours after its conclusion, the athletes underwent anthropometric measurements and performed a simulated judo match, which was videotaped. The strategies adopted for rapid weight loss in the EG were structured with the goal of achieving a weekly weight loss of approximately 5%. The instrument used was the Game Performance Assessment Instrument (GPAI) as a criterion to assess the judokas' decision-making performance ($p < 0.01$). A group-by-time interaction effect was identified for body mass, with a reduction observed only in the experimental group. A significant group-by-time interaction was also observed for the GPAI index, with an improvement in decision-making observed only in the control group. RWL negatively affected judokas' reaction time and decision-making effectiveness, with evidence of temporary cognitive impairment.

Miarka et al. (2016) conducted an observational study that aimed to compare decision-making and time-motion analysis in elite Olympic and non-Olympic women's judo matches, based on the competitive outcome (victory versus defeat). They analyzed a sample of 638 matches contested by 98 athletes who qualified for the Olympic Games. Decision-making was analyzed using Markov models, and combat actions were analyzed sequentially according to frequency and time. Losses in non-Olympic competitions showed lower grip frequencies. In the non-Olympic context, losing judokas recorded a significantly lower frequency of attacks in the front and back orientations compared to other groups. Winning decisions by judokas tend to be more versatile and faster, resulting in greater behavioral unpredictability in the Olympic Games.

Miarka et al. (2018), using a mixed-method analysis, aimed to compare the rhythm and decision-making of judokas, reflecting the effort-pause relationships that occur in the various phases (elimination rounds, quarterfinals, semifinals, repechage, third-place match, and final) that are part of a judo championship. They analyzed performances at the Olympic Games and international championships. The sample consisted of 53,403 sequential actions analyzed during 774 elite matches. The analysis of effort-pause relationships included separating matches into approaching, catching, attacking, groundwork, and pause states, according to frequency and time. To analyze decision-making, a multistate Markov model and analysis of variance ($p \leq 0.05$) were applied. The approach time in the qualifying rounds showed differences between the Olympic Games and the finals of international championships. There were also differences in the third-place match in the Olympic Games and the semifinals and third-place match in international competitions. The semifinals of the Olympic Games also differed from the qualifying rounds, quarterfinals, semifinals, repechage, third-place match, and final of international competitions. The pause time showed differences between the semifinals of the Olympic Games and the knockout stage. Current data suggest a focus on pacing strategy throughout the championship stages, which mimic the requirements of judo matches. Judokas' decisions appear to become more conservative in the final stages, demonstrating that pacing and strategy adapt to the context.

The descriptive and comparative study by Soto et al. (2020) aimed to compare the motor action variables of the combat phases of judo and biomechanically evaluate the technique in the seven men's weight categories. The sample consisted of 638 matches covering the motor actions of the combat phases of approach, grappling, attack, defense, and groundwork. They verified the interactions between

actions using Markov models and inferential comparisons ($p \leq 0.05$). The results showed that the lightweight categories presented more frequent approach phases than the heavyweight category, and the lightweight group demonstrated more frequent defensive actions than the middleweight and heavyweight categories. The heavyweight and middleweight categories demonstrated more frequent ground fighting than the lightweight categories, and the heavyweight category presented more frequent pauses than the lightweight category. Regarding the decision-making model, the main transitions presented by the Markov models showed a higher prevalence of the following combinations: gripping before torque and lever attacks, torque attack followed by lever attack, and lever attack occurring before the groundwork phase. The results also revealed that lighter judokas make faster and more varied technical decisions; heavier weights use simpler and more powerful actions.

In Table 2 we present a summary of the main analysis indicators for the four articles. The studies analyzed demonstrate that decision-making in judo results from a complex interaction between physiological, contextual, and structural factors. Three of the four selected studies used Markov chain analysis to map tactical and performance patterns throughout matches, while one used the Game Performance Assessment Instrument (GPAI), focusing on the qualitative assessment of decision-making behavior in a competitive context. This methodological diversity reflects a predominant preference for observational analysis, although it also reveals the lack of controlled experimental approaches and standardized instruments to rigorously measure the cognitive processes involved in decision-making.

Table 2. Summary table of studies regarding objectives, methods, instruments and main results

Study	Objective	Method/Sample	Instruments	Main Results
Fortes et al. (2016)	To assess the effects of rapid body weight loss (RWL) on decision making.	To assess the effects of rapid body weight loss (RWL) on decision making.	Game Performance Assessment Instrument (GPAI).	RWL reduced reaction time and decision-making efficiency; evidence of temporary cognitive impairment.
Miarka et al. (2016)	Comparing tactical decisions in wins vs. losses and between Olympic vs. non-Olympic events (female judokas).	Observational; 638 elite female fights.	Time-motion analysis; technical categorization. Markov models.	Winning decisions are more versatile and faster; greater unpredictability at the Olympic Games.
Miarka et al. (2018)	Compare "pacing" and decision-making strategies at different competitive stages.	Mixed analysis (quantitative and qualitative); 774 elite fights (53,403 actions) male and female.	Time-motion analysis; tactical categorization of actions; Markov models.	Decisions become more conservative in the later stages; pacing and strategy adjust to the context.
Soto et al. (2020)	Relate decisions to biomechanical techniques in different weight categories in male judo.	Descriptive-comparative; 638 male fights (various categories).	Time-motion analysis; biomechanical classification of techniques. Markov models.	Lighter judokas make faster and more varied technical decisions; heavier weights use simpler and more powerful actions.

Structural factors emerge as key determinants in how judoka make decisions during combat (Table 3). Evidence shows that the morphofunctional profile—particularly the weight category—directly shapes decisional strategies. Lighter-weight athletes tend to employ more approach actions, greater technical diversity, and faster transitions, whereas heavier categories display more conservative patterns, with a higher incidence of groundwork actions and more direct, strength-based decision-making. These findings are consistent with those reported in the initial studies, reinforcing the importance of tailoring training models to the structural and biomechanical characteristics of the athletes.

Another recurrent theme in the analysed literature is the importance of identifying technical-tactical combat patterns. The analysis of action sequences, particularly through Markov chain modelling, reveals regularities in the progression of techniques. For example, athletes in lighter weight categories tend to prioritise more dynamic approach and throwing phases, while heavier athletes display a higher frequency of ne-waza actions, characterised by a longer and more systematic gripping phase prior to attack execution. These observations underscore the need to adapt training models to the morphofunctional characteristics and specific tactical profiles of each category.

The effort-pause relationship, closely linked to pacing strategy, emerges as one of the most relevant tactical aspects, with clear evidence that athletes adjust their behaviour according to the stage of the



competition. In championship finals, particularly in Olympic settings, more conservative patterns are observed, with marked changes in the effort–pause ratio and greater economy of action. Although adaptive, this strategic adjustment warrants further investigation integrating physiological and neurological indicators to assess the cognitive and metabolic implications of such adaptations.

Particular emphasis is placed on the study focusing on female judoka, which compared won and lost matches. The results indicate that the frequency and duration of decisive actions, as well as their variability, are associated with competitive success. Winning bouts are characterised by greater technical diversity, faster decision-making, and more effective mastery of transitions—features indicative of a more proactive and efficient decisional profile.

From contextual factors, the data show that the stage of the tournament directly influences decision-making patterns. In preliminary rounds, more open and offensive actions are observed, whereas in final phases, more cautious and risk-managed strategies emerge. Decisions become more conservative and action economy assumes greater relevance—highlighting the need for training to incorporate realistic simulations of different competitive stages to enhance tactical transfer.

From a physiological standpoint, the adverse influence of rapid weight loss (RWL) on cognitive factors, particularly decision-making quality, stands out. Judoka subjected to intensive dehydration and energy restriction protocols demonstrated increased reaction times and reduced effectiveness in responding to tactical stimuli. In contrast, athletes who maintained stable body weight showed superior cognitive performance, suggesting that traditional rapid weight-cutting strategies should be critically reconsidered due to their implications for executive function and, consequently, athletic performance.

Table 3. Qualitative synthesis of factors influencing decision-making in judo

Category	Description/Evidence	Related Studies	Practical Implications
Structural Factors	The athlete's morphofunctional profile (weight category) influences their decision-making strategy: - Lightweight: more approach and technical diversity - Heavyweight: more actions on the ground, direct and powerful decisions.	Soto et al. (2020),	Personalize technical and tactical training according to the athlete's category and profile.
Technical-Tactical Patterns	Markov chains identify predictable patterns in action sequences. The grasping phases are crucial before attacks.	Miarka et al. (2016)	Using video analytics to map patterns of success and adapt them to training.
Effort–Pause Relationship	High-level competition demands pacing adjustments. In Olympic contexts, pauses and actions become more strategic.	Miarka et al. (2018)	Control the volume and intensity of training according to the competition phase to be simulated.
Contextual Factors	Decision-making varies depending on the stage of the tournament (preliminar vs. finals). Strategies become more conservative in the final stages.	Miarka et al. (2018),	Simulate specific competitive contexts in training (e.g., finals) to improve tactical transfer.
Cognitive Factors	Executive function is affected by rapid weight loss (RWL), reducing reaction time and decisional effectiveness.	Fortes et al. (2016)	Avoid aggressive weight loss practices; integrate nutritional and psychological monitoring.
Methodological Limitations	Predominance of observational analyses; few experimental or neurocognitive studies; lack of standardization of assessment instruments.	All studies analyzed	Develop integrative methodologies (neuroscience + tactical analysis + physiology); apply technologies such as EEG, HRV.

In summary, according to Table 3, the results converge in identifying three determinants of decision-making in judo: structural factors, namely, weight category and the athlete's technical profile; contextual

factors, such as tournament stage and level of challenge; and physiological factors, with emphasis on the impact of rapid weight loss on cognitive factors. Current research, however, remains, limited by a predominance of observational methodologies and the lack of controlled experimental studies that comprehensively explore the neurocognitive mechanisms underlying real-time decision-making. This methodological deficit poses a significant challenge for future research in judo science.

Discussion

The present systematic review aimed to (1) conduct a comprehensive analysis of decision-making in judo, filtering key indicators such as study objectives, methodological designs, and main findings; (2) reflect on the limitations of existing studies, as well as the practical implications for training and competition, while highlighting perspectives for future research; and (3) identify the determinants of decision-making in judo according to the current scientific literature.

The results revealed that decision-making in judo is a complex and multifactorial skill, influenced by cognitive, contextual, structural, technical-tactical, and physiological factors, emerging from a dynamic interaction between the athlete, the opponent, and the situational demands of the combat. The synthesis of the four included studies shows that rapid weight loss compromises cognitive performance, that match pace varies across competitive phases, that morpho-functional profile shapes decisional strategy, and that predictable tactical patterns exist within sequences of actions.

Structural Factors, rather than the morphological profile, reveal a direct influence on decision-making style. Soto et al. (2020) indicate that lighter judokas tend to act more creatively and adaptively, while heavier judokas rely on more direct and conservative actions. This pattern is complemented by the results of Batista et al. (2022) and Ceylan and Balci (2021), who report differences between genders and weight categories in the duration of matches and the type of penalties incurred, which impacts the nature of decisions made. In general, lighter weight and women's divisions show greater tactical diversity, while heavyweights reveal a more linear style, sometimes less affected by the negative effects of weight loss.

Differences in decision-making between weight classes are also relevant. Soto et al. (2020) observed that lighter judokas more frequently resort to strategies based on quick approaches and defensive actions, while athletes in heavier weight categories favor ground combat, with longer pauses and more direct and objective actions. This tactical distinction between morphological profiles requires specific training, adapted to reading patterns and anticipating behaviors typical of their weight category, as previously pointed out by Franchini and Sterkowicz (2000) and more recently corroborated by Kashiwagura et al. (2021). The tactical variation based on the athlete's profile reinforces the idea that decision-making should be trained in a context-specific manner, considering the specific demands of each category.

The literature analyzed confirms that the transition between combat phases, while partially predictable, exhibits significant variations in duration, frequency, and efficiency of actions depending on the competitive context, as demonstrated by the studies of Miarka et al. (2016, 2018) and Soto et al. (2020). These authors show that judokas tend to adjust their pace and combat strategy according to the tournament phase, with tactical decisions being faster and more objective in the final phases. This confirms the conclusions of Batista et al. (2022), revealing a prevalence of biomechanically more effective techniques aimed at direct scoring in decisive moments of international tournaments.

In turn, the physiological component, especially rapid weight loss, negatively influences decision-making. The study by Fortes et al. (2016) identified significant impairment in metacognitive functions, such as attention and anticipation, in judokas undergoing aggressive weight-loss processes. This physiological condition is particularly relevant when associated with the need for quick and effective decisions in matches, especially considering the data from Barreto et al. (2022), who document a progressive reduction in match duration throughout the Olympic cycles, reinforcing the demand for resilience and quick decision-making. Additionally, Agostinho and Franchini (2021) showed that more successful judokas exhibit greater technical variability and tactical flexibility, suggesting that action diversity is a key indicator of decision-making performance in high-pressure scenarios.

Another crucial aspect of decision-making is the influence of penalties (shido) during combat. Studies such as those by Balci and Ceylan (2020) and Ceylan and Balci (2021) show that these penalties can significantly alter the dynamics of combat, influencing the pace, strategy, and even the final outcome. This impact is also highlighted by Dopico-Calvo et al. (2023), who point out that many fights are not resolved by technical scoring, but by accumulated penalties. Therefore, strategic time and scoring management, as well as risk and pause control, must be understood as integral parts of the decision-making process. Also in this area, Dopico-Calvo et al. (2024) reinforce the importance of training athletes in situations that simulate real-world contexts of time pressure, such as imminent penalties or golden score combat, to develop skills related to the right moment to attack, retreat, or manage effort.

The evolution of competitive judo in recent decades has also directly affected the cognitive and technical demands placed on athletes. The work of Batista et al. (2025) and Batista et al. (2024) demonstrate a transformation in predominant actions, with greater use of sacrifice techniques and rapid throws. These changes, combined with regulatory changes such as the elimination of yuko and the reduction of combat time (Kons et al., 2022), increase the need for more effective decisions and a smaller margin of error, requiring greater technical precision and tactical robustness from athletes. However, it is also important to consider the impact of rule changes in effect since the beginning of 2025, which introduced opportunities for technical actions that had previously been penalized, as well as the return of yuko as a means of scoring an advantage over ground immobilization time (ne-waza).

The relationship between rapid weight loss and decision-making deficits was further supported by data from Fortes et al. (2016), who found that dehydration and caloric restriction are associated with significant deficits in attention and reaction time. This evidence is paralleled by studies by Balci and Ceylan (2020), who demonstrate that penalized athletes tend to have longer and more adverse matches, often due to hasty decisions or hesitations caused by reduced cognitive clarity. These results support the importance of a more careful and controlled approach to weight loss, promoting safer practices that do not compromise cognitive performance.

In line with Miarka et al. (2018), the results suggest that the pace of matches adjusts throughout the competition, influencing decisions in real time. This idea is reinforced by recent data from Batista et al. (2025), which indicate variations in match length and penalty types between tournament phases, with increasing use of the golden score in the final phases (Kons et al., 2024). These data imply the need for strategies tailored to the remaining time and competitive pressure, requiring athletes to accurately read the combat moment tactically. Technical diversity, especially in grips and transitions, clearly distinguishes top athletes, as demonstrated by Agostinho and Franchini (2021), underscoring the importance of training tactical variability and adaptability in real-world contexts.

Competitive pressure in the final stages significantly influences athletes' tactical behavior. Recent studies show that successful judokas are able to maintain high technical variability even under pressure, alternating between grips, attacks, and transitions (Barreto et al., 2022; Ceylan & Balci, 2021; Dopico-Calvo et al., 2024). This evidence suggests that pacing is not only a physical effort management strategy, but also a tactical-cognitive skill. Less successful athletes tend to repeat techniques and demonstrate less adaptability, suggesting limitations in reading the fight or tactical processing under pressure.

Despite the richness of data and the diversity of competitive contexts analyzed, it is important to acknowledge some limitations in the studies included in this review. Most of the studies analyzed predominantly used observational methods and video-based performance analysis, as evidenced by Miarka et al. (2016), Soto et al. (2020) and Ceylan and Balci (2021), lacking experimental approaches or direct measurements of cognitive and physiological processes. This methodological imbalance limits understanding of the mechanisms underlying decision-making, especially in high-pressure competitive contexts. Furthermore, studies focus primarily on elite athletes, which limits the generalizability of results to other populations, such as aspiring or intermediate-level athletes (Batista et al., 2022; Dopico-Calvo et al., 2023).

From a practical perspective, the analyzed data suggest that decision-making in judo should be trained in representative environments that simulate cognitive, emotional, and tactical demands similar to those of real competition (Agostinho & Franchini, 2021; Kons et al., 2022), surpassing traditional training methods based on technical repetition. Situational training strategies based on constraint manipulation, video analysis with tactical feedback, and time-pressured tasks can promote faster, more varied,



and more effective responses (Franchini & Sterkowicz, 2000; Barreto et al., 2022), fostering not only motor execution but also tactical reasoning, anticipation, and cognitive flexibility—essential skills for success in high-performance sports.

Furthermore, evidence on the negative impact of rapid weight loss (Fortes et al., 2016) points to the need for integrated weight control monitoring to mitigate the negative effects on attention, anticipation, and reaction time. Also, the recent guidelines-position stand developed for combat sports might help to minimize the negative impact of rapid weight loss (Ricci et al., 2025). Especially among youth judokas engaging in rapid weight loss (RWL) prior to competition, coaches may focus on technical-tactical training to enhance decision-making strategies. However, acute weight cuts—commonly losing $\geq 3\text{--}5\%$ of body mass within days—have been shown to impair perceptual-motor skills, decision-making ability, and cognitive functions, which can degrade performance and raise injury risk (Morales et al., 2018; Fortes et al. 2016; Pocecco et al. 2024).

Regarding future research prospects, we recommend expanding methodological designs, integrating experimental approaches with neurocognitive and psychophysiological monitoring tools. Measures such as electroencephalography (EEG), heart rate variability (HRV), eye tracking, and hormonal biomarkers (such as cortisol) can provide valuable insights into mental states and stress reactivity (Fortes et al., 2016; Kons et al., 2024), or even, integrating the measurement of mental fatigue indices or the introduction of tracking systems. Future research should also explore the impact of gender, age, athletic maturation, and psychological profile on combat decision-making, given that significant differences have been observed between weight categories and sex (Soto et al., 2020; Ceylan & Balci, 2021). Finally, it will be important to develop and evaluate cognitive-tactical training programs specifically designed for different categories and competitive levels, testing their effectiveness in controlled longitudinal studies (Batista et al., 2024; Dopico-Calvo et al., 2024).

Conclusions

Based on the systematic review, it is possible to clearly and substantiate the conclusion that decision-making in judo is a complex skill, influenced by a multitude of dynamically interacting factors. In response to the first objective of this research, different methodological approaches were identified—with a predominance of observational studies and analyses of technical-tactical performance—which allowed for the extraction of consistent indicators related to combat patterns, technical variability, penalties, competitive context, and the influence of body weight. Despite this, the scarcity of studies with experimental designs and the near absence of neurocognitive or psychophysiological metrics were evident, representing a significant limitation in the in-depth understanding of the phenomenon.

The second objective has significant practical implications for training and competition. The data indicate that decision-making should be trained contextually under conditions of temporal and tactical pressure, promoting technical variability and adaptability. Furthermore, weight management practices should be reviewed, given the negative impact of rapid weight loss on decision-making ability. Strategic management of pacing and combat time, especially in final stages and golden score situations, emerges as a critical skill to be integrated into training.

Regarding the third objective, it was possible to identify several factors that determine decision-making in judo, including: tournament phase, morphological profile and weight category, experience level, type of penalties, cognitive demands imposed by the opponent, and pacing strategies. Decision-making is not simply an isolated cognitive function, but a skill integrated into the technical-tactical system, dependent on situational experience, contextual demands, and the athlete's physical and psychological condition.

In summary, this review highlights the need for a multidimensional and ecological approach to research and training in decision-making in judo, integrating the technical, cognitive, physiological, and strategic domains with greater methodological rigor and practical applicability.

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