Tracking the development of technical-tactical skills in judo athletes with visual impairments over four Paralympic cycles (2012-2024)

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Abstract

Judo performance is inherently complex due to the dynamic interplay of various factors influencing technique execution. This retrospective cohort study examined data on the technical-tactical performance of judo athletes with visual impairments across four Paralympic cycles (London 2012, Rio 2016, Tokyo 2020+1, and Paris 2024), categorized by sex (male and female), using a motor-technical classification system. Data from 718 matches and 1,028 technical performances were analyzed. The association between technique group frequencies and Paralympic Games editions, stratified by sex (male and female) was assessed by independent Chi-square tests. The results revealed that athletes consistently favored Group 1 (techniques with turning action, forward throw, and two supporting feet) and Group 10 (groundwork techniques) for both female (X^2 = 52.40, p = 0.002) and male athletes (X^2 = 53.97, p = 0.002) across all four Paralympic cycles. These consistent patterns suggest that judo athletes with visual impairments maintain stable technical preferences across cycles, regardless of sex. The findings provide valuable aspects into the technical-tactical performance of judo athletes with visual impairments, highlighting the consistency of technique preferences across multiple Paralympic Games. Coaches can focus on these techniques in training, customizing their approaches to align with the athletes' strengths and preferences, especially those involving turning actions, forward throws, two supporting feet, and groundwork techniques.

Keywords: Martial arts; combat sports; judo; para judo; adapted sport; Paralympic Games; performance analysis; technique; tactics; motor skills.

Seguimiento del desarrollo de las habilidades técnico-tácticas en judokas con discapacidad visual a lo largo de cuatro ciclos paralímpicos (2012–2024)

Resumen

El rendimiento en judo es inherentemente complejo debido a la interacción dinámica existente entre los diversos factores que influyen en la ejecución técnica. Este estudio retrospectivo de cohorte examinó datos sobre el rendimiento técnico-táctico de judokas con discapacidad visual a lo largo de cuatro ciclos paralímpicos (Londres 2012, Río 2016, Tokio 2020+1 y París 2024), categorizados por sexo (masculino y femenino), utilizando un sistema de clasificación motriz-técnica. Se analizaron un total de 718 combates y 1.028 ejecuciones técnicas. Para evaluar la asociación entre las frecuencias de los grupos técnicos y las ediciones de los Juegos Paralímpicos, estratificadas por sexo (masculino y femenino), se realizaron pruebas independientes de Chi-cuadrado. Los resultados revelaron que los atletas favorecieron consistentemente el Grupo 1 (técnicas con acción de giro, proyección hacia adelante y apoyo en ambos pies) y el Grupo 10 (técnicas de suelo), tanto

Acompanhamento do Desenvolvimento das Habilidades Técnico-Táticas em Judocas com Deficiência Visual ao Longo de Quatro Ciclos Paralímpicos (2012–2024)

Resumo

O desempenho no judô é inerentemente complexo devido à interação dinâmica de diversos fatores que influenciam a execução das técnicas. Este estudo de coorte retrospectivo analisou dados sobre o desempenho técnico-tático de judocas com deficiência visual ao longo de quatro ciclos paralímpicos (Londres 2012, Rio 2016, Tóquio 2020+1 e Paris 2024), categorizados por sexo (masculino e feminino), utilizando um sistema de classificação motora-técnica. Foram analisados dados de 718 lutas e 1.028 execuções técnicas. Testes de Qui-quadrado independentes foram realizados para avaliar a associação entre as frequências dos grupos técnicos e as edições dos Jogos Paralímpicos, estratificados por sexo (masculino e feminino). Os resultados revelaram que os atletas favoreceram consistentemente o Grupo 1 (técnicas com ação de rotação, projeção à frente e apoio com os dois pés) e o

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en mujeres (X^2 = 52,40, p = 0,002) como en hombres (X^2 = 53,97, p = 0,002) en los cuatro ciclos analizados. Estos patrones consistentes sugieren que los judokas con discapacidad visual mantienen preferencias técnicas estables a lo largo de los ciclos, independientemente del sexo. Los hallazgos aportan elementos valiosos sobre el rendimiento técnico-táctico de judokas con discapacidad visual, destacando la consistencia en las preferencias técnicas a través de múltiples ediciones de los Juegos Paralímpicos. Los entrenadores pueden centrarse en estas técnicas durante el entrenamiento, personalizando sus enfoques para alinearse con las fortalezas y preferencias de los atletas, especialmente aquellas que implican acciones de giro, proyecciones hacia adelante, apoyo en ambos pies y técnicas de suelo.

Palabras clave: Artes marciales; deportes de combate; judo; para judo; deporte adaptado; Juegos Paralímpicos; análisis del rendimiento; técnica; táctica; habilidades motrices.

Grupo 10 (técnicas de solo), tanto no feminino (X^2 = 52,40, p = 0,002) quanto no masculino (X^2 = 53,97, p = 0,002), ao longo dos quatro ciclos paralímpicos. Esses padrões consistentes sugerem que os judocas com deficiência visual mantêm preferências técnicas estáveis ao longo dos ciclos, independentemente do sexo. Os achados oferecem contribuições relevantes para a compreensão do desempenho técnico-tático desses atletas, destacando a constância nas preferências técnicas ao longo de múltiplos Jogos Paralímpicos. Treinadores podem direcionar o treinamento para essas técnicas, personalizando os métodos de ensino conforme os pontos fortes e preferências dos atletas, especialmente em ações de rotação, projeções à frente, apoio com os dois pés e técnicas de solo.

Palavras-chave: Artes marciais; esportes de combate; judô; para-judô; esporte adaptado; Jogos Paraolímpicos; análise de desempenho; técnica; tática; habilidades motoras.

1. Introduction

Over the past few years, the technical-tactical performance of judo athletes has been extensively studied (Franchini et al., 2013), with research focusing on key factors such as time-motion analysis (Miarka et al., 2012, 2014), technical variation (Franchini et al., 2008; Kons et al., 2022), pacing strategies (Franchini et al., 2019), transition to groundwork (Nagai et al., 2019), and performance-related outcomes (Kons et al., 2022). These studies aim to identify the elements that contribute to overall performance in official competitions (Miarka et al., 2018). In the case of judo for athletes with visual impairments, studies have explored specific aspects related to technical-tactical performance such as differences across sports classes (e.g., B1, B2, B3) (Kons et al., 2019), comparisons between medal-winning and non-medal-winning athletes (Kons et al., 2024a, b), and athlete profiles related to sex (e.g. male and female) (Kons et al., 2019).

Specific studies on judo athletes with visual impairments have explored the time-motion structure of judo matches and technical-tactical performance (Gutiérrez-Santiago et al., 2011, 2012, 2023; Kons et al., 2019, 2021a), competition outcomes over multiple years (Mashkovskiy et al., 2019), the relationship between visual function and competitive performance (Krabben et al., 2021a, b), physical performance (Kons et al., 2021b, 2023), and world ranking performance (Kons et al., 2021c). The results of these studies generally suggest that athletes with higher levels of visual impairment tend to perform less effectively, both in terms of competitive skills (e.g., technical variability) and physical performance (e.g., number of throws in judo-specific tests) (Gutiérrez-Santiago et al., 2023; Kons et al., 2025).

Recently, significant revisions have been made to the classification system for judo athletes with visual impairments, marking a pivotal shift in the para sport's approach to ensuring fair competition. In 2022, the International Blind Sports Federation (IBSA) introduced an updated visual impairment classification, dividing athletes into two distinct groups based on a combination of visual acuity and vision field tests results (see Table 1). This reform was driven by extensive scientific research, which revealed that the previous system failed to account for the wide range of visual impairments within the same group, leading to inequitable competition (Krabben et al., 2019a, 2021a, b; Kons et al., 2019, 2021a).

Table 1. Classification criteria for judo athletes with visual impairments, based on International Blind Sports Federation (IBSA) regulations under the new classification system introduced in 2022.

New Classification System	Visual Acuity (LogMAR)	Visual Field (radius)
J1	Less than or equal 2.6	n.a.
J2	1.3 to 2.5	Less than 60 degrees

n.a. = not applicable

The revised system now ensures that athletes with similar levels of visual ability compete against each other, reducing disparities and promoting fairness. Moreover, the two groups (J1 and J2) now compete separately in four weight categories, creating a more balanced playing field considering the levels of vision (IBSA, 2022). This change reflects a strong commitment to inclusive and equitable competition in judo for athletes with visual impairments, enabling athletes to compete in conditions that more accurately reflect their individual capabilities, considering technical-tactical performance profile.

Determining the technical-tactical performance profile of judo athletes with visual impairments is a complex task, especially in the context of official competitions (Krabben et al., 2019b). This complexity arises from several factors, including the continuous evolution of judo rules across different Paralympic cycles (Calmet et al., 2017a, b) and recent changes in the classification code and the reduction of weight categories (IBSA, 2022). Additionally, judo for athletes with visual impairments tends to be slower during official matches (Gutiérrez-Santiago et al., 2012) compared to able-bodied judo athletes. This slower pace is partly due to the absence of visual cues, which forces athletes to take more time to execute techniques and prepare for attacks (Kons et al., 2021a). For example, Gutiérrez-Santiago et al. (2023) found that athletes with total blindness experience longer pause times compared to partially sighted athletes, as they often need more time to reposition themselves or prepare an attack, sometimes requiring referee assistance. In contrast, partially sighted athletes, with better visual acuity, can move more quickly and restart the match with greater efficiency. This slower pace is further compounded by more frequent referee interventions, necessary to ensure athlete safety due to the lack of vision (Kons et al., 2024a). Together, these factors add multiple layers of complexity to the analysis of technical performance in judo athletes with visual impairments.

The complexity of judo techniques arises from the classification of throwing techniques into four main groups of *katame-waza* (throwing techniques): *ashi-waza* (leg techniques), *te-waza* (arm techniques), *koshi-waza* (hip techniques), and *sutemi-waza* (sacrifice techniques), along with groundwork techniques (*ne-waza*) such as pins (*osaekomi-waza*), strangles (*shime-waza*), and joint locks (*kansetsu-waza*) (Daigo, 2005). However, the traditional judo classification system is limited, as it does not account for the motor patterns of the techniques. Under this old system, different techniques are often grouped into the same category despite differing movement mechanics (Daigo, 2005; Martins et al., 2019). To address this, Dopico et al. (2014) proposed an alternative classification based on tactical and motor criteria. This system more effectively groups techniques by considering factors such as movement structure (turning, non-turning, or supine position), support base (one foot, two feet, or back support), throw direction (forward or backward), dynamic leg direction (ipsilateral or contralateral), and spatial zones (inner or outer). Martins et al. (2019), applying this classification to able-bodied judo athletes at the 2017 Senior Judo World Championship, found that female athletes more frequently used techniques without turning actions, with ipsilateral leg direction, in the external zone, with backward throws, and one supporting foot. In contrast, male athletes were more likely to use techniques without turning actions, both forward and backward throws, and with two supporting feet.

Considering recent changes in judo for athletes with visual impairments, coupled with the inherent complexity of judo matches (Krabben et al., 2019b; IBSA, 2022), makes performance assessment particularly challenging (Gutiérrez-Santiago et al., 2023; Kons et al., 2025). Recent reviews have highlighted key insights into Para judo performance, emphasizing the need for objective and practical methods to assess athletes' performance (Gutiérrez-Santiago et al., 2023; Kons et al., 2025). These reviews collectively underscore the multifaceted nature of performance in para judo, reinforcing the importance of focused investigations in aspects related to performance in competition, for example. One effective approach for objectively classifying judo techniques is the system proposed by Dopico et al. (2014), which provides valuable indicators related to motor factors and allows for a meaningful analysis of technical-tactical performance patterns across competitions. In this context, the aim of this study was to analyze the technical-tactical performance of judo athletes with visual impairments across four Paralympic cycles (London 2012, Rio 2016, Tokyo 2020+1, and Paris 2024), using the Dopico et al. (2014) classification system to frame the analysis by sex (male and female).

2. Methods

2.1. Study design

This retrospective cohort study analyzed the data related to the technical-tactical performance of judo athletes with visual impairments across four Paralympic cycles (London 2012, Rio 2016, Tokyo 2020+1, and Paris 2024) by sex (male and female). An expert referee from the International Judo Federation recorded the official results. Throwing and groundwork techniques information was then extracted from the official results and were classified by a judo (2 dan) expert with over 15 years of experience, holding a black belt, and specializing in judo athletes with visual impairment, using the classification system developed by Dopico et al. (2014) and recently used by Kons et al (2022) with Olympic judo athletes.

2.2. Data collection

We analyzed all matches from seven male and six female weight categories at the London 2012, Rio de Janeiro 2016, Tokyo 2020+1 and Paris 2024 Paralympic Games. According to the International Judo Federation competition rules, there are two semifinals, where the winners advance to the final to compete for the gold and silver medals. In contrast, the semifinal losers compete for two bronze medals and two fifth places. Data from a total of 526 athletes and 718 matches from three Paralympic Games were analyzed. The analysis considered sex (male and female) and four Paralympic Games editions (2021, 2016, 2020+1 and 2024) considering a total of 1028 recorded technical performances over these four editions. It is important to highlight that in 2022, a new visual impairment classification code was introduced for judo, grouping athletes into two categories (J1 and J2) based on visual acuity and visual field assessments. The J1 group includes athletes with a binocular visual acuity of LogMAR (logarithm of the minimum angle of resolution) 2.6 or worse, while the J2 group includes those with a binocular visual acuity between LogMAR 1.3 and 2.5, or a binocular visual field of 60° or less in diameter. As a result of this updated classification, J1 and J2 athletes now compete in separate categories. Additionally, to address the challenge of limited participant numbers, the IBSA reduced the number of weight classes from seven to four by consolidating them. It is worth noting that until the Tokyo 2020+1 Paralympic Games, Para athletes competed under the previous classification system, which used three visual classifications: B1 (total blind), B2, and B3 (partial sighted).

2.3. Judo techniques classification

The traditional judo classification system is limited as it fails to account for the distinct motor patterns involved in various techniques (Daigo, 2005). Under this outdated system, techniques with differing movement mechanics are often grouped into the same category. As a result, we have opted not to use this traditional classification, as it does not accurately reflect the diversity and complexity of judo techniques. Instead, the updated judo technique classification follows the proposal by Dopico et al. (2014) and the recommendations of Martins et al. (2019), as outlined below:

(1) Techniques with turning action, forward throw and two supporting feet (e.g. *o-goshi, koshi-guruma, seoi-nage, sode-tsurikomi-goshi, seoi-otoshi*);

(2) Techniques with turning action, forward throw and one supporting foot (e.g. *uchi-mata, harai-goshi, hane-goshi, ashi-guruma, o-guruma*);

(3) Techniques without turning action, ipsilateral leg direction, external zone, backward throw and one supporting foot (e.g. *o-soto-gari, o-soto-gake, o-soto-otoshi, o-soto-guruma, o-soto-gaeshi*);

(4) Techniques without turning action, ipsilateral leg direction, inner zone, backward throw and one supporting foot (e.g. *ko-uchi-gari, ko-uchi-gake, ko-uchi-makikomi*);

(5) Techniques without turning action, contralateral leg direction, inner zone, backward throw and one supporting foot (e.g. *o-uchi-gari, o-uchi-gake, o-uchi-makikomi*);

(6) Techniques without turning action, contralateral leg direction, external zone, backward throw and one supporting foot (e.g. *ko-soto-gake, de-ashi-harai, yoko-gake, o-uchi-gaeshi, tani-otoshi*);

(7) Techniques without turning action, contralateral leg direction, external zone, forward throw and one supporting foot (e.g. *sasae-tsurikomi-ashi, hiza-guruma, harai-tsurikomi-ashi*);

(8) Techniques without turning action, forward or backward throw and two supporting feet (e.g. ura-nage, ushiro-goshi, sumi-otoshi, daki-wakare);

(9) Techniques of supine position, forward throw and back support (e.g. *tomoe-nage, sumi-gaeshi, hikikomi-gaeshi, yoko-tomoe-nage, uki-waza*).

(10) For the groundwork techniques the traditional system was used (e.g. Osaekomi-waza, Kansetsu-waza, and Shime-waza) as there are no other proposed classification system. In the present study, these techniques were considered as group 10.

2.4. Statistical analysis

The normality of the variable distributions was evaluated using the Kolmogorov-Smirnov test, which confirmed that the data followed a normal distribution ($p>0.05$). Independent Chi-square tests were used to examine the association between the frequency of technique groups and the Paralympic editions. The strength of associations was reported using Cramer's V, where values below 0.20 indicate a small effect, 0.21–0.35 suggest a medium effect, and values above 0.35 indicate a large effect (Cohen, 1988). Statistical significance was set at $p<0.05$, and all analyses were performed using JASP software (version 0.11.1, JASP Team, University of Amsterdam, Netherlands).

3. Results

Table 2 presets the association between the classification of judo techniques and the distribution of female judo athletes with visual impairments considering different editions of Paralympic Games (2012, 2016, 2020+1 and 2024). A significant association was detected (X^2 = 52.40, p = 0.002; Cramer's V = 0.20 [small effect]), with higher frequencies in technique groups of 1 and 10 for all editions.

Table 2. Classification of judo techniques for female judo athletes with visual impairments in the in different Paralympic Games editions

Technique groups	PG 2012 N (%)	PG 2016 N (%)	PG 2020+1 N (%)	PG 2024 N (%)
1	18 (33.2)	38 (25.3)	15 (14.7)	40 (30.7)
2	7 (12.9)	19 (12.6)	11 (10.7)	18 (13.8)
3	3 (5.5)	16 (10.6)	7 (6.8)	8 (6.1)
4	2 (3.7)	4 (2.6)	5 (4.9)	4 (3.0)
5	4 (7.4)	3 (2.0)	3 (2.9)	3 (2.3)
6	3 (5.5)	21 (14.0)	7 (6.8)	16 (12.3)
7	1 (1.8)	0 (0.0)	0 (0.0)	2 (1.5)
8	0 (0.0)	8 (5.3)	15 (14.7)	3 (2.3)
9	0 (0.0)	6 (4.0)	7 (6.8)	10 (7.6)
10	16 (29.6)	32 (23.3)	32 (31.3)	26 (20.0)

PG: Paralympic Games; Techniques groups: *Group 1* = Techniques with turning action, forward throw, and two supporting feet; *Group 2* = Techniques with turning action, forward throw, and one supporting foot; *Group 3* = Techniques without turning action, ipsilateral leg direction, external zone, backward throw, and one supporting foot; *Group 4* = Techniques without turning action, ipsilateral leg direction, inner zone, backward throw, and one supporting foot; *Group 5* = Techniques without turning action, contralateral leg direction, inner zone, backward throw, and one supporting foot; *Group 6* = Techniques without turning action, contralateral leg direction, external zone, backward throw, and one supporting foot; *Group 7* = Techniques without turning action, contralateral leg direction, external zone, forward throw, and one supporting foot; *Group 8* = Techniques without turning action, forward or backward throw, and two supporting feet; *Group 9* = Techniques of supine position, forward throw, and back support; *Group 10* = Groundwork techniques.

Table 3 shows the association between the classification of judo techniques and the distribution of male judo athletes with visual impairments considering different editions of

Paralympic Games (2012, 2016, 2020+1 and 2024). A significant association was detected (X^2 = 53.97, p = 0.002; Cramer's V = 0.17 [small effect]), with higher frequencies in technique groups of 1 and 10 for all editions.

Table 3. Classification of judo techniques for male judo athletes with visual impairments in the in different Paralympic Games editions

Technique groups	PG 2012 N (%)	PG 2016 N (%)	PG 2020+1 N (%)	PG 2024 N (%)
1	14 (16.8)	27 (11.5)	35 (23.4)	32 (25.1)
2	10 (12.0)	40 (17.1)	14 (9.3)	13 (10.2)
3	0 (0.0)	14 (6.0)	5 (3.3)	2 (1.5)
4	4 (4.8)	8 (3.4)	3 (2.0)	2 (1.5)
5	4 (4.8)	8 (3.4)	8 (3.4)	3 (2.3)
6	6 (7.2)	25 (10.7)	8 (3.4)	24 (18.8)
7	4 (4.8)	6 (2.5)	4 (2.6)	3 (2.3)
8	15 (18.0)	22 (9.4)	21 (14.0)	13 (10.2)
9	4 (4.8)	29 (12.4)	18 (12.0)	12 (9.4)
10	22 (26.5)	54 (23.1)	33 (22.1)	23 (18.1)

PG: Paralympic Games; Techniques groups: *Group 1* = Techniques with turning action, forward throw, and two supporting feet; *Group 2* = Techniques with turning action, forward throw, and one supporting foot; *Group 3* = Techniques without turning action, ipsilateral leg direction, external zone, backward throw, and one supporting foot; *Group 4* = Techniques without turning action, ipsilateral leg direction, inner zone, backward throw, and one supporting foot; *Group 5* = Techniques without turning action, contralateral leg direction, inner zone, backward throw, and one supporting foot; *Group 6* = Techniques without turning action, contralateral leg direction, external zone, backward throw, and one supporting foot; *Group 7* = Techniques without turning action, contralateral leg direction, external zone, forward throw, and one supporting foot; *Group 8* = Techniques without turning action, forward or backward throw, and two supporting feet; *Group 9* = Techniques of supine position, forward throw, and back support; *Group 10* = Groundwork techniques.

3. Discussion

This study aimed to analyze the technical-tactical performance of judo athletes with visual impairments over four Paralympic cycles (London 2012, Rio 2016, Tokyo 2020+1, and Paris 2024), using the Dopico et al. (2014) classification system as the framework for analysis by sex (male and female). The main results showed that similar behavior related to technical performance, considering male and female judo athletes with visual impairments, with high frequency of judo techniques for group 1 (techniques with turning action, forward throw, and two supporting feet) and group 10 (groundwork techniques) over the four Paralympic cycles.

The technical performance of judo athletes, within the context of the traditional Kodokan classification, was explored by Kons et al. (2019). Their analysis of the results from the London and Rio 2016 Paralympic Games revealed a significant prevalence of sacrifice techniques (nearly 40%) and leg techniques (around 35%). While these classifications provide valuable insights, the Kodokan's technique categories have notable limitations, particularly because they fail to account for the complexity of the motor tasks involved in judo techniques (Dopico et al., 2014). For athletes with visual impairments, there is a clear preference for specific techniques, such as *seoi-nage, sode-tsurikomi-goshi*, and groundwork techniques involving pins, strangles and joint locks, with similar patterns observed across both male and female athletes. It is important to emphasize that despite the added complexity of judo athletes with visual impairments, in terms of temporal structure and safety considerations (Gutierrez-Santiago et al., 2012; Kons et al., 2024b), there is a noticeable adaptation in the preference for these techniques, which follow a consistent pattern across Paralympic cycles.

The high frequency of techniques observed in Group 10 may be attributed to the preference of athletes with reduced visual acuity for close-contact situations, where they tend to experience a greater sense of security and control, especially during phases of the match that involve prolonged

contact with the ground. In judo, groundwork techniques such as pins, strangles, and joint locks require sustained physical engagement, which significantly reduces the need for visual input (Krabben et al., 2021a; Kons et al., 2019). These conditions promote the use of proprioceptive and tactile feedback over visual cues (Kons et al., 2023), allowing athletes to more effectively perceive, execute, and control their actions during combat (Kons et al., 2019). For judo athletes with visual impairments, such techniques may offer a distinct tactical advantage, as physical contact and body positioning provide essential sensory information that improves their ability to anticipate opponents' movements, maintain balance, and make timely strategic adjustments (Kons et al., 2021b, 2024b).

Despite numerous rules modifications (Calmet et al., 2017) and the change of visual classification code (Krabben et al., 2021) for judo athletes with visual impairments, the technical performance patterns of this group have remained remarkably consistent across four Paralympic cycles. This stability suggests that athletes have effectively adapted to these changes, while maintaining their distinctive technical preferences. Supporting this, Martins et al. (2019) found similar trends in able-bodied judo athletes, with a high percentage of Group 1 techniques being utilized by both medalists and non-medalists at the 2017 World Championships. Similarly, Kons et al. (2022), in their analysis of the technical performance of Olympic judo athletes during the Tokyo 2020+1, observed a notable prevalence of Group 1 techniques among medalists. These findings further reinforce the consistency of technical preferences across different groups of judo athletes, including both Olympic and Paralympic levels, demonstrating a general stability in technique choices across the sport.

It is important to highlight that the present results cannot be interpreted in the context of the new classification system (e.g., J1 and J2 sport class groups), as the primary objective was to analyze individual technical and tactical performance behaviors of judo athletes across four Paralympic cycles. While the revised classification system provides a more precise grouping of athletes based on the degree of visual impairment, it does not necessarily imply that their technical and tactical performance, or their situational perception during official judo matches, will be directly affected by this reclassification (Kons et al., 2024a). The current system aims to enhance fairness and comparability by grouping athletes with similar levels of visual function (Krabben et al., 2020). However, comparing performance outcomes across different visual classes may not be appropriate for longitudinal analyses conducted before the implementation of this system. Future studies are encouraged to identify and classify athletes according to their sports class, as this will be essential for understanding long-term performance trends and supporting athlete development in competitions conducted under the new classification framework (Mashkovskiy et al., 2019).

Based on the results of this study, some limitations can be highlighted. First, it does not include video analysis of judo techniques for athletes with visual impairments, which could offer a more accurate and reliable assessment, particularly in relation to the absence of real-time data collection. This limitation may hinder the ability to capture dynamic, context-dependent factors that influence performance during competitions, such as the pace of the matches, referee interventions, and situational adjustments made by athletes in response to changing conditions. Second, the sports class and weight categories of the athletes were not thoroughly examined. However, analyzing these classifications separately by sex and across four Paralympic Games cycles could still provide important information's related to the athletes' evolving technical profiles over time. Finally, future research should include the analysis of techniques by two experienced evaluators and incorporate reproducibility or concordance testing to ensure a more reliable assessment. Additionally, identifying specific techniques used during groundwork matches, such as pins, strangles, and joint locks would contribute to a deeper understanding of athletes' performance during ground combat.

4. Conclusion

In conclusion, judo athletes with visual impairments have shown remarkable consistency in their technique preferences, particularly for Group 1 (techniques with turning action, forward throw, and two supporting feet) and Group 10 (groundwork techniques) across four Paralympic Games editions (2012, 2016, 2020+1, and 2024). These consistent patterns suggest that judo athletes with visual impairment maintaining technical preferences across different Paralympic cycles considering

male and female groups. This study enhances our understanding of the technical-tactical performance of judo athletes with visual impairments, providing valuable insights into the key performance patterns of high-level Para athletes.

5. Practical Applications

The findings of this study are crucial for refining training and competition strategies for judo athletes with visual impairments. By identifying the consistent use of specific techniques (Group 1 and Group 10) across multiple Paralympic cycles, coaches and trainers can focus on developing these techniques in training, tailoring their approach to align with the preferences and strengths of judo athletes with visual impairments

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