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Original

ACCIONES TÉCNICO-TÁCTICAS DE GANADORES EN TAEKWONDO MASCULINO SÚPER-ELITE

TECHNICAL-TACTICAL ACTIONS THAT LEAD TO WINNING IN MALE TAEKWONDO IN SUPER-ELITE COMBATS

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RESUMEN

El análisis técnico-táctico en los combates de taekwondo muestran puntos relevantes para lograr el máximo rendimiento. El presente estudio comparó el análisis técnico-táctico por frecuencias, tiempo absoluto y razón de tiempo, analizando deportistas masculinos que compitieron en la final del Gran Premio de taekwondo. Para esto, se aplicó un protocolo específico donde se comparó elementos de interacciones técnicas y tácticas de combates masculinos. Los principales resultados demostraron que las acciones técnico-tácticas en los ganadores mostraron una mayor frecuencia de ataques resultando en 1 punto [3.0 (1.0; 5.3) vs. 6.5 (3.8; 10.0), $p \geq 0.001$]; a su vez, los perdedores mostraron una mayor frecuencia de desplazamientos posteriores [18.5 (13.5; 24.0) frente a 11.5 (6.8; 21.0); $p=0.031$], mientras que para el tiempo absoluto se encontraron diferencia en las variables *Titchagui* ($p=0.037$), *Cover kicks* ($p=0.024$), *Punch* ($p = 0.028$), donde los perdedores demostraron mayor frecuencia. En conclusión, los deportistas ganadores mostraron una mayor eficiencia al realizar ataques que resultan en 1 y 3 puntos; por otro lado, los deportistas derrotados mostraron mayor frecuencia en el uso de técnicas que son menos efectivas para ganar puntuaciones, junto con mayores desplazamientos posteriores.

Palabras clave: Desempeño y análisis de tareas, artes marciales, estudios de tiempo y movimiento, desempeño atlético.

ABSTRACT

A technical-tactical analysis in taekwondo matches pointed out crucial points to achieve maximum performance. This study compared the technical-tactical analysis by frequencies, absolute time and time ratio among male athletes who competed in the final taekwondo Grand Prix. For this, we applied a specific protocol, this study compared elements of technical and tactical interactions of male competitive matches. The main results showed that the technical-tactical actions, winners showed a higher frequency of attacks resulting in 1-point [3.0 (1.0; 5.3) vs. 6.5 (3.8; 10.0), $p \geq 0.001$]; in turn, losers showed a higher frequency of rear displacement [18.5 (13.5; 24.0) vs. 11.5 (6.8; 21.0); $p=0.031$]. There was a difference between the absolute time devoted to the variables *Titchagui* ($p=0.037$), *Cover kicks* ($p=0.024$), *Punch* ($p=0.028$), where losers had a higher frequency. In conclusion, winning athletes showed a higher efficiency in making attacks that result in 1 and 3 points; on the other hand, defeated athletes demonstrate more frequency regarding the use of techniques which are less effective in terms of scoring and move further back.

Keywords: Task performance and analysis, martial arts, time and motion studies, athletic performance.



INTRODUCTION

Competitive taekwondo is characterized as an intermittent sport; the competitors perform high-intensity attacks preceded by a period of low-intensity effort during combat (Falco, Estevan, Álvarez, Morales-Sánchez, & Hernández-Mendo, 2014; Cristina Menescardi, Falco, Ros, Morales-Sánchez, & Hernández-Mendo, 2019; Cristina Menescardi, Lopez-Lopez, Falco, Hernandez-Mendo, & Estevan, 2015). Taekwondo entered the Olympic games in 2000, and since then there have been several changes to the rules (Janowski, Zieliński, & Kusy, 2019). Thus, specific demands have emerged which can modify athletes' preparations for competition. This fact has resulted in greater interest by countries in investing in studies and technologies to adapt to the new demands of sport (Sevinç & Çolak, 2019). In this context, studies of technical-tactical analysis (TT) have been developed in recent years to provide data in fighting situations which enables planning and prescription of specialized training (Falco et al., 2014; Cristina Menescardi et al., 2019).

TT Analysis can be a vital reference to instruct coaches to understand how combat sport behaves in real situations, thereby allowing greater detail of the effective actions in the weight divisions (C. Menescardi, Falco, Ros, Morales-Sanchez, & Hernandez-Mendo, 2019; Tabben, Miarka, Chamari, & Beneke, 2018; Tornello et al., 2014). In addition, with the obtained data coaches can prescribe specific training for athletes, since these data allow to verify speed and frequency of strokes performed during combat (Cristina Menescardi et al., 2019). In this line of analysis, Falco et al. (2014) observed that winning athletes differ from others in terms of the speed at which they apply the strokes, especially the techniques applied in counterattack.

Other studies which have carried out a TT analysis in taekwondo matches pointed out crucial points to achieve competitive excellence in performance (Cristina Menescardi et al., 2015). Among the decisive actions, we highlight the effective execution of procedures and counterattacks, anticipation of strikes, and simultaneous counterattacks (Falco et al., 2014). Furthermore, Tornello et al. (2014) suggested that coaches should prescribe different attack and counterattack sequences to increase the ability to respond to the opponent during combat. However,

the studies mentioned above were carried out with university athletes and cadets. New approaches which analyse elite athletes can present more specific information to coaches who aim to place their athletes among the world champions and Olympic medallists. Therefore, this study aimed to compare the TT analysis by frequencies, absolute time, and time ratio among male athletes who competed in the final taekwondo Grand Prix. We hypothesize that winning athletes have a higher frequency of efficient technical-tactical actions versus the losers

METHODS

Experimental approach

This is characterized as a descriptive study addressing description, correlation and comparison of the TT analysis of male competitive Taekwondo (TKD) athletes. Firstly, official videos of the matches for each weight division were collected to assess the performed techniques. The study was performed by analysing videos from the Grand Prix Final 2014 (Querétaro, Mexico). It is a super-elite championship. Only the eight best athletes by weight division were invited. The analyses were performed by videos collected from the Internet on the official World Taekwondo Federation (WTF) channel. The respective study was approved by the local Human Research Ethics Committee, following resolution 196/96 of the National Health Council and the WMA Declaration of Helsinki.

Video sample

All the championship matches were analysed. These bouts represented 188 performances (two athletes per round) in 94 rounds (32 matches). Of these, 43 results were defined by summing points, seven by a 12-point difference, four by withdrawal, and 10 by sudden death, or golden score. The athletes were aged between 18-28 years in all divisions, of which: men up to 58 kg (n=46), up to 68 kg (n=40), up to 80 kg (n=50) and above 80 kg (n=40).

Technical-tactical analysis protocol

An expert evaluator (with more than 15 years of practice and competition) affiliated to the Brazilian Taekwondo Federation and the Brazilian Olympic Committee carried out video capture and analysis. The hardware used was: a) high-performance video



computer (Intel®, SP, Brazil); and b) a high-performance tablet (Samsung® Galaxy, Seoul, South Korea). We used a valid protocol (Barrientos et al., 2021) for the present study which consists of the following technical-tactical variables: a) stand positioning; b) applied techniques; c) clinching; d) Pause, and; e) scores obtained for effective actions.

- a) *Positioning*: defined from the back leg adopted in the stance during the match. In addition to the right or left, the stance was also characterized as closed and open, with the closed stance being the situation in which the two athletes have the same leg positioned behind (and thus their front leg would hit the front of the opponent's protector). Open stance is the situation in which an athlete has one leg behind, for example, the right leg, and the other left leg in front (and thus, it would be the back leg which would hit the front of the opponent's protector more easily). Therefore, four basic possibilities for combat were defined: Right Open Stance (ROS), Left Open Stance (LOS), Right Closed Stance (RCS), Left Closed Stance (LCS).
- b) *Techniques*: the component of Taekwondo was classified into attack and counterattack actions. Kicking was considered when the athlete takes their foot off the ground until they return to it. Punching starts with the elbow extension movement until contact of the wrist with the opponent. These actions can be performed with the right or left limb being positioned in front or behind. The following techniques were selected in this protocol: 1. *Bandal chagui* (BAN); 2. *Dolyo chagui* (DOL); 3. *Dubal chagui* (DUB) - or *Nare chagui*; 4. *Furyo chagui* (FUR); 5. *Chagui Yop* (YOP) - or prop technique; 6. *Bitro chagui* (BIT); 7. *Titchagui* (TIT); 8. *Torgue chagui* (TOR); 9. *Mondolyo chagui* (MD). 10. Coverage kicks (COV), constituting a category which groups *Anchagui*, *Bakatchagui*, *Tigo chagui* and *Neryo chagui*; 11. Frontal Kicks (FRO), constituting a category which groups *Ap chagui* and *Miro chagui*; 12. Punch (PUN); and 13. Feints (FEIN), mostly characterized by a knee lift without the intention of completing a specific kicking technique.

- c) *Clinching*: clinching is a combat situation used by athletes in the hand-to-hand moment. It starts from the moment when the athletes shorten the distance until they touch and ends with the technical execution of one or both parties, mutual separation, and with the intervention of the main referee.
- d) *Pausing*: pausing in the match can be recurrent due to several factors: technical request, video replay, falling, leaving the contest area, penalty, medical assistance, or at the request of the referee. The main referee signals were considered for the start and the end of the break time.

Data processing and statistical analyses

The Statistical Package for Social Sciences 20.0 (SPSS) was used for statistical analysis. The data were presented in mean (M) ± standard deviation (SD) according to the frequency of the actions, total time, and relative actions by time; analyses of variance were conducted between the various technical and tactical variables, then followed by Tukey's post hoc if they were non-parametric, and the Kruskal-Wallis test was used followed by the Mann-Whitney test to compare the groups. A significance level of 5% was adopted in all analyses

RESULTS

The only attack variable which did not present any frequency was the *Yop chagi*. Table 1 demonstrates the technical-tactical analysis by median and quartiles of frequencies per TKD bout and comparisons by outcomes. For the technical-tactical actions, winners showed a higher frequency of attacks resulting in 1-point ($P \geq 0.001$); in turn, losers showed a higher frequency of rear displacement ($P = 0.031$). Table 2 shows the technical-tactical analysis by mean and SD per TKD bout and comparisons by outcomes.



Table 1. Descriptive and comparative analysis of technical-tactical actions of TKD bouts, separated by outcomes.

Technical-Tactical actions	Losers	Winners	Inferences			
	50 th (25 th ; 75 th)	50 th (25 th ; 75 th)	U	Z _{score}	P-value	ES
BAN	30.0 (20.0; 37.5)	28.5 (19.8; 53.5)	448.50	-0.02	0.982	0.00
ESC	11.0 (6.0; 21.0)	14.0 (6.0; 22.8)	405.50	-0.66	0.510	-0.08
BIT	0.0 (0.0; 0.3)	0.0 (0.0; 0.0)	419.50	-0.65	0.518	-0.08
BAD	7.5 (1.8; 17.5)	12.5 (1.0; 36.3)	399.00	-0.76	0.449	-0.09
CLI	12.0 (5.0; 24.0)	13.0 (5.0; 22.3)	449.00	-0.01	0.988	0.00
DOL	2.0 (1.0; 6.0)	3.0 (1.0; 6.3)	411.50	-0.57	0.566	-0.07
DUB	0.5 (0.0; 3.0)	1.0 (0.0; 3.0)	433.00	-0.26	0.792	-0.03
1 PT*	3.0 (1.0; 5.3)	6.5 (3.8; 10.0)	213.00	-3.52	≥0.001	-0.44
BAE	14.0 (1.0; 31.5)	9.5 (3.0; 21.8)	424.50	-0.38	0.706	-0.05
QUE	0.0 (0.0; 1.0)	0.5 (0.0; 2.0)	397.50	-0.85	0.393	-0.11
COB	3.0 (1.0; 5.0)	1.0 (0.0; 2.3)	283.50	-2.50	0.012	-0.31
FUR	0.0 (0.0; 1.0)	0.0 (0.0; 1.0)	399.50	-0.92	0.360	-0.11
3 PT	0.0 (0.0; 1.0)	0.5 (0.0; 2.0)	337.00	-1.90	0.057	-0.24
BFD	5.5 (0.0; 18.5)	7.5 (0.0; 19.8)	433.50	-0.25	0.805	-0.03
PRV QUE	0.0 (0.0; 1.0)	0.0 (0.0; 1.0)	448.00	-0.03	0.974	0.00
TIT	1.0 (0.0; 3.0)	0.5 (0.0; .10)	330.00	-1.86	0.063	-0.23
FRO	0.5 (0.0; 2.0)	0.0 (0.0; 1.0)	376.50	-1.21	0.228	-0.15
4 PT	0.0 (0.0; 0.0)	0.0 (0.0; 0.0)	435.00	-0.59	0.557	-0.07
BFE	8.0 (1.0; 20.0)	4.5 (0.8; 15.3)	409.50	-0.60	0.546	-0.08
PAU	12.5 (7.8; 24.3)	13.5 (7.8; 24.3)	447.00	-0.04	0.965	-0.01
MD	0.5 (0.0; .10)	0.0 (0.0; 1.0)	338.00	-1.92	0.055	-0.24
TOR	0.0 (0.0; 1.0)	0.0 (0.0; 0.0)	324.50	-2.39	0.017	-0.30
ATA	31.0 (25.5; 44.8)	33.0 (24.5; 47.3)	430.50	-0.29	0.773	-0.04
FRE	51.5 (38.8; 70.3)	60.5 (40.0; 77.3)	390.00	-0.89	0.375	-0.11
PEN	2.0 (0.0; 3.0)	2.0 (1.0; 4.3)	364.50	-1.29	0.198	-0.16
SOC	2.5 (1.0; 4.3)	1.0 (0.0; 3.0)	309.50	-2.11	0.035	-0.26
FIN	13.5 (4.0; 20.3)	12.0 (5.0; 19.0)	431.00	-0.28	0.779	-0.04
C ATA	21.0 (17.0; 34.3)	26.0 (18.8; 35.5)	422.00	-0.41	0.678	-0.05
TRA	18.5 (13.5; 24.0)	11.5 (6.8; 21.0)	304.00	-2.16	0.031	-0.27
FIM	3.0 (3.0; 3.0)	3.0 (3.0; 3.0)	436.50	-0.32	0.748	-0.04

50th = median; 25th = 1st quartile; 75th = 3rd quartile; U = Mann Whitney calculated; ES = effect size; BAN = Bandal chagi; ESC = Block Kick; BIT = Bitro chagi; BAD = Right Open Stance; CLI = Clinch; DOL = Dolyo chagi; DUB = Dubal chagi; 1 PT = 1 point scored; BAE = Left Open Stance; QUE = Projection; COB = Cover kicks; FUR = Furyo chagi; 3 PT = 3 points scored; BFD = Base Right Closed Stance; PRV QUE = Induced projection; TIT = Titchagui; FRO = Frontal kicks; 4 PT = 4 points scored; BFE = Left Closed Stance; PAU = pause; MD = Mondolyo chagi; TOR = Torgue chagi; ATA = attack; FRE = displacement; PEN = penalty; SOC = Punch; FIN = Feint; C ATA = counterattack; TRA = Rear displacement; FIM = round finished. * P≤0.031 winners vs. losers.



There was a difference between the absolute time devoted to the variables TIT ($p=0.037$), COB ($p=0.024$), and SOC ($p=0.028$), where losers had a higher frequency. On the other hand, winners had significantly more time dedicated to actions that result in 1PT ($p=0.035$) and 3PT ($p=0.023$). Table 3 shows the relative technical-tactical action-time by mean and SD of TKD bout and comparisons by outcomes.

The main results of Table 3 indicate that there was a significant difference for 1PT when analyzing the variables for the relative time by action, where winners had a higher frequency of actions per time ($p=0.043$) and losers showed a higher relative frequency for the TRA ($p=0.048$).

Table 2. Descriptive and comparative analysis of technical-tactical actions-time of TKD bouts, separated by outcomes (seconds).

T-t action/groups		Mean±SD	t	df	p-value	95% CI of the Difference	
						Lower	Upper
BAN	LOS	22.8±10.8	0.065	58	0.949	-6.0; 6.4	
	WIN	22.6±13.0		56			
BIT	LOS	0.2±0.5	0.0	58	1.0	-0.3; 0.3	
	WIN	0.2±0.6		57			
DOL	LOS	2.6±3.2	-0.712	58	0.479	-2.7; 1.3	
	WIN	3.3±4.4		53			
DUB	LOS	1.1±1.8	0.393	58	0.696	-0.7; 1.1	
	WIN	0.9±1.5		57			
FUR	LOS	0.3±0.7	-0.405	58	0.687	-0.8; 0.5	
	WIN	0.5±1.7		38			
TIT	LOS	1.8±2.7	2.140	58	0.037	0.1; 2.6	
	WIN	0.6±1.3		41			
MD	LOS	0.7±1.5	1.725	58	0.090	-0.1; 1.8	
	WIN	0.2±0.4		33			
TOR	LOS	0.8±1.8	1.466	58	0.148	-0.2; 1.3	
	WIN	0.3±1.1		48			
FRO	LOS	0.6±1.3	0.735	58	0.465	-0.3; 0.7	
	WIN	0.4±0.8		50			
COB	LOS	2.6±2.6	2.320	58	0.024	0.2; 2.5	
	WIN	1.3±1.8		53			
SOC	LOS	09.3±10.7	2.250	58	0.028	0.6; 9.6	
	WIN	04.3±6.1		46			
ATA	LOS	25.6±14.5	0.363	58	0.718	-5.9; 8.5	
	WIN	24.3±13.2		58			
C ATA	LOS	18.5±9.4	-0.175	58	0.862	-5.4; 4.5	
	WIN	18.9±9.8		58			
1 PT	LOS	19.2±19.5	-2.160	58	0.035	-23.7; -0.9	
	WIN	31.5±24.4		55			
3 PT	LOS	2.2±4.8	-2.334	58	0.023	-11.6; -0.9	
	WIN	8.5±13.8		36			
4 PT	LOS	1.7±8.1	1.056	58	0.295	-1.4; 4.5	
	WIN	0.1±0.7		29			
ESC	LOS	7.9±6.5	-1.357	58	0.18	-6.9; 1.3	
	WIN	10.7±9.3		52			
CLI	LOS	43.4±30.6	-0.420	58	0.676	-20.8; 13.6	
	WIN	47.0±35.6		57			
FIN	LOS	5.7±4.3	0.090	58	0.929	-2.1; 2.3	
	WIN	5.6±4.3		58			
FRE	LOS	259.2±146.5	-0.772	58	0.443	-113.8; 50.5	
	WIN	290.9±170.5		57			
TRA	LOS	83.6±54.5	1.332	58	0.188	-9.7; 48.2	
	WIN	64.3±57.5		58			



BAD	LOS	91.5±116.7	-1.362	58	0.178	-116.6; 22.2
	WIN	138.7±149.6		55		
BAE	LOS	147.0±153.7	1.376	58	0.174	-22.1; 118.9
	WIN	98.6±116.5		54		
BFD	LOS	70.2±88.0	-0.042	58	0.966	-46.6; 44.7
	WIN	71.1±88.7		58		
BFE	LOS	81.9±105.6	0.700	58	0.487	-32.9; 68.3
	WIN	64.2±89.7		57		
QUE	LOS	1.5±2.6	-1.507	58	0.137	-4.0; 0.6
	WIN	3.2±5.7		41		
PAU	LOS	173.2±117.6	-0.024	58	0.981	62.1; 60.7
	WIN	173.9±120.2		58		
PEN	LOS	17.2±21.6	1.041	58	0.302	-0.2; 13.4
	WIN	12.6±10.8		43		
FIM	LOS	0.2±0.9	-1.631	58	0.108	-26.7; 2.7
	WIN	12.1±40.3		29		

BAN = Bandal chagi; BIT = Bitro chagi; DOL = Dolyo chagi; DUB = Dubal chagi; FUR = Furyo chagi; TIT = Titchagui; MD = Mondolyo chagi; TOR = Torgue chagi; FRO = Frontal kicks; COB = Cover kicks; SOC = Punch; ATA = attack; C ATA = counterattack; 1 PT = 1 point scored; 3 PT = 3 points scored; 4 PT = 4 points scored; ESC = Block Kick; CLI = Clinch; FIN = Feint; FRE = displacement; TRA = Rear; BAD = Right Open Stance;; BAE = Left Open Stance; BFD = Base Right Closed Stance; BFE = Left Closed Stance; QUE = Projection; PRV QUE = Induced projection was 0 to winning and losing groups; PAU = pause; PEN = penalty; FIM = round finished.

Table 3. Descriptive and comparative analysis of technical-tactical actions-time of TKD relative time by action, separated by outcomes.

T-t action/ groups	Mean±SD	t	df	p-value	95% CI of the Difference	
					Lower;	Upper
BAN	LOS	24.6±12.4	-0.319	58	0.751	-6.2; 16.7
	WIN	23.8±13.1				56
BIT	LOS	0.1±0.1	0.453	58	0.652	-0.1; 4.5
	WIN	0.01±0.1				56
DOL	LOS	0.6±1.4	0.020	58	0.984	-0.6; 0.1
	WIN	0.6±1.1				55
DUB	LOS	0.4±0.8	0.611	58	0.544	-0.3; 0.7
	WIN	0.3±0.7				55
FUR	LOS	0.1±0.1	-0.568	58	0.572	-0.2; 1.5
	WIN	0.1±0.4				37
TIT	LOS	0.7±1.9	1.097	58	0.277	-0.3; 1.2
	WIN	0.3±0.9				40
MD	LOS	0.1±0.1	1.533	58	0.131	-0.1; 0.1
	WIN	0.1±0.1				34
TOR	LOS	0.4±0.9	1.974	58	0.053	-0.0; 0.7
	WIN	0.1±0.1				30
FRO	LOS	0.1±0.3	-0.110	58	0.913	-0.2; 0.2
	WIN	0.1±0.3				58
COB	LOS	0.9±1.6	0.476	58	0.636	-0.7; 2.7
	WIN	0.7±1.7				58
SOC	LOS	3.0±4.3	0.036	58	0.972	-2.6; 2.7
	WIN	2.9±5.9				54
ATA	LOS	7.9±14.3	1.951	58	0.056	-0.1; 11.3
	WIN	2.3±6.3				40
C ATA	LOS	3.2±4.1	0.714	58	0.478	-1.2; 2.6
	WIN	2.5±3.3				56
1 PT	LOS	5.5±13.9	-2.070	58	0.043	-17.9; 11.3
	WIN	14.6±19.7				
3 PT	LOS	0.8±2.4	-1.349	58	0.183	-05.8; 2.6
	WIN	3.2±9.2				33
4 PT	LOS	1.6±8.0	1.079	58	0.285	-1.4; 4.5
	WIN	0.0±0.0				29
ESC	LOS	0.3±0.3	-1.271	58	0.209	-0.3; 0.2



	WIN	0.4±0.4		51		
CLI	LOS	8.8±15.2	-0.251	58	0.802	-10.6; 21.4
	WIN	10.0±20.9		53		
FIN	LOS	1.8±2.8	0.102	58	0.919	-1.3; 1.5
	WIN	1.7±2.7		58		
FRE	LOS	8.6±4.7	-0.764	58	0.448	-4.3; 1.9
	WIN	9.8±7.1		50		
TRA	LOS	3.7±3.3	2.016	58	0.048	0.1; 2.6
	WIN	2.3±1.6		42		
BAD	LOS	20.0±0	-0.061	58	0.952	-38.9; 3.9
	WIN	21.2±0		56		
BAE	LOS	33.2±53.6	0.777	58	0.44	-15.9; 1.9
	WIN	23.1±46.6		57		
BFD	LOS	20.1±53.6	-0.143	58	0.887	-32.1; 2.7
	WIN	2.3±6.4		57		
BFE	LOS	1.6±6.3	1.384	58	0.172	-0.7; 3.9
	WIN	0.1±0.2		29		
QUE	LOS	0.5±2.1	0.484	58	0.631	-0.6; 0.3
	WIN	0.3±0.8		38		
PAU	LOS	28.5±50.3	-0.380	58	0.705	-31.4; 21.4
	WIN	33.5±51.8		58		
PEN	LOS	0.4±0.4	0.852	58	0.398	-0.1; 0.3
	WIN	0.3±0.4		57		
FIM	LOS	0.01±0.1	-1.379	58	0.173	-2.3; 0.4
	WIN	0.9±3.7		29		

BAN = Bandal chagi; BIT = Bitro chagi; DOL = Dolyo chagi; DUB = Dubal chagi; FUR = Furyo chagi; TIT = Titchagui; MD = Mondolyo chagi; TOR = Torgue chagi; FRO = Frontal kicks; COB = Cover kicks; SOC = Punch; ATA = attack; C ATA = counterattack; 1 PT = 1 point scored; 3 PT = 3 points scored; 4 PT = 4 points scored; ESC = Block Kick; CLI = Clinch; FIN = Feint; FRE = displacement; TRA = Rear; BAD = Right Open Stance; BAE = Left Open Stance; BFD = Base Right Closed Stance; BFE = Left Closed Stance; QUE = Projection; PRV QUE = Induced projection was 0 to winning and losing groups ; PAU = pause; PEN = penalty; FIM = round finished.

DISCUSSION

Specific and accurately planned strategies are determining factors for success in competitive Taekwondo (Cristina Menescardi et al., 2019). In this sense, different technical-tactical analysis protocols were applied to athletes in this combat sport for better scientific understanding of the tactical behaviour of high-performance athletes (Barrientos et al., 2021; C. Menescardi et al., 2019; Cristina Menescardi et al., 2019). Therefore, the purpose of the present study was to compare technical and tactical analysis by frequencies, absolute time and time ratios between outcomes from international TKD athletes. The main results demonstrated significant differences between outcomes of TKD athletes; winning bouts demonstrated higher frequencies of 1 PT and losers showed a higher frequency for COB, TOR, SOC and TRA actions. The main difference regarding action-time was observed in absolute time; winners demonstrated longer 1 PT and 3 PT action time than losers, while losers showed a higher time dedicated

to TIT, COB and SOC. Winners showed a higher 1PT score regarding relative time, and TKD losers had a longer relative time for TRA actions. The present results can be applied in elaborating contextualized training for high-performance athletes, since the present protocol focused on analysing actions and decision making by super-elite athletes, differentiating winners and losers.

Our data indicate that winning athletes have a higher frequency than results in 1PT and 3PT; these findings are in line with those observed by Olympic medallists. Our analyses indicate little difference in the total number of attacks between winners and losers. Thus, we believe that the main differences between athletes are associated with the speed and accuracy of attacks as previously observed (Falco et al., 2014; Cristina Menescardi et al., 2019; Cristina Menescardi et al., 2015). When comparing the actions performed by two Olympic medallists, Cristina Menescardi et al. (2019) observed that the medallists can anticipate and manage to connect



direct strikes to the opponents' chest. Along the same lines, Falco et al. (2014) emphasize that the main focus of coaches when planning training should be directed to direct attacks. These are fundamental to differentiate winning athletes from others. Therefore, this set of results suggests that coaches should focus on the quality of training, mainly aimed at developing speed and anticipating the opponent's attacks, training sequences of 2 or 3 actions to seek the exact moment to score, as the athlete needs to focus on a sequence of actions during the fight to determine what to do before performing an action. One of the keys to success in competitive taekwondo is to concentrate after the point to avoid the counterattack.

An important point that also differentiates competitors is the choice of techniques. Losers had a higher frequency of cover-kicks and tit-chagi. When applied without the proper preparation, such techniques can result in scoring for the opponent, as they work with a wide range of movement and have a lower execution speed (Pieter & Pieter, 1995). Given this situation, winning athletes take advantage of the moment to score by applying faster techniques such as bandal-chagi (Gutiérrez-Santiago, Pereira-Rodríguez, & Prieto-Lage, 2020). In fact, Falco et al. (2014) observed that winners have a higher frequency of anticipatory counterattacks.

Losing fighters spend more time moving backwards during the rounds. This type of behaviour demonstrates technical and psychological inferiority to the opponent. Li et al. (2020) previously observed that athletes with a higher profile of success have more positive personalities and traits compared to athletes with less success who present greater aggressiveness and low self-control. In our study, winning athletes have twice as many actions per fight resulting in a minimum score (1PT). These scores can be crucial for defining the match, as 72% of the combats in a previous study in karatekas were won by those who scored the first point (Tabben et al., 2018). An attack must be precise, fast (Cristina Menescardi et al., 2019; Tornello et al., 2014) and executed at the correct distance to be effective in attacks and counter-attacks and to score. However, when the competitor is at a disadvantage, they stay longer in backward movement, representing an escape from the opponent's strikes, when they should

be looking for the best moment and distance to score (Cristina Menescardi et al., 2019; Cristina Menescardi et al., 2015). Thus, we believe that fighters at a disadvantage in combat tend to feel pressured and make incorrect decisions regarding the actions to be taken. It is essential to note that an athlete in a disadvantaged situation will possibly give their attention even more from actions which generate scoring to defensive actions that deviate from the actions of the fighter who is at an advantage, which can result in less precise attacking. Thus, we believe that fighters at a disadvantage in combat tend to feel pressured and make incorrect decisions regarding the actions to be taken.

Coaches can use the data from the present study to plan specific strategies aimed at high-performance. It is important to note that this study presents analyses of super-elite athletes as a limiting factor, which should be considered when creating practical applications based on our results. In addition, the technical-tactical analysis shows a real result of the sporting behaviour during the combat; however, other variables that may intervene in the performance were not measured, such as the athlete's mood and physique. Future studies should carry out similar analyses in the female gender and also separated by weight category.

CONCLUSIONS

Based on our objectives, the applied methods and the results obtained, we can conclude that winning athletes are more efficient in making attacks that result in 1 and 3 points. On the other hand, defeated athletes demonstrate more frequency of less effective techniques in terms of scoring and moving backwards.

REFERENCES

1. Barrientos, C. A. V., Antonietto, D. Á., Oliveira, C. L. R., Barreto, L. B. M., Miarka, B., & Aedo-Muñoz, E. A. (2021). Frami® software protocol for Taekwondo: development, reliability and reproducibility. *Ido Movement for Culture*, 21(4), 1-27.
2. Falco, C., Estevan, I., Álvarez, O., Morales-Sánchez, V., & Hernández-Mendo, A. (2014). Tactical analysis of the winners' and non-winners'



- performances in a Taekwondo University Championship. *International Journal of Sports Science & Coaching*, 9(6), 1407-1416.
3. Gutiérrez-Santiago, A., Pereira-Rodríguez, R., & Prieto-Lage, I. (2020). Detection of the technical and tactical motion of the scorable movements in taekwondo. *Physiology & Behavior*, 217, 112813.
 4. Janowski, M., Zieliński, J., & Kusy, K. (2019). Exercise Response to Real Combat in Elite Taekwondo Athletes Before and After Competition Rule Changes. *Journal of Strength and Conditioning Research*, 35(8), 2222-2229.
 5. Li, B., Ding, C., Fan, F., Shi, H., Guo, L., & Yang, F. (2020). Associations Between Psychological Profiles and Performance Success Among Professional Taekwondo Athletes in China: A Multidimensional Scaling Profile Analysis. *Frontiers in Psychology*, 11, 822. doi:10.3389/fpsyg.2020.00822
 6. Menescardi, C., Falco, C., Ros, C., Morales-Sanchez, V., & Hernandez-Mendo, A. (2019). Development of a Taekwondo Combat Model Based on Markov Analysis. *Frontiers in Psychology*, 10, 2188. doi:10.3389/fpsyg.2019.021
 7. Menescardi, C., Falco, C., Ros, C., Morales-Sánchez, V., & Hernández-Mendo, A. (2019). Technical-tactical actions used to score in taekwondo: an analysis of two medalists in two Olympic Championships. *Frontiers in Psychology*, 10, 2708.
 8. Menescardi, C., Lopez-Lopez, J. A., Falco, C., Hernandez-Mendo, A., & Estevan, I. (2015). Tactical aspects of a National University Taekwondo Championship in relation to round and match outcome. *The Journal of Strength and Conditioning Research*, 29(2), 466-471.
 9. Pieter, F., & Pieter, W. (1995). Speed and force in selected taekwondo techniques. *Biology of sport*, 12(4), 257-266.
 10. Sevinç, D., & Çolak, M. (2019). The effect of electronic body protector and gamification on the performance of taekwondo athletes. *International Journal of Performance Analysis in Sport*, 19(1), 110-120.
 11. Tabben, M., Miarka, B., Chamari, K., & Beneke, R. (2018). Decisive moment: a metric to determine success in elite karate bouts. *International Journal of Sports Physiology and Performance*, 13(8), 1000-1004.
 12. Tornello, F., Capranica, L., Minganti, C., Chiodo, S., Condello, G., & Tessitore, A. (2014). Technical-tactical analysis of youth Olympic Taekwondo combat. *The Journal of Strength and Conditioning Research*, 28(4), 1151-1157.