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Are Technical and Timing Components in Para-Badminton Classifications Different?

¿Son diferentes los componentes técnicos y de tiempo en las clasificaciones de parabádminton?

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Abstract

Considering the smaller number of studies investigating Para-Badminton (PBd) and the need to understand the technical, tactical and functional classes, the purpose of this research is to investigate the frequency of technical components and timing characteristics in the PBd categories of WH1(Wheelchair/severe impairment) and WH2 (Wheelchair/minor impairment) and to compare between classes. Twenty PBd matches were analyzed in the men's individual category at the 11th World PBd Championship. The mean playing time of the matches was 1,780 (± 575) s for the WH1 class and 2,012 (± 1,098) s for WH2. The average rally time was 10.2 (± 8.4) min for the WH1 and 12.5 (± 12.5) min for WH2. The mean pause time was 15 (± 10.3) s for the WH1 class and 14.1 (±10.5) s for the WH2. The mean number of shots per game was 552 (±197) and 719 (±480) for class WH1 and WH2 respectively. In both classes: the most frequent shots performed by the players were Clear, Lob, Drop, and Net-shot; the players used backhand more often than the forehand service and the short service compared to the long one; the errors stood out in relation to the winner points. In addition, there was a higher proportion of shots at the front of the court in both classes. It was found that the WH2 class showed a higher intensity (longer rally time and shorter pause time) and a higher frequency of technical actions (higher number of shuttle hits) when compared to the WH1. This information can assist coaches during training to guide the development of the temporal and technical aspects of the PBd, as well as monitor them during matches to obtain victory.

Keywords: *Paralympic sport; notational analysis; Para-Badminton; physical disabilities.*

Resumen

Teniendo en cuenta la reducida cantidad de estudios con el parabádminton (PBd) y la necesidad de entender las clases técnicas, tácticas y funcionales, el objetivo de esta investigación es indagar la frecuencia de los componentes técnicos y las características de tiempo en las categorías WH1 (silla de ruedas/discapacidad severa) y WH2 (silla de

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ruedas/discapacidad menor) de PBd, así como comparar dichos datos entre clases. Se analizaron veinte partidos de PBd en la categoría individual masculina en el 11° Campeonato Mundial de PBd. El tiempo medio de juego de los partidos fue de 1780 segundos (SD = 575) para la clase WH1 y 2012 segundos (SD = 1098) para WH2. El tiempo promedio de peloteo fue de 10,2 minutos (SD = 8,4) para WH1 y 12,5 (SD = 12,5) para WH2. El promedio relacionado con el tiempo de pausa fue de 15 segundos (SD = 10,3) para la clase WH1 y 14,1 (SD = 10,5) para la WH2. El número medio obtenido de golpes en el volante por partido fue de 552 (SD = 197) y 719 (SD = 480) para la clase WH1 y WH2, respectivamente. En ambas clases, los golpes más frecuentes realizados por los jugadores fueron *Clear, Lob, Drop y Net-shot*; los jugadores utilizaron más el servicio de revés que el de derecha y el servicio corto en comparación con el largo; los errores se destacaron en relación con los puntos ganadores. Además de esto, hubo una mayor proporción de golpes en la parte delantera de la cancha en ambas clases. Se encontró que la clase WH2 mostró mayor intensidad (mayor tiempo de peloteo y menor tiempo de pausa) y mayor frecuencia de acciones técnicas (mayor número de golpes en el volante) en comparación con la WH1. Esta información puede ayudar a los entrenadores para orientar el desarrollo de los aspectos temporales y técnicos del PBd, así como a monitorearlos durante los partidos para obtener la victoria.

Palabras clave: *Deporte paralímpico, análisis notacional, parabádminton, discapacidades físicas.*

Introduction

Para-Badminton (PBd) is a sport that is on the rise worldwide and presents itself with a promising future following its inclusion in the Paralympic Games (IPC, 2014). PBd is a racket sport with individual or doubles matches across five events: men's and women's singles, men's and women's doubles, and mixed doubles, each requiring specific preparation in terms of technique, control, and physical fitness. Besides, the basic rules of the sport have adaptations to the playing court and additional equipment, under the players' classification and event (BWF, 2020).

The classification systems aim to ensure that para-athletes achieve sporting excellence regardless of their disability (Tweedy & Vanlandewijck, 2011; Ungerer, 2018). Each Paralympic sport determines its functional classification system for physical disabilities (Beckman, Connick & Tweedy, 2017). This system is based on functional skills and specific assessments that allocate para-athletes to specific sports classes (Ungerer, 2018) to warrant fairness in the competition (Tweedy, Mann & Vanlandewijck, 2016; Tweedy & Vanlandewijck, 2011). Based on these assessments, there are six classifications in PBd: WH1 and WH2 for wheelchair users; SL3, SL4, and SU5 for ambulant players; SH6 for short stature (BWF, 2020). Specifically, the types of disabilities eligible to participate in PBd include decreased muscle strength, decreased range of motion, athetosis, hypertonia, ataxia, limb deficiency, differences in limb length and short stature (BWF, 2020).

Regarding sports performance, it becomes common in conventional Badminton, analysis of matches components, and indicators of performance success (Chiminazzo et al., 2017; Chiminazzo et al., 2018). The quantification of strokes performed during matches provides useful information to establish performance-specific training prescription parameters (Fernandez-Fernandez, Sanz-Rivas & Mendez-Villanueva, 2009). Notational analysis provides an objective assessment of an individual's performance through the analysis of selected variables, therefore providing useful feedback for coaches and players to improve performance (Phomsoupha & Laffaye, 2015).

While there are some studies exploring PBd in the literature, these are comparatively few compared to conventional Badminton (Strapasson, et al., 2017; Strapasson et al., 2018). Although the structure of PBd is similar to Badminton, issues related to functional classes must be investigated to ensure the principle of fairness in the competition (Tweedy et al., 2016). These classification systems group athletes into classes to minimize the impact of disability on the outcome of the competition (Tweedy et al., 2016; Tweedy & Vanlandewijck, 2011). The literature has indicated that functional classes are factors that differentiate sports performance in training or competition contexts (Antunes et al., 2017; Burkett et al., 2018; Rhodes, Mason, Malone & Goosey-Tolfrey, 2015). Despite this, discussions regarding sports classes, functionality, and performance potential are still constant in different Paralympic modalities (Antunes et al., 2017; Burkett et al., 2018; Tweedy et al., 2016; Tweedy & Vanlandewijck, 2011; Ungerer, 2018).

Considering the lack of studies with PBd athletes (Strapasson et al., 2017; Strapasson et al., 2018) and the need to understand the technical, tactical and functional classes of the sport, the purpose of this research was to investigate the frequency of technical components and timing characteristics in categories WH1 and WH2 of PBd, and to compare between classes.

Materials and Methodology

From a total sample of 58 players (n = 33 WH1 - Wheelchair / severe impairment; n = 25 WH2 - Wheelchair / minor impairment), 20 PBd matches from the men's singles category at the 11th World PBd Championship held in Ulsan, South Korea, in 2017 were randomly selected for analysis. The analysed games involved 28 players in the WH1 and 14 players in WH2 categories; performance was coded from the group phase to the finals. The matches were recorded using three camcorders (JVC® brand), installed on tripods positioned in the cabin reserved for television professionals, thus providing coverage of the entire playing court. Subsequently, the matches were watched and analyzed by one of the researchers who transcribed the data to a spreadsheet in Microsoft Excel® 2016. It should be emphasized that a single evaluator was responsible for recording the data, thus avoiding the variability of information and the adoption of different technical criteria.

One match was randomly selected to be analyzed on two separate occasions by the same evaluator. There was an interval of 10 days between the analysis so that the observation was not influenced by the memory of previous observations when recording the different game situations. This process allowed the determination of intra-observer reliability. The intra-class correlation coefficient (ICC - mixed bidirectional effects, consistency) was used to test the reliability between rally-time observations, the number of shots and pause time. The ICC results (ICC3.1 = 1.00; CI95% = 0.99 to 1.00; p < 0.001) indicated reliable values for game observations (Landis & Koch, 1977).

Variables Analyzed

For the analysis of temporal aspects, the match duration, the duration of rallies, the pause time, and the number of shots per rally were verified. The occurrence of the following technical actions of the game: Service, Clear, Smash, Lob/Lift, Net-shot, Drop and Drive, Winners Points (WP), Forced Errors (FE) and Unforced Errors (UE) were also recorded for the analysis of spatial aspects, the sectors of the court were divided into two zones (Front and Back), to indicate the areas on the court where the winning point shuttle fell most frequently.

Data Analysis

Descriptive statistics composed of mean, standard deviation (SD), confidence interval (95%CI) and frequency distribution (absolute and relative) were used to summarize the data. The Cohen's effect size (ES) (d - continuous data, w - for chi² test, odds ratio - data frequency) and percent delta (Δ%) were calculated to examine the differences between variables.

The Kolmogorov-Smirnov test demonstrated that the variables did not exhibit normal distribution (rally time: K-S = 0.164; p < 0.001; number of shots: K-S = 0.177; p < 0.001 and pause time: K-S = 0.164249; p < 0.001). The Mann-Whitney U test was used to compare rally time, the number of shots, and the pause time between WH1 and WH2 classes. The comparison of number of shot between WH1 and WH2 was performed using the chi² test (χ^2). The effect size Cohen's was used for quantifies the magnitude of the difference in means (*D*) and in chi-square test (*w*).We used a value of α = 5% to identify significant differences between classes.

Results

The mean playing time of the matches was 1,780 (± 575) s for the WH1 class and 2,012 (± 1098) s for WH2. Table 1 presents the results for the duration of rallies, shots and pause time for PBd matches. Table 1 presents the descriptive results and comparison between WH1 vs. WH2 Classes.

Table 1.
Descriptive results and comparison between WH1 vs WH2 Classes.

	Rally Time (min)		Shots (#)		Pause Time (s)	
	WH1	WH2	WH1	WH2	WH1	WH2
Mean (SD)	10.2 (8.4)	12.5 (12.5)	8.0 (7.0)	10.0 (10.0)	15.0 (10.3)	14.1 (10.5)
CI95%	9.5 to 10.9	11.6 to 13.4	8 to 9	9 to 11	14.2 to 15.8	13.3 to 14.9
D	0.2 (small; -0.4 to -0.03)		0.3 (small; -0.4 to -0.04)		0.1 (trivial; -0.1 to 0.3)	
Δ%	23.0 %		27%		-6%	
M-W test	Z = -1.942, p = 0.05		Z = -3.064, p = 0.002		Z = -5.835, p < 0.001	

Legend: CI95% = 95% confidence interval; D = Cohen's effect size; Δ% = percent of change; M-W test: Mann-Whitney U test.

The mean number of shots per game obtained was 552 (±197) and 719 (±480) for class WH1 and WH2, respectively. The WH2 players showed a higher frequency of technical actions (*p* < 0.001; effect size *w* = 0.3 to 1.3; medium to large), in Drive (*w* = 1.3; large) and Smash (*w* = 0.8; large) and in short forehand and backhand services (*w* = 0.6; large). Table 2 shows that the most frequent shots performed by the players in both classes, Clear, Lob, Drop, and Net-shot.

The association between from the points coming from winners, unforced errors and unforced errors these variables was not significant (χ^2 = 0.89; p = 0.64; w = 0.1 - small).

There was a higher proportion of shots at the front of the court in both classes. The chi-square test was conducted to examine the relationship between functional classes and the region of the court where most winners occurred. The association between these variables was non-significant (χ^2 = 1.41; p = 0.23; w = 0.1 - small).

Table 2.
Absolute and relative frequency of shots performed by players.

Shots	WH1 n (%)	WH2 n (%)	Chi-square test (effect size w, category)
Clear	1982 (43%)	2635 (57%)	χ^2 = 92.35, p < 0.001* (w = 0.3; medium)
Drive	23 (23%)	79 (77%)	χ^2 = 30.74, p < 0.001* (w = 1.3; large)
Drop	737 (40%)	1102 (60%)	χ^2 = 72.44, p < 0.001* (w = 0.4; medium)
Lob	870 (37%)	1463 (63%)	χ^2 = 150.73, p < 0.001* (w = 0.5; large)
Net-shot	525 (37%)	903 (63%)	χ^2 = 100.06, p < 0.001* (w = 0.5; large)
Short Forehand Service	146 (43%)	197 (57%)	χ^2 = 16.71, p < 0.001* (w = 0.5; large)
Long Forehand Service	118 (65%)	63 (35%)	χ^2 = 16.71, p < 0.001* (w = 0.6; large)
Short Backhand Service	200 (37%)	336 (63%)	χ^2 = 34.50, p < 0.001* (w = 0.5; large)
Long Backhand Service	150 (56%)	116 (44%)	χ^2 = 4.34, p < 0.037* (w = 0.3, medium)
Smash	128 (31%)	281 (69%)	χ^2 = 57.23, p < 0.001* (w = 0.8; large)
Total	4879 (40%)	7175 (60%)	χ^2 = 437.30, p < 0.001* (w = 0.4; medium)

Legend: Small, medium and large effect sizes as defined by Cohen (1988).

Discussion

The result of this research shows that in the WH2 classification matches, the rallies last longer, players have more shots, and the pause time between games was shorter compared to the WH1 class. It is possible that these differences occurred due to the characteristics of both classifications. The PBd players allocated to the WH2 class present impairment in one or both lower limbs and minimal or non-existent impairment of the trunk whereas, WH1 class players have a greater motor impairment, especially in the lower limbs and trunk function (Latino, Cassese & Tafuri, 2018). The more pronounced impairment of the trunk function that affects WH1 class players influences the movement speed on the court (Haydon, Pinder, Grimshaw & Robertson, 2018) and it may be associated with the fact that they had fewer hits, less rally time, as well as taking more time to retrieve the shuttle from the floor increasing the pause time. Thus, it appears that the motor limitation of WH1 players directly impacts the match dynamics.

Despite the statistical differences in "number of shots" and "pause time" between classes, this result should be observed with caution. The comparison between these variables was small and trivial, which indicates the need for further investigations to avoid overvaluing the observed differences.

The findings in this study indicate a greater match volume in WH2 class matches due to an increased number of shots, longer average rally time, and shorter pause time when compared to the WH1 class. In this way, it is possible to affirm that the intensity in the WH2 class matches may be associated with the greater mobility capacity of players in this class (Strapasson et al., 2017).

Additionally, players of the WH2 class showed a higher frequency of technical actions in "Drives" and "Smashes" compared to the WH1 class. The "Drive" is one of the fastest shots in Badminton and commonly used in doubles matches (Cabello-Manrique & Gonzalez-Badillo, 2003). The superior trunk control and stability of the WH2 class players, as well as faster reaction speeds and movements with the wheelchair (Rietveld et al., 2019), may explain the greater use of the "Drive" in this class compared to WH1.

In the case of the Smash, the WH2 class players showed a higher frequency of executing this shot when compared to the WH1 class players. The "Smash" is a strike on the shuttle that is executed above the headline and with a descending trajectory at maximum speed, aiming to hit the floor as quickly as possible (Strapasson et al., 2017). The results confirmed that the use of a Smash by a player in a wheelchair depends directly on the level of motor impairment. An indication of this was that WH2 class players showed greater use of this shot compared to WH1 class players, mainly due to the greater impairment of WH1 players' trunk function (Latino et al., 2018).

As for services, players of both classes used backhand more often than the forehand service and the short service compared to the long one. Varying the types of services cause unpredictability and makes it difficult for the opponent to return them (Phomsoupha & Laffaye, 2015). The WH2 class players prefer to use short backhand and forehand services, while the WH1 class has a preference for long services (forehand and/or backhand). Additionally, in PBd, the backhand service is more commonly used and is associated with stability due to a minimization of trunk imbalance. The backhand service is performed with two arms close to the body without requiring high levels of joint amplitudes. In this way, this would be a tactical indication for matches in which the opponent has a decrease in passive range of movement and hypertonia, eligible conditions for PBd players. In this sense, world-class players prefer to serve short to prevent their opponents from gaining an offensive advantage (Fernandez-Fernandez et al., 2009; Phomsoupha & Laffaye, 2015).

Another observation resulting from this study is related to the higher frequency of unforced errors in both classes, signaling a lack of consistency in the match, which leads them to make many mistakes during the game. One of the characteristics of Badminton is the accuracy; therefore, players who make fewer mistakes are more likely to win a match (Abian-Vicent, Castanedo, Abian & Sampedro, 2013; Chiminazzo et al., 2017; Cabello-Manrique & Gonzalez-Badillo, 2003). These results suggest that the consistency of shots and winner points are a decisive factor towards the final result. These results are repeated in each sport class.

In relation to the region of the court where most winning points occurred, the front was the most frequent in both classes. The area at the front of the court is the most vulnerable part, and it relates to the offensive game strategy (Phomsoupha & Laffaye, 2015; Strapasson et al., 2017; Ribeiro & Almeida, 2020). The decision to use this strategy in PBd can be explained by the difficulty in reaching the shuttle due to the sitting position and the players' trunk flexion difficulties, common in wheelchair players (Beckman et al., 2017; Zemková, Muyor & Jeleň, 2018).

Despite the small number of matches analyzed, the results of this research provided additional knowledge about the sport, in view of the limitation in the number of publications relating to PBd. New and further studies, to verify the other PBd classes would be required, for both male and female, in individual and doubles categories. Another area of study would be regarding the main types of shots which lead to unforced errors. Related studies on the distance that a player moves on the court would also provide greater insights into the demands of PBd.

Conclusion

This study concludes that there are significant differences between the WH1 and WH2 classes. These sports classifications that allocate similar disabilities in predetermined classes are a fundamental requirement for providing a level playing field for players. The classes' main differences are the higher intensity in WH2 class matches and technical aspects with greater frequency of technical actions performed by WH2 players, including shots that require more speed, like the Drive or Smash. The information generated in this research can assist coaches during training to guide the development of the temporal and technical aspects of the PBd, as well as monitor them during matches to obtain victory.

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