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From cumulative points to the 'Best of Three' system: a comprehensive analysis of World Taekwondo rule changes and their performance implications

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ORIGINAL PAPER

Abstract

Taekwondo competition rules underwent profound transformations between 2012 and 2026, driven by the need for transparency and to increase spectator appeal. This study analyzed the regulatory evolution of taekwondo and its impact on match dynamics and performance. To this end, we reviewed official World Taekwondo documents and scientific literature to synthesize changes in scoring, technology, and combat structure. The main results indicated that evolution was marked by the progressive implementation of the Protector Scoring System (PSS), expanding from torso-only in 2012 to head and sock sensors in 2017. The 2022 reform introduced the "Best of Three" system, resetting scores every round and capping at five *gam-jeom* (penalties) per round. By 2026, updates integrated sensing gloves for punches and a 60 cm "Warning Area" for spatial awareness. Scoring reforms increased the value of complex techniques, such as raising turning head kicks to six points (2026). Penalty frameworks transitioned from a 10-penalty disqualification limit (2017) to a 5-penalty round-loss threshold (2022). Structural changes included the transition to octagonal arenas and streamlining Instant Video Review by removing head-kick reviews when the PSS is used (2026). Scientific literature indicate that these regulatory shifts have increased combat intensity, with studies reporting a rise in post-combat lactate levels and higher kinematic demands, forcing athletes to adopt more offensive technical-tactical strategies. In conclusion, the regulatory trajectory has modernized taekwondo into a more dynamic, technologically driven, and physically demanding sport. The shift to independent round scoring and 2026 updates prioritizes explosive performance and spectator clarity, requiring training protocols to adapt to the increased anaerobic and strategic demands.

Keywords: Martial arts; combat sports; taekwondo; competition; performance indicators; physiological demands; technical-tactical analysis; Protector Scoring System.

De los puntos acumulativos al sistema 'al mejor de tres': un análisis integral de los cambios en las reglas de World Taekwondo y sus implicaciones en el rendimiento

Dos pontos acumulativos ao sistema 'melhor de três': uma análise abrangente das mudanças nas regras da World Taekwondo e suas implicações no desempenho

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Resumen

Entre 2012 y 2026, las reglas de competición del taekwondo experimentaron profundas transformaciones, impulsadas por la necesidad de tener una mayor transparencia y aumentar el atractivo para los espectadores. Este estudio analiza la evolución normativa del taekwondo y su impacto en la dinámica de los combates y en el rendimiento. Para ello, se revisaron documentos oficiales de la World Taekwondo y literatura científica para sintetizar los cambios en el sistema de puntuación, la tecnología utilizada y la estructura de los combates. Los principales resultados muestran que esta evolución estuvo marcada por la implementación progresiva del Sistema Electrónico de Puntuación (*Protector Scoring System* – PSS), que pasó del uso exclusivo en el peto en 2012 a la incorporación de sensores en el casco y en los calcetines en 2017. La reforma de 2022 introdujo el sistema "al mejor de tres", reiniciando la puntuación en cada asalto y con un límite de cinco *gam-jeom* (penalizaciones) por asalto. En 2026 se incorporaron guantes con sensores para los golpes de puño y una "Zona de Advertencia" de 60 cm para el control espacial. Las reformas del sistema de puntuación aumentaron el valor de técnicas complejas, como la patada giratoria a la cabeza, que pasó a puntuar seis puntos en 2026. El sistema de penalizaciones evolucionó desde un límite de diez para la descalificación (2017) hasta la pérdida automática del asalto al alcanzar cinco penalizaciones (2022). Los cambios estructurales fueron la adopción de áreas octogonales y la simplificación del la Repetición Inmediata de Video, eliminando la revisión de patadas a la cabeza cuando se utiliza el PSS (2026). La literatura científica indica que estos cambios incrementaron la intensidad de los combates, con estudios que reportan mayores niveles de lactato postcombate y mayores exigencias cinemáticas, obligando a los atletas a adoptar estrategias técnico-tácticas más ofensivas. En conclusión, la evolución normativa ha modernizado el taekwondo, convirtiéndolo en un deporte más dinámico, tecnológicamente avanzado y físicamente exigente. La adopción de la puntuación independiente por asalto y las actualizaciones de 2026 priorizan el rendimiento explosivo y la claridad para el público, lo que exige que los protocolos de entrenamiento se adapten a las mayores demandas anaeróbicas y estratégicas.

Palabras clave: Artes marciales; deportes de combate; taekwondo; competición; indicadores de rendimiento; exigencias fisiológicas; análisis técnico-táctico; Sistema Electrónico de Puntuación.

Resumo

As regras de competição do taekwondo passaram por profundas transformações entre 2012 e 2026, impulsionadas pela necessidade de maior transparência e de aumentar o apelo para os espectadores. Este estudo analisou a evolução regulatória do taekwondo e seu impacto na dinâmica das lutas e no desempenho. Os documentos oficiais da World Taekwondo e a literatura científica foram revisados, com o objetivo de sintetizar as mudanças nos sistemas de pontuação, nas tecnologias utilizadas e na estrutura dos combates. Os principais resultados indicaram que essa evolução foi marcada pela implementação progressiva do Sistema Eletrônico de Pontuação (*Protector Scoring System* – PSS), que se expandiu do uso exclusivo no protetor de tronco em 2012 para a inclusão de sensores no capacete e nas meias em 2017. A reforma de 2022 introduziu o sistema "melhor de três", com reinicialização da pontuação a cada round e limite de cinco *gam-jeom* (penalidades) por round. Em 2026, novas atualizações incorporaram luvas com sensores para os socos e uma "Área de Advertência" de 60 cm para controle espacial. As reformas no sistema de pontuação aumentaram o valor de técnicas complexas, como o chute giratório na cabeça, que passou a valer seis pontos em 2026. O sistema de penalidades evoluiu de um limite de 10 penalidades para desclassificação (2017) para a perda automática do round ao atingir cinco penalidades (2022). Mudanças estruturais incluíram a adoção de áreas octogonais e a simplificação da Revisão Imediata de Video, com a retirada da revisão de chutes na cabeça quando o PSS é utilizado (2026). A análise da literatura científica indica que essas alterações regulatórias aumentaram a intensidade dos combates, com estudos relatando elevação dos níveis de lactato pós-luta e maiores exigências cinemáticas, obrigando os atletas a adotarem estratégias técnico-táticas mais ofensivas. Conclui-se que a trajetória regulatória modernizou o taekwondo, tornando-o um esporte mais dinâmico, tecnologicamente avançado e fisicamente exigente. A adoção da pontuação independente por round e as atualizações de 2026 priorizam o desempenho explosivo e a clareza para o público, exigindo que os protocolos de treinamento sejam adaptados às maiores demandas anaeróbias e estratégicas.

Palavras-chave: Artes marciais; desportos de combate; taekwondo; competição; indicadores de desempenho; exigências fisiológicas; análise técnico-tática; Sistema Eletrônico de Pontuação.

1. Introduction

Originating from Japanese karate and officially named in 1955, taekwondo consolidated in the second half of the 20th century as one of the most practiced martial arts worldwide, distinguished by its emphasis on fast and technical kicking (Moenig & Kim, 2016). Its international recognition culminated in its inclusion as a demonstration sport at the 1988 Seoul Olympics and later as an official Olympic event starting in Sydney 2000 (Choi et al., 2024; Pshenichnikov & Mitova, 2025). Since then, taekwondo has undergone continuous adaptations to meet the demands of high-performance sports, regulatory fairness, and technological evolution. The introduction of electronic scoring systems, such as the Protector Scoring System (PSS), marked a turning point by replacing subjective judging with automated hit detection, thereby enhancing scoring accuracy and transparency (Choi et al., 2021; Park & Yang, 2019). These regulatory changes, progressively implemented since 2012, have improved athlete safety and influenced technical-tactical strategies, leading to increased diversity and speed in the kicking techniques used during competition (Huang & Tasnaina, 2024; Márquez et al., 2022).

Studies have shown that different PSS models affect athletes' technical and tactical behaviors, highlighting the need for ongoing adaptation of scoring technology to maintain fairness and effectiveness in competition (Márquez et al., 2022; Pshenichnikov & Mitova, 2025). Despite the importance of these updates, the rapid and frequent nature of regulatory changes often results in a fragmented understanding of the sport's evolution. There is a lack of consolidated literature that systematically maps these transitions from a longitudinal perspective, especially considering the most recent shifts toward the 'Best of Three' system and the upcoming 2026 technological updates. Therefore, a comprehensive documentation of these changes is essential not only for historical record but also to provide coaches and researchers with a clear framework for understanding current performance demands and future trends.

The World Taekwondo Federation (WTF) has implemented successive revisions to its competition rules over the past 20 years, including adjustments to match duration, refinement of scoring criteria with increased value for more complex techniques, changes to the competition area, and the introduction of the PSS (Moenig, 2017; Shin, 2015). In parallel, the federation itself evolved institutionally, including a formal name change in 2017 from WTF to World Taekwondo (WT), which has created some terminological issues in the academic and technical literature (Pshenichnikov & Mitova, 2025). The rules changes aimed to enhance decision transparency, ensure regulatory fairness among athletes, standardize technical procedures, and raise safety standards, thereby strengthening the sport's global credibility (Jeong et al., 2023; Mikhalskyi et al., 2025; Moenig, 2015).

The PSS was introduced primarily to reduce subjectivity in refereeing by using standardized electronic criteria for valid-impact detection. This technological innovation was part of broader reforms designed to make matches more dynamic and appealing to television audiences by automating real-time scoring through sensors embedded in protective gear, reducing interruptions, and improving visual clarity during broadcasts (Márquez et al., 2022; Mikhalskyi et al., 2025; Moenig, 2015). However, the rapid transition from a traditional martial art to a highly regulated Olympic combat sport has not been without controversy (Mikhalskyi et al., 2025; Moenig, 2017). Many practitioners and leaders argue that the reliance on electronic sensors has 'de-martialized' the sport, leading to the emergence of 'foot fencing', a style that prioritizes light, rapid touches over the powerful, decisive strikes characteristic of traditional taekwondo (Moenig, 2017). This tension between technological modernization and the preservation of martial essence represents a fundamental challenge for the sport's future (Márquez et al., 2022; Moenig, 2017).

Additionally, the introduction of Instant Video Replay in 2017 provided a rapid review mechanism for controversial actions, allowing the correction of potential PSS errors and further increasing transparency in officiating decisions (Jeong et al., 2023; Jeong et al., 2025). Research shows that these rule changes have influenced athletes' technical-tactical behaviors and increased exercise intensity during competition, while also contributing to a reduction in severe injuries and enhancing athlete safety (Janowski et al., 2020; Janowski et al., 2019; Jeong et al., 2025). However, some unintended consequences have emerged, indicating the need for ongoing assessment and refinement of rules and equipment to balance sports integrity with entertainment value (Mikhalskyi et al., 2025; Moenig, 2015; Shin et al., 2024).

Regulatory changes in taekwondo have a direct practical impact on training periodization, requiring continuous adaptation in physical and tactical preparations (Laurin, 2024). Chronological analyses of effective combat time, scoring patterns, and penalty frequency, such as the 35% increase in *gam-jeom* penalties after 2017, are essential for adjusting metabolic models and redefining stimulus intensities according to new effort-pause densities in competition formats (Janowski et al., 2020). These changes also demand the development of specific skills aligned with revalued techniques, such as the prioritization of spinning kicks now worth five points and the restructuring of competitive strategies (Janowski et al., 2019; Mikhalskyi et al., 2025). Research has highlighted that rule modifications since 2012 have increased exercise intensity and physiological demands during matches, necessitating tailored high-intensity training and recovery protocols to meet these elevated requirements (Janowski et al., 2020; Janowski et al., 2019). Coaches reported significant tactical shifts influenced by computerized scoring systems and mandatory kick scoring, emphasizing psychological resilience, integrated training, and technical skills as key factors for success under evolving rules (Mikhalskyi et al., 2025). Frequent rule revisions underscore the need to preserve

historical knowledge while providing organized data to help coaches and researchers adapt training methodologies, reassess performance indicators, and contextualize scientific findings relative to current regulations (Strelchuk et al., 2022).

In this context, the present study aims to document and critically analyze the regulatory changes implemented in competitive taekwondo from 2012 to 2026, with a specific focus on three structural axes: (i) the evolution of combat time (including round duration, intervals, and Golden Point procedures); (ii) reforms in scoring systems (technical valuation, validity criteria, and PSS-based automation); and (iii) updates to the penalty framework (classification of infractions, *gam-jeom* accumulation, and tactical impact). The rationale is based on a dual need: to preserve historical knowledge considering the high frequency of regulatory revisions (seven changes in a decade) and to support coaches and researchers with organized data that enable the adaptation of training methodologies, reassessment of performance indicators, and contextualization of scientific findings according to the rules in force in each period.

2. Methods

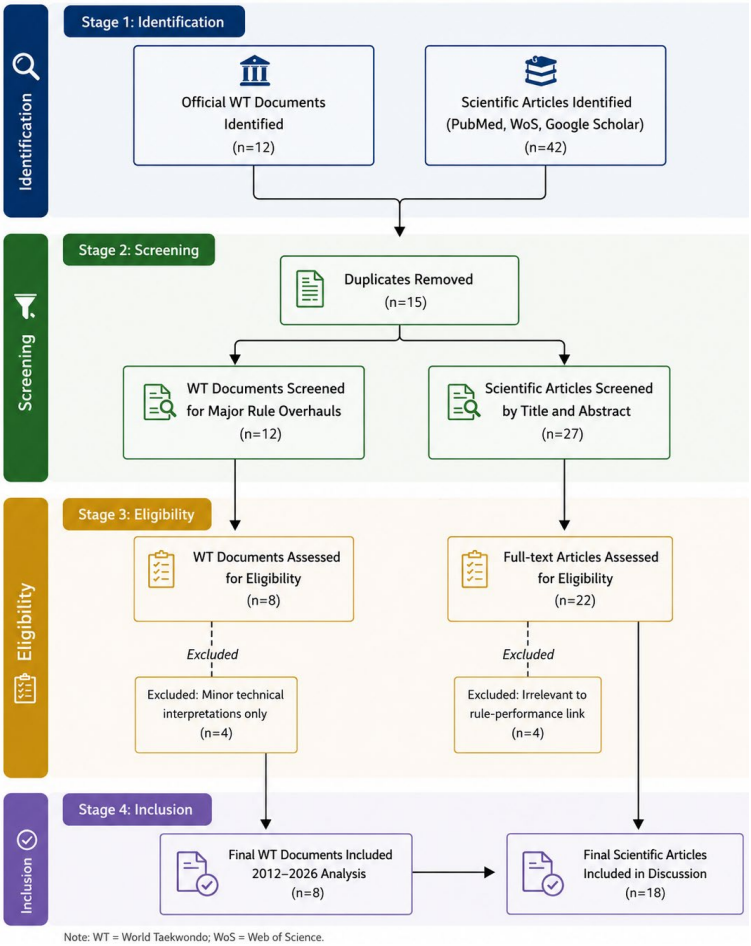
2.1. Experimental approach

This study is characterized as a narrative review combined with a retrospective documentary analysis. In this study, we performed a search and analysis of official documents that regulated taekwondo competition rules after the addition of the electronic PSS in 2012. The search for official documents was carried out on the WT website, acknowledging that while major overhauls occur periodically, minor adjustments and technical interpretations are implemented almost every year. We identified primary documents detailing significant rule changes effectively in the years 2012, 2015, 2017, 2018, 2019, 2022, 2024, and 2026.

To support the discussion on the impact of these rules on combat intensity and physiological demands, a systematic search for scientific articles was conducted across the PubMed, Web of Science, and Google Scholar databases. The search used combinations of keywords such as "taekwondo", "competition rules", "Protector Scoring System", "combat intensity", and "performance analysis". Inclusion criteria for these articles were: (1) peer-reviewed original research or systematic reviews; (2) focus on elite taekwondo performance; and (3) analysis of rule-related changes.

A total of 42 potential articles were initially identified; after removing duplicates (n=15) and screening titles and abstracts, 18 articles were selected for full-text review and final inclusion. The study selection process is summarized in Figure 1, which presents a PRISMA-style flowchart detailing the identification, screening, eligibility assessment, and final inclusion of official WT documents and scientific articles.

Figure 1. PRISMA-style flowchart of the study selection process used to identify and screen official World Taekwondo (WT) documents and scientific articles. Figure generated by the authors using the Nano Banana AI as a tool.



2.2. Search database and data extraction

Documents were screened according to predefined inclusion criteria: (1) official publications from WT; (2) publication dates between January 2012 (post-PSS implementation) and January 2026; and (3) explicit descriptions of changes in scoring, penalties, or combat structure. Non-official sources (e.g., media articles), duplicates, and incomplete or irrelevant documents were excluded. Data extraction was conducted using a standardized protocol by two independent researchers, focusing on: (a) scoring system (PSS validation protocols, point values for body/head/spinning kicks, and punch-sensing technology); (b) penalties (*gam-jeom* classifications, disqualification thresholds, and cumulative effects); and (c) combat structure (round duration, 'Best of Three' rules, superiority criteria, and overtime procedures). The selection process occurred in two stages: initial screening by a research assistant, followed by validation by the senior author. Discrepancies in selection or data extraction were resolved by a senior taekwondo expert, with priority given to the World Taekwondo Competition Rules and Interpretation as the reference standard.

2. Results

A summary of the major changes in taekwondo rules that occurred between 2012 and 2026 regarding combat structure, technology, and regulations is presented in Table 1. In 2012, the initial implementation of the PSS targeted torso kicks and the experimental use of the Instant Video Review (IVR). By 2015, the system had expanded to include head and torso sensors, and the IVR was standardized with a limit of one request per match. The 2017 overhaul introduced sensors in socks, mandatory IVR, and a Review Jury. The most significant structural shift occurred in 2022 with the adoption of the 'Best of Three' system, where each round is scored independently and the score resets to zero, effectively replacing the cumulative-point format. By 2026, the system further evolved to include sensing gloves for punches and a visual "Health Bar" display to enhance spectator engagement. The competition area transitioned from squares (8×8m in 2012) to octagons (12×12m in 2015) and hybrid formats (2017). In 2026, a 60 cm "Warning Area" of contrasting color was implemented inside the boundary line to improve athletes' spatial awareness and reduce accidental out-of-bounds penalties. Equipment rigor increased with the introduction of colored mouthguards (2015) and sensing socks (2017). By 2024, headgear with face shields became standard for Cadet categories, and sensing gloves were introduced in 2026. Weigh-ins remained consistent (day before, zero tolerance) but adopted double verification in 2015 and a mandatory random weigh-in protocol on the day of competition by 2022, with a 5% weight-tolerance

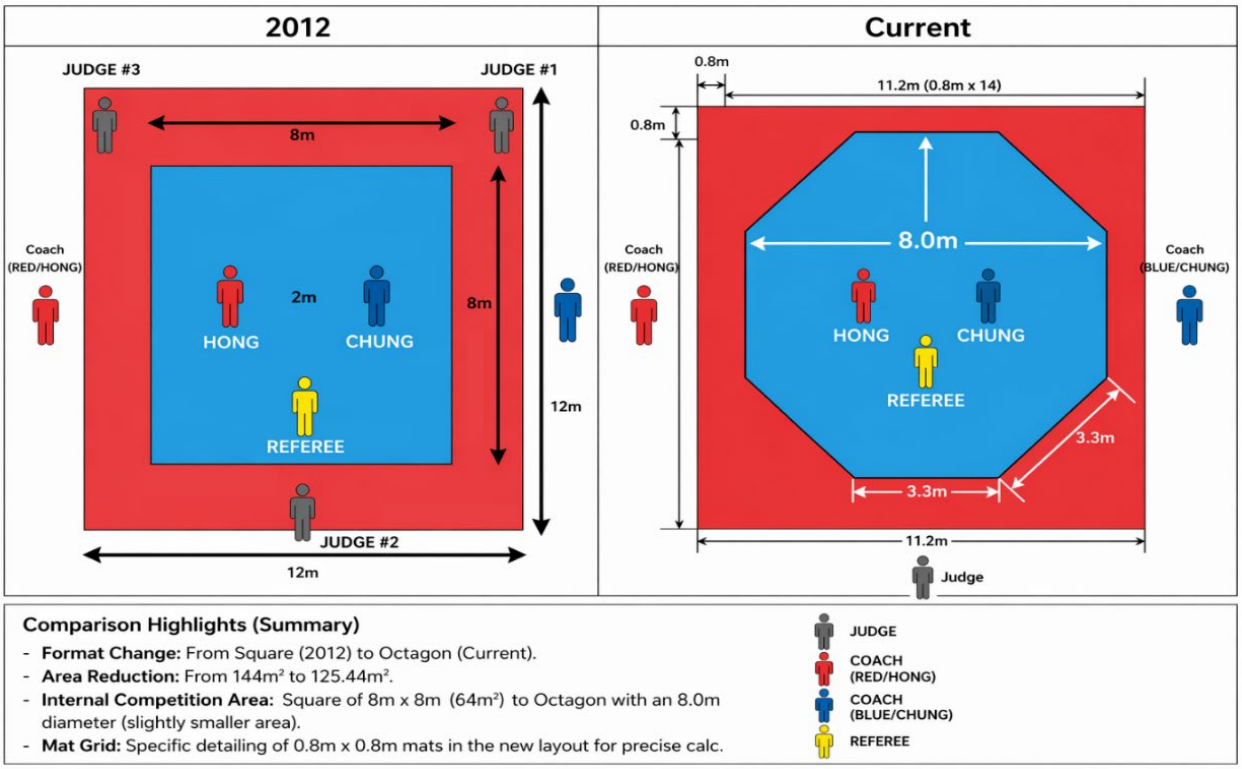
Table 1. Evolution of combat structure, technology, and regulations (2012–2026)

Year	Combat format and duration	Technology and equipment	Combat area and Weigh-in
2012	3 cumulative rounds (2 min); Golden Point (2 min).	Initial PSS (torso only); Experimental IVR.	Square (8x8m); Day-before weigh-in.
2015	3 cumulative rounds; Golden Point (1 min).	PSS on headgear; Standardized IVR.	Octagonal (12x12m); Double verification weigh-in.
2017	3 cumulative rounds; Golden Point (1 min).	Sensors in socks; Mandatory IVR with Review Jury.	Hybrid formats; Non-slip surfaces.
2022-23	Best of Three System (Score resets each round).	Consolidation of PSS/IVR protocols.	Random weigh-in on competition day (5% tolerance).
2024-26	Best of Three**;** Tie-break rounds (2-point victory).	Sensing gloves for punches; "Health Bar" scoreboard.	Warning Area (60cm); Visual-spatial updates.

Note. PSS: Protector and Scoring System; IVR: Instant Video Review; Best of 3: Match format decided by winning two out of three independent rounds; Health Bar: Visual scoring display format mimicking electronic combat games; Warning Area: 60cm colored safety strip inside the boundary line for spatial orientation; Source: Compiled by the authors based on World Taekwondo (WT) Competition Rules and Interpretation (2012–2026) available at www.worldtaekwondo.org

Figure 2 illustrates the layout of the competition area used until 2012 and the format adopted from 2015 onward.

Figure 2. Comparison of the taekwondo competition area layout according to the 2012 and current regulations. Figure generated by the authors using the Nano Banana AI as a tool



In 2012, spinning kicks to the head scored 4 points, which increased to 5 points by 2015. The 2017 reform redefined the framework: punches were awarded 1 point, spinning kicks to the torso 3 points, and spinning kicks to the head 4 points. The 2022 'Best of Three' reform maintained these values but introduced a 12-point gap threshold per round to ensure technical dominance. By 2026, the value of spinning kicks was further increased to four points for the torso (2+2) and six points for the head (3+3). Concurrently, penalties were restructured: the disqualification threshold increased from four (2012) to ten *gam-jeom* (2017), before transitioning in 2022 to a 5-penalty limit per round, which resulted in the immediate loss of the round (Table 2). The Golden Point format, reduced to 1 min in 2017, was largely superseded by the superiority criteria in the 'Best of Three' format, although a 2-point requirement for victory was established for tie-break rounds by 2026.

Table 2. Evolution of Scoring Systems and Penalty Frameworks (2012–2026)

Year	Scoring Values (Torso / Head / Spinning)	Penalty Framework (*gam-jeom*)
2012	Torso: 1 pt; Head: 3 pts; Spinning Head: 4 pts.	4-penalty disqualification limit.
2015	Torso: 1 pt; Head: 3 pts; Spinning Head: 5 pts**.**	Focus on technical validity of kicks.
2017	Torso: 2 pts**;** Head: 3 pts; Spinning Torso: 3 pts.	Disqualification limit increased to 10 *gam-jeom***.**
2022-24	Torso: 2 pts; Head: 3 pts; 12-point gap threshold.	5 *gam-jeom* per round limit (automatic round loss).
2026	Spinning Torso: 4 pts (2+2); Spinning Head: 6 pts (3+3).	IVR for head kicks removed if PSS is used.

Note. PSS: Protector and Scoring System; IVR: Instant Video Review; *Gam-jeom*: Penalty for infractions (adds 1 point to the opponent); RJ: Review Jury; GDP: Golden Point Round (overtime); Best of 3: Match format decided by winning two out of three independent rounds. Source: Compiled by the authors based on World Taekwondo (WT) Competition Rules and Interpretation (2012–2026) available at www.worldtaekwondo.org

Figure 3 presents the evolution of the taekwondo scoring system, from a manual, referee-based approach to the current electronic system, which enables automated and more objective scoring.

Figure 3. Comparison between the traditional taekwondo scoring system and the modern electronic scoring system. Figure generated by the authors using the Nano Banana AI as a tool.

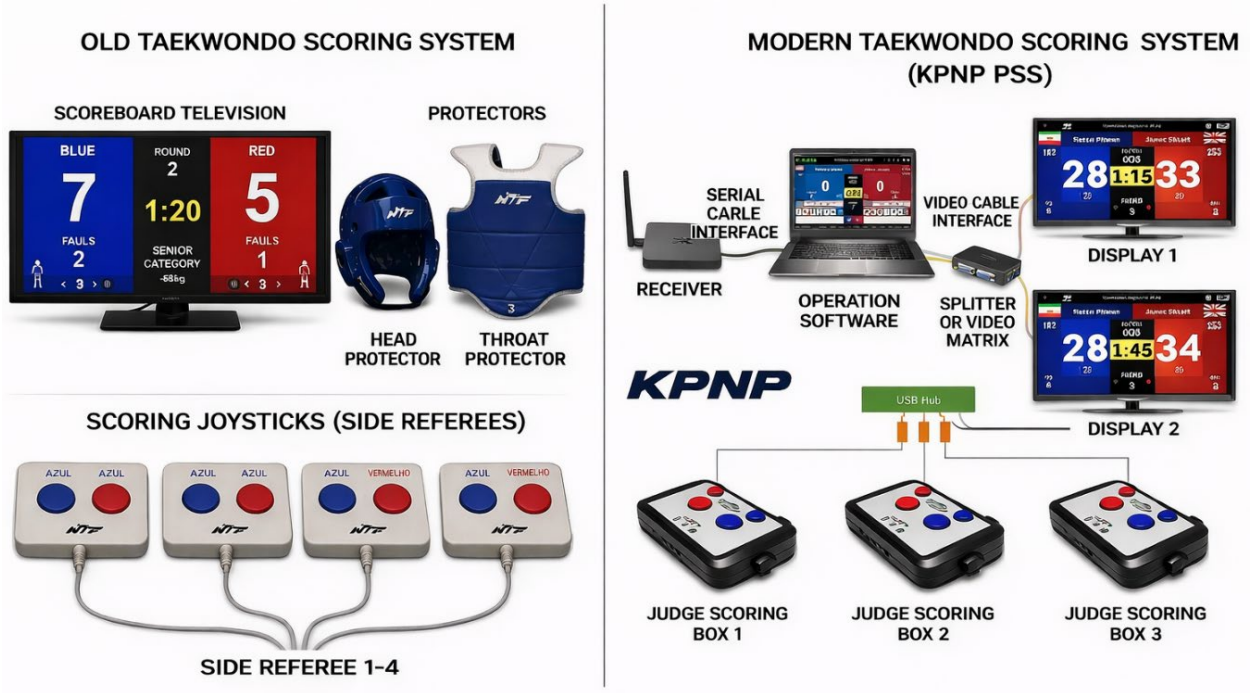


Figure 4 presents a representative photograph of an official competition, highlighting the main protective equipment integrated with the electronic PSS, including the headgear, gloves, chest protector, and sensing socks, as well as the referee, electronic scoreboard, and standardized competition area.

Figure 4. Representative photograph of an official taekwondo match showing the main protective equipment used in competition, including the headgear, gloves, chest protector, and sensing socks integrated with the Protector and Scoring System (PSS). Figure generated by the authors using the Nano Banana AI as a tool.

3. Discussion

The evolution of competitive taekwondo rules, particularly between 2012 and 2026, was driven by the continuous pursuit of greater precision, transparency, and dynamism in the sport (Huang & Tasnaina, 2024). Technological evolution and officiating accuracy have become central pillars of this modernization (Barrientos-Varela et al., 2025). In 2012, the introduction of the PSS for torso kicks and the experimental use of IVR represented an initial milestone (Mikhalskyi et al., 2025). Progressively, until 2015, the PSS expanded to include sensors in the trunk and head protectors, while the IVR was standardized, allowing one request per match (Márquez et al., 2022; Mikhalskyi et

al., 2025). The year 2017 consolidated this trajectory with the implementation of sensors in socks, the mandatory use of IVR (with aerial cameras in semifinals and finals), and the creation of the Review Jury, which ensured decisions within 30 s (Mikhalskyi et al., 2025; Park & Yang, 2019). Concurrently, the restructuring of competitive rules has significantly altered scoring and penalties. In 2012, spinning kicks to the head were worth 4 points, which increased to 5 points in 2015, encouraging higher-risk and more complex techniques (Huang & Tasnaina, 2024; Mikhalskyi et al., 2025). The 2017 reform redefined the scoring logic: punches to the torso became worth 1 point, spinning kicks to the torso 3 points, and spinning kicks to the head 4 points, in addition to granting 1 extra point for each opponent's *gam-jeom* (Huang & Tasnaina, 2024; Shin et al., 2024). Penalties were also made more flexible, with the disqualification limit for *gam-jeom* increasing from four (in 2012) to ten (in 2017), favoring the continuity of matches. The Golden Point format was adjusted from 2 min (in 2012) to 1 min (in 2017), with victory being awarded for two opponent's *gam-jeom* or technical superiority (Mikhalskyi et al., 2025; Wąs & Siedlecki, 2022).

The regulatory trajectory of taekwondo presents a complex balance of benefits and drawbacks. On the 'pro' side, the PSS and IVR have undeniably achieved their primary goal: reducing the rampant subjectivity and regional bias that plagued the sport in the pre-electronic era (Choi et al., 2021; Moenig, 2017; Qureshi & Krishnan, 2022). This transparency was essential for maintaining taekwondo's status within the Olympic program (Barrientos et al., 2021; Qureshi & Krishnan, 2022). Furthermore, the 'Best of Three' system (2022) has successfully reduced passive 'point-sitting' strategies, forcing a more explosive and engaging pace (Kim et al., 2025; Moenig et al., 2023). Conversely, the 'cons' are significant. The PSS has fundamentally altered the technical-tactical nature of the sport (Márquez et al., 2022; Moenig, 2017). Because sensors require a specific threshold of pressure rather than 'martial power,' athletes have developed techniques like the 'monkey kick' or 'scorpio kick'; actions that have little to do with traditional martial efficacy but are highly effective at triggering sensors (Choi et al., 2021; Huang & Tasnaina, 2024; Moenig, 2017). This shift has led to a perceived loss of 'seriousness' as a martial art, where the tactical focus has moved from neutralizing an opponent to 'gaming' a technological system (Choi et al., 2021). The 2026 introduction of sensing gloves for punches is a direct attempt by World Taekwondo to address this by re-incentivizing hand techniques, which had nearly disappeared in the PSS era (Chae et al., 2026).

It is also crucial to recognize that the technical evolution of taekwondo was not only driven by rule changes but also by the specific technologies of the PSS providers. In the early stages of electronic scoring, systems like the Adidas PSS were used, particularly in Europe. Unlike modern systems, the Adidas PSS did not rely on magnetic sensors but functioned through compression impact, requiring a much higher level of physical force to register a point (Moenig, 2015). This favored a more traditional, powerful kicking style. In contrast, the subsequent dominance of Daedo and KPNP systems, which utilize magnetic proximity sensors, shifted the tactical focus toward speed and 'touch' precision (Márquez et al., 2022). This technological transition played a significant role in the emergence of 'foot fencing,' as athletes adapted their techniques to the specific sensitivities and sensor placements of each brand (Márquez et al., 2022; Moenig, 2015; Moenig et al., 2023), demonstrating that the 'game style' is intrinsically linked to the hardware used in competition.

These rules changes tend to modify the dynamics of combat, which in turn requires coaches to create contextualized training for the current rules (Pshenichnikov & Mitova, 2025; Strelchuk et al., 2022). A comparative study indicated that the post-2017 rules increased combat intensity, with increments in kinematic variables (3–8%), average heart rate (1.5–1.8%), and energy expenditure (3–5%). The most significant increase was observed in post-combat blood lactate concentration, which rose from an average of 12.02 $mmol \cdot L^{-1}$ under the old rules to 13.83 $mmol \cdot L^{-1}$ under the new rules (an increase of ~15%), suggesting an even greater reliance on glycolytic anaerobic metabolism to sustain the new fight dynamics (Janowski et al., 2019). This trend of increasing intensity is further supported by recent time-motion analyses of elite competitions; in the Tokyo 2020 Olympic Games, the attack/skipping ratio reached approximately 1:1.5, representing a drastic increase in effort density compared to the 1:6 or 1:8 ratios reported in the pre-2008 era (Apollaro et al., 2023). This higher physiological demand is a direct reflection of the restructuring of scoring rules and stricter passivity penalties, which have successfully fostered a much more active and offensive combat environment (Apollaro et al., 2023; Janowski et al., 2019).

This higher physiological demand is a direct reflection of the restructuring of scoring rules, which began to incentivize a greater volume of offensive actions. While in London 2012 the technical profile was dominated by circular techniques and a more conservative style focused on counter-attacks (Menescardi et al., 2019), the 2017 changes, which increased the value of torso kicks from 1 to 2 points and spinning kicks to up to 5 points, forced athletes to maintain a faster combat pace to keep up with the competitive average (Janowski et al., 2019). Notational analysis revealed that this technical valuation, combined with the reduction in penalty severity (10 *gam-jeom* limit), resulted in fights with fewer interruptions and greater effort density, requiring athletes to move more quickly and execute high-complexity techniques more frequently (Huang & Tasnaina, 2024; Mikhalskyi et al., 2025). In this context, the interaction between anaerobic and aerobic metabolism has become crucial for maintaining the short, intermittent kicking actions required by modern rules (Apollaro, Panascì, Franchini, et al., 2025). Consequently, recent evidence validates the use of sport-specific indicators, such as the kick frequency at the heart rate deflection point derived from the Progressive Specific Taekwondo Test, to prescribe interval training that accurately mimics the 3-round official match structure without compromising muscle power (Apollaro, Panascì, Ouergui, et al., 2025). These findings provide coaches with precise guidelines for developing high-intensity interval training protocols that meet the current technical-tactical and metabolic needs of elite athletes (Apollaro, Panascì, Ouergui, et al., 2025; Apollaro et al., 2023).

Structural standardization and trends in equipment and arenas were also observed. The competition area evolved from square formats (8 × 8 m in 2012) to octagons (12 × 12 m in 2015) and subsequently to hybrid formats in 2017, with non-slip surfaces and controlled inclination, aiming for greater dynamism and safety (Jeong et al., 2023). Apparel followed increasing technical rigor, with the permission of colored mouthguards (except red) in 2015 and the inclusion of sensors in socks by the PSS in 2017 (Jeong et al., 2025). Weigh-in procedures, while maintaining the rule of occurring the day before with zero tolerance, began to have double verification in 2015. Standardization of arenas and technological evolution have also played crucial roles in modifying strategies. The transition to the octagon (2015) and the implementation of sensors in socks (2017) reduced “ghost points” and subjectivity but also introduced new tactical challenges (Jeong et al., 2023; Jeong et al., 2025). For example, an analysis of Olympic medalists between 2012 and 2016 showed a shift in patterns: in 2012, direct attacks and anticipatory counter-attacks were key to success, whereas in 2016 and beyond, technical variability increased significantly in response to the PSS accuracy (Menescardi et al., 2019). Combat dynamics have become an evolutionary system in which the effectiveness of a technique (such as using side kick – *yeop-chagi* as an evasion or distance control tool) is constantly reevaluated in light of new sensor sensitivities and inactivity penalties. Barrientos-Varela et al. (2025) demonstrated that while some temporal indicators remained stable, the opening and decisive moments were significantly influenced by regulatory shifts between 2008 and 2016. Specifically, the introduction of the PSS led to a higher prevalence of initial scores from head strikes (3-0), which increased from 0% in 2008 to 21.1% in 2012, reflecting a more aggressive pursuit of high-value points early in the bout.

The period between 2019 and 2026 marked a paradigm shift in the competitive structure of taekwondo. The most significant change occurred in 2022 with the introduction of the ‘Best of Three’ system, where each round was scored independently and the score was reset to zero. This reform aimed to eliminate passive strategies and” fencing’ observed in previous Olympic cycles, forcing athletes to maintain high intensity throughout every round. Jeon and Lim (2024) identified that under this new system, the ‘Winning Situation’ and ‘Number of Kicks’ became the primary determinants of victory, as athletes must secure rounds individually rather than accumulating points over time. Their decision tree analysis showed that winning the first round significantly increased the probability of overall victory, emphasizing the tactical importance of an aggressive start in the ‘Best of Three’ format. The point gap threshold was also adjusted to 12 points per round, further emphasizing the technical dominance. By 2026, the regulation introduced the ‘Warning Area’ (a 60 cm colored strip inside the boundary line) to provide better spatial awareness and reduce accidental penalties. Additionally, the 2026 rules streamlined the Instant Video Review (IVR) process by removing head kick reviews when electronic head protectors are used, trusting the technological accuracy of PSS. Yan et al. (2025) analyzed the impact of IVR during the Paris 2024 Olympics and found that 44.04% of coach-initiated appeals resulted in point adjustments that altered round

outcomes. Their study highlighted that IVR requests significantly increase in the final 30 seconds of the round ($p < 0.05$), and that appeals are more successful when the athlete is in a 'leading' status (69.05% approval) compared to 'lagging' (42.00%), suggesting that IVR is often used strategically to consolidate an existing advantage. The introduction of sensing gloves for punches and the 'Health Bar' visual display in 2026 further aligned the sport with modern broadcast standards and spectator expectations.

This study, while providing a comprehensive analysis of the evolution of taekwondo rules and their impact, has some inherent limitations. The main limitation lies in the dependence on existing studies, which do not always cover all transition periods with the same depth or use comparable methodologies. Our study is its strict documentary and retrospective nature. While we provide a comprehensive mapping of regulatory shifts, we do not provide primary physiological or kinematic data from athletes. Furthermore, our discussion of the performance impacts of these rules relies on existing literature, which, as previously mentioned, can be of inconsistent methodological quality. The lack of longitudinal studies tracking specific athletes across multiple regulatory eras prevents a more granular understanding of individual and collective adaptation. Furthermore, most research tends to focus on elite athletes, which may not reflect the dynamics of lower competitive levels. Future studies should prioritize longitudinal studies and collect primary data to allow for more robust comparisons between different regulatory periods. It is also crucial that new research explores the differences in performance indicators and technical-tactical strategies between weight categories and sexes, as physiological demands and tactical approaches can vary significantly between these groups (Janowski et al., 2020; Jeong et al., 2025). Investigating the psychological impact of rule changes and athletes' adaptation capacity also represents a promising area.

An evolutionary analysis of the rules can have direct practical implications for coaches, athletes, and multidisciplinary teams in taekwondo. Understanding that the most recent rules impose greater physiological and kinematic demands requires the continuous reevaluation of training programs. Coaches should focus on developing glycolytic anaerobic capacity and optimizing post-combat recovery using strategies such as active recovery (Janowski et al., 2020; Mikhalskyi et al., 2025; Moenig, 2015; Park & Yang, 2019). Emphasis should be placed on high-intensity taekwondo-specific exercises that simulate combat conditions under the current rules. From a technical-tactical standpoint, it is essential for athletes to develop a diverse repertoire of techniques, especially those that are highly scored and effective under the PSS, such as spinning kicks. Notational analysis should be a constant tool for identifying success patterns and adapting strategies in real-time. Furthermore, psychological preparation to cope with the pressure of a more dynamic and technologically mediated combat environment is crucial for competitive success.

4. Conclusion

Between 2012 and 2026, the continuous evolution of competitive taekwondo rules transformed the sport into a highly specialized Olympic discipline through the pursuit of greater transparency and objectivity, driven by the implementation of PSS and the standardization of IVR system. One of the most significant regulatory change occurred in 2022 with the adoption of the 'Best of Three' system, which eliminated passive strategies and required more intense and explosive performances in each round. Although these modifications increased combat intensity and the physiological demands imposed on athletes, they also generated technical controversies by favoring light-contact techniques and the predominant use of the lead leg at the expense of traditional martial power and technical diversity. Consequently, athletes and coaches were required to adapt their training methodologies, prioritizing high anaerobic capacity, technical-tactical proficiency, and strategies tailored to different electronic scoring systems. Therefore, while these changes strengthened taekwondo as a global and spectator-oriented sport, they also compromised part of its historical and martial heritage, making it essential for future regulations to achieve a balance between technical effectiveness and technological transparency to preserve both the sport's competitive credibility and its traditional identity.

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