Original Article

Methodological analysis of boxing activity profile by category

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Abstract:

Introduction: The purpose of this research is to carry out an observational descriptive analysis to create an analysis instrument that determines the most relevant patterns and characteristics of boxing, so that useful bases can be established to create links in the planning process based on winning strategies. **Material and Methods:** The sample includes eight elite male boxers from the Welter category of the London 2012 Olympics, with an age range of 21 to 28 years (mean = 24.50 ± 2.20) and weight 64-69 kg (defined by their category). **Results:** A descriptive analysis is undertaken of the average points per match, the main technical/tactical actions and the time percentage of the motor actions involved during the round. Based on the normality of the sample, the difference between the variables is determined with the Kruskal-Wallis Test. The statistical correlation technique is used to evaluate possible relationships between the variables to the average points per match with the Spearman Rho test. Five significant correlations stand out, two positive and three negative, including: Blows landed (rho = 0.740), % Blows landed (rho = 0.581), Blocks (rho = -0.635), %T. Block (rho = -0.661) and Blows evaded (rho = -0.540) and average points per match. Finally, a multiple linear regression is made between the average points, the technical/tactical actions and the time percentage of the motor actions ($R^2 = 0.76$). **Discussion:** winner launches more blows during the round and creates more time for attack actions, which would justify the reason for his lower records minors in terms of Blows evaded, Blocks, % Blocks, %T. Blocking and %T. Null. His average Blows landed and % Blows landed are also higher, he launches more blows and so have more chances of hitting the valid scoring zone, because he maintains a higher frequency of attack manoeuvres and because his accuracy in striking is more efficient. **Conclusion:** The results establish that in this particular category and that, to win an event of this nature, the boxers have to move around the ring through the work of the lower body more than half of the round, maintain a high offensive and defensive action activity and optimum precision in the blows executed.

Key Words: *performance, statistics, technical/tactical actions, indicators, time patterns.*

Introduction

The analysis of technical/tactical actions enables behaviour patterns to be established related to sports performance in boxing (Balmaseda, 2011). A performance analysis can help to understand the nature and complexity of any sports discipline (O'Donoghue, 2010), it is an effective method that had already been used to classify boxing demands (Thomson, 2015). That is why the technical, tactical, physical and psychological requirements of the sport in question need to be known before designing a training program (Solé, 2015). The main basic elements that constitute the technical media of boxing are those that form the basis of all the motor actions in this sport; the guard position, movements, turns, straight blows, hook blows, cross blows, defences with the upper extremities, defences with the trunk and defences with the lower extremities (Balmaseda, 2009). In other contact sports such as karate, the quality of motor patterns differentiates athletes between the results, with technical and motor efficiency prevailing in the winners (Jukić et al., 2017).

In a time analysis of the different motor actions that occurred during the round and, considering 35 sparrings and 37 professional matches (Merlo, 2012), the averages of the main technical movements that were executed in each round and time percentages were observed by technical movement, considering that one of the major indices of a boxer's skill is the time of executing technical actions (Korobeynikov et al., 2020). For 10% of the round time, the boxers launched blows (50 blows), for 53% of which they moved around the ring (60 meters), for 30% of which they were dodging (50 dodges) and 7% of which they were blocking (35 blocks). Following other registration methodologies, Kruszewski et al. (2016) analysed 10 finals of different boxing categories during the London 2012 Olympics where they found that the boxers launched an average of 63 blows per round, with the straight blow being the most used and most accurate (37.1%), defensive manoeuvres using the arms added a total of 60%, defences using the trunk 20% and defences with foot work 20%. There is also evidence that the winners defend more with the trunk during the third round (Ashker, 2011).

Optimal training planning improves sports performance (Costa, 2013). Analysis offer a deeper understanding of competition, allowing coaches and participants to optimize training, targeting and understanding key points to perform their strategy (Smith et al., 2020). In this sport, it has been suggested that to body winning strategies, the boxer's ability must be integrated to maintain high activity during combat, a high movement score, a higher blow accuracy without fail and good hip movement. A specific technique that also differentiated winners and losers was the number of failed blows and defensive foot movements (Davis et al., 2016). Comparing the activity between winning or losing and the judges' scores, Davis et al. (2013) suggested that in order to launch blows that score, boxers have to maintain greater attack frequency, specifically directly to the head followed by combinations, and that defensive movements are very important for evading blows and initiating counterattacks, also indicating that blows landing on the opponent may not be the only way to win.

Knowing the scoring system and regulation is another component that may be related to strategic and tactical factors (Davis et al., 2018; Kruszewski et al., 2016). Before the rules changed in 2013, one point was scored each time a clean blow landed with the knuckle part of the glove in the scoring area (Davis et al., 2018). The change in regulations also implied the removal of protective helmets (Bianco et al., 2013). After the rules changed, the judges awarded 10 points to the winner of the round and 9 or less (7 is the minimum score) to the loser. The judges independently determine the points based on the number of blows launched in the scoring area, combat mastery in terms of technical/tactical superiority and competitiveness (AIBA, 2019). However, the scoring system has been and continues to be controversial because it is a subjective method, since it has been shown that the judges' decisions don't take the blows correctly landed in the scoring area into account (Davis et al., 2013, 2016, 2018; Smith, 2006).

Combat sports are acyclic in nature due to their high-intensity actions and movements (Silva et al., 2011). Boxing is a contact sport with fixed action and recovery intervals, with 2-3 minutes of combat depending on the categories, but always with one minute of rest (Balmaseda, 2011). That is why understanding physiological demands during combat is a relevant factor when scheduling a training plan (El-Ashker & Nasr, 2012; Nassib et al., 2017), all energy systems being required for intermittent activity (Franchini et al., 2019). Bompa and Buzzichelli (2016) affirm that the metabolic pathway participation percentage is: 10% alactic, 40% lactic and 50% aerobic. Other authors affirm that the majority of energy demands in boxing come from the oxidative system, with 77% corresponding to aerobic metabolism, 19% to anaerobic alactic and 4% to lactic anaerobic (Davis et al., 2014). The oxidative system also contributes to constant attacks with the greatest force and speed during prolonged combat. Aerobically, the recovery process is assured during breaks, in particular the phosphagen system (Slimani et al., 2017).

The purpose of this research is to carry out an observational descriptive analysis to create an analysis instrument that determines the most relevant patterns and characteristics of boxing, so that useful bases can be established to create links in the planning process based on winning strategies. An analysis of the trajectory of the champion and the finalist of the welterweight category in the 2012 London Olympics is therefore presented.

Material & methods

Participants

The sample of this observational study included eight elite male boxers from the Welter category of the London 2012 Olympics, with an age range of 21 to 28 years (mean = 24.50 ± 2.20) and weight between 64-69 kg (defined by their category). In this research, trajectory was analysed in matches of: Round 16 (last sixteen was not available), quarter final, semi-final and final, both the champion and the finalist. These finalists were analysed in four matches respectively and the other six boxers were only analysed in one match due to the eliminatory nature of the competition. Seven matches of three rounds of three minutes were considered, corresponding to a total of 42 rounds (12 rounds both finalists and three rounds the other boxers).

Design and procedure

The videos of the matches were provided by the International Olympic Committee, indicating a download link on the Official Olympic Channel (AIBA, 2012). A range of variables was analysed (see table 1) with the software for sports analysis, KINOVEA (version 0.8.15 downloadable at <https://www.kinovea.org/>). With this program, the sequences of the matches were viewed as many times as needed to record the different results and obtain their maximum reliability.

In accordance with the regulations prior to 2013 (Davis et al., 2018), the average points per match determined at the end of each match was analysed, resulting from the average of the three rounds. The other variables were analysed under the criteria of the new regulations (AIBA, 2019). To identify the main offensive and defensive actions (technical/tactical actions), the option of changing the software's playback speed was used. To obtain a time record of the main motor patterns involved during the round (time percentage of motor actions), the software's timer was used, playing videos on two screens and counting the time taken according to the playback speeds that were applied. When the playback speed was slowed down, the chronometer speed was also reduced. An annotation procedure was followed that was used in each of the matches. A variable was chosen that was analysed during one of the boxers' first, second and third round, then that same variable was analysed for the opponent, until all of the boxers' variables during the matches were analysed. All the results obtained from the video analysis were recorded in a Microsoft Excel spreadsheet.

Statistical analysis

The records of the different variables were analysed with the statistical software JASP 9.2.0 (JASP TEAM, Amsterdam). A descriptive analysis of central trend was completed with the results obtained. A statistical analysis was subsequently carried out, considering the normality of the sample. The possible differences between the average points per match and the actions of each boxer were assessed with the Kruskal-Wallis test. Subsequently, possible relationships between the technical/tactical actions, the time percentage of motor actions and the average points per match were determined using the Spearman rho test. This index ranges between -1 and +1, defining the magnitude of the relationships, according to Hopkins (2002) criteria as casual: 0-0.09; low: 0.10-0.29; moderate: 0.30-0.49; high: 0.50-0.69; very high: 0.70-0.89; almost perfect 0.90-0.99; 1 perfect. The significance level for all tests is $p < 0.05$. Finally, a multiple linear regression was performed to predict the average value of points per match based on predictive variables. The determination coefficient index (R^2) ranges from 0 to 1, the closer to 1 the variable predictor model, the more perfect (Martínez, 2005).

Table 1. Description of dependent variable and independent variables analysed.

<i>Dependent variable</i>	
<i>Average points per match</i>	Average point value of the three rounds of the match
<i>Independent variables</i>	
<i>Technical/tactical actions</i>	
Blows launched	Average value of blows launched by round, whether blows into the air or that do not land in the valid scoring zone.
Blows landed	Average value of blows that land in the valid scoring zone, on the front or on the sides of the head and on the trunk area above the waist and below the neck by round.
% Blows landed	Average percentage of blows landed in the valid scoring zone in reference to the blows launched during the round.
Blows evaded	Average value of blows evaded through defensive manoeuvres during the round are the total dodges and blocks.
Dodges	Average value of blows evaded during the round through trunk, neck and foot movement dodges.
Blocks	Average value of blows evaded by blocks, with the basic guard or with the hands.
% Dodges	Average percentage of blows evaded by waist, trunk, neck and foot movement dodges.
% Blocks	Average percentage of blows evaded by blocking, with the basic guard or with the hands.
<i>Time percentage of motor actions</i>	
%T. Blows launched	The average time percentage dedicated to launching blows during the round is the total blows launched.
%T. Travel with lower body	Average time percentage moving around the ring during the round, through the work of the lower body.
%T. Dodges	Average time percentage performing waist, trunk, neck and foot movement dodges during the round.
%T. Blocks	Average time percentage blocking with the basic guard or with three hands during the round.
%T. Null	Average time percentage not performing any action, being grasped or receiving an account from the arbitrator during the round.

Results

Based on the descriptive analysis (Table 2) of the average point per match, it is observed that the average valuation of the boxers (Central trend) was 13.57 ± 5.03 per match. In turn, boxer 1 (gold medal) obtained an average of 20.50 ± 3.00 , boxer 2 (silver medal) 11.25 ± 1.86 and the other boxers average values ranging between 14 ± 0.00 for boxer 7 and 7 ± 0.00 for boxer 6.

Table 2. Average results of points per match of central trend and for each boxer.

	Central trend	1 (gold medal)	2	3	4	5 (silver medal)	6	7	8
<i>n</i>	42	12	3	3	3	12	3	3	3
<i>(x)</i>	13.57	20.50	11.00	9.00	12.00	11.25	7.00	14.00	10.00
<i>SD</i>	5.03	3.00	0.00	0.00	0.00	1.86	0.00	0.00	0.00

Mean (x) and standard deviation (SD) that explain the average points for the set (Central Trend) and for each boxer (1 to 8) depending on the rounds analysed (n).

The statistical descriptive of the central trend and the analysis of each boxer's technical/tactical actions (Table 3) showed that the boxers launched 82.21 ± 26.78 blows during the round (Blows launched), oscillating between the maximum values of the gold medal (105.5 ± 18.36) and boxer 2 (62.97 ± 3.51). Of these blows launched, they land in the valid scoring zone (Blows landed) 23.57 ± 12.91 , with a range of 37.25 ± 11.52 and 8.00 ± 1.00 between the gold medal and boxer 6 respectively. Evade through defensive manoeuvres (Evaded blows) 58.64 ± 23.33 blows, with values ranging between 73.00 ± 30.82 of the silver medal and 43.00 ± 3.00 of boxer 2, of which; 29.52 ± 10.83 are evaded by dodges (Dodges), with a range of 33.92 ± 12.28 and $18.00 \pm$

2.64, between the silver medal and boxer 2; 29.12 ± 17.27 are evaded by blocking (Blocks), ranging between values of 39.08 ± 23.54 and 16.83 ± 5.95 between the silver medal and the gold medal respectively. The boxers land a percentage of blows launched in the valid scoring zone (% Blows landed) of 28.62 ± 12.10 of the blows launched, with maximum values of 38.09 ± 1.95 (boxer 7) and minimum values of 8.74 ± 3.42 (boxer 6). A percentage of 52.20 ± 13.08 of evasive manoeuvres are carried out by dodges (% Dodges), the gold medal corresponding to the highest value (61.40 ± 8.39) and boxer 6 the highest value low (34.01 ± 18.59), and a percentage of 47.80 ± 13.08 through blocks (% Blocks), between values of 65.99 ± 18.59 and 38.60 ± 8.39 , respectively between boxer 6 and the gold medal.

Table 3. Results of the technical/tactical actions of central tend and of each boxer.

		Central trend	1 (gold medal)	2	3	4	5 (silver medal)	6	7	8
	<i>n</i>	42	12	3	3	3	12	3	3	3
Blows launched	(x)	82.21	105.5	62.97	65.67	86.67	68.33	97.33	65.00	78.33
	SD	26.78	18.36	3.51	9.86	10.69	29.89	22.94	24.02	19.35
Blows landed	(x)	23.57	37.25	22.33	18.33	28.00	14.50	8.00	24.67	21.67
	SD	12.91	11.52	4.04	4.16	11.53	7.14	1.00	8.62	10.21
% Blows landed	(x)	28.62	37.09	35.47	27.46	31.67	21.05	8.74	38.09	26.44
	SD	12.10	14.08	4.53	2.79	9.59	4.72	3.42	1.95	7.66
Blows evaded	(x)	58.64	43.67	43.00	64.33	60.00	73.00	58.67	71.67	56.67
	SD	23.33	12.21	3.00	3.05	18.19	30.82	8.50	36.68	9.07
Dodges	(x)	29.52	26.83	18.00	31.67	33.33	33.92	21.00	33.00	33.33
	SD	10.83	8.40	2.64	6.43	17.93	12.28	13.53	6.00	7.66
Blocks	(x)	29.12	16.83	25.00	32.67	26.67	39.08	37.67	38.67	23.33
	SD	17.27	5.95	2.00	4.16	1.53	23.54	5.03	31.01	3.78
% Dodges	(x)	52.20	61.40	41.77	49.03	53.22	49.39	34.01	51.08	58.54
	SD	13.08	8.39	4.52	7.95	11.91	13.44	18.59	14.75	6.59
% Blocks	(x)	47.80	38.60	58.23	50.97	46.78	50.61	65.99	48.92	41.46
	SD	13.08	8.39	4.52	7.95	11.91	13.44	18.59	14.75	6.59

Mean (x) and standard deviation (SD) that explain the values of the technical/tactical actions of the set (Central Trend) and of each boxer (1 to 8) of the variables analysed; Blows launched, Blows landed, % Blows landed, Blows evaded, Dodges, Blocks, % Dodges and % Blocks based on the rounds analysed (n).

Table 4 shows how the average percentage of the time intervened by the movements through the work of the lower body (%T. Travel with lower body), turned out to be the highest of the time percentage of the motor actions during the round, with a 55.78 ± 5.85 and with a range of 64.61 ± 4.92 and 47.68 ± 1.29 between boxer 2 and boxer 6. The blow time percentage (%T. Blows) was an average of 16.07 ± 5.63 , with the gold medal corresponding to the highest values (21.35 ± 4.44) and the lowest boxer 2 (11.69 ± 1.54). Next, the time percentage of evasive manoeuvres by dodging (%T. Dodges) intervened with an average of 15.44 ± 5.05 , fluctuating between the values of boxer 8 (23.82 ± 4.10) and boxer 2 (10.20 ± 1.21). Finally, the percentage of time involved in evasive manoeuvres through blocks (%T. Blocks) and the percentage of time that the boxers are not performing any type of action (%T. Null) are the time percentages of motor actions that least intervene, 6.35 ± 3.13 and 6.35 ± 2.50 respectively, oscillating; %T. Blocks between the gold medal (3.78 ± 0.96) and boxer 7 (8.45 ± 5.97), and %T. Null between the gold medal (4.81 ± 1.17) and boxer 3 (9.62 ± 3.16).

Table 4. Results of the time percentage of central trend motor actions and of each boxer.

		Central trend	1 (gold medal)	2	3	4	5 (silver medal)	6	7	8
	<i>n</i>	42	12	3	3	3	12	3	3	3
%T. Blows	(x)	16.07	21.35	11.69	13.79	15.90	13.28	18.61	12.52	13.93
	DE	5.63	4.44	1.54	1.93	1.05	5.87	4.15	4.71	4.35
%T. Travel with lower body	(x)	55.78	57.08	64.61	58.48	57.46	55.34	47.68	50.46	52.57
	DE	5.85	4.20	4.92	5.25	3.09	5.41	1.29	2.61	8.56
%T. Dodges	(x)	15.44	12.97	10.20	12.03	14.78	16.07	16.46	22.73	23.82
	DE	5.04	3.67	1.21	1.34	3.03	4.65	3.42	1.72	4.10
%T. Blocks	(x)	6.35	3.78	8.06	6.07	5.59	7.94	8.27	8.45	5.58
	DE	3.13	0.96	2.20	0.39	0.30	3.84	0.62	5.97	0.63
%T. Null	(x)	6.35	4.81	5.42	9.62	6.28	7.36	8.97	5.84	4.08
	DE	2.50	1.17	1.61	3.16	0.68	2.67	1.99	1.54	2.46

Mean (x) and standard deviation (SD) that explain the values of the time percentage of motor actions of the set (Central trend) and of each boxer (1 to 8) of the variables analysed; %T. Blows, %T. Travel with lower body, %T. Dodges, %T. Blocks and %T. Null depending on the rounds analysed (n).

Subsequently, the Kruskal-Wallis Test statistical analysis enabled the significant differences to be observed between the set of actions of each of the boxers during the matches ($W = 35.69$; $p < 0.001$). Each boxer has a different sparring style.

Spearman's RHO test (Table 5), showed significant moderate positive relationships between the average points per match and the set of variables of the technical/tactical actions and the time percentage of motor actions, such as the Blows launched ($\rho = 0.475$; $p = 0.001$); % Dodges ($\rho = 0.490$; $p < 0.001$) and %T. Blows ($\rho = 0.491$; $p < 0.001$), there are high positive relationships with % Blows landed ($\rho = 0.581$; $p < 0.001$), and very high for Blows landed ($\rho = 0.740$; $p < 0.001$). There were also negative, high ratios for the Blocks ($\rho = -0.635$; $p < 0.001$), %T. Blocks ($\rho = -0.661$; $p < 0.001$), Blows evaded ($\rho = -0.540$; $p < 0.001$) and %T. Null ($\rho = -0.535$; $p < 0.001$), and moderated for % Blocks ($\rho = -0.490$; $p < 0.001$).

Table 5. Rho Spearman correlation test of technical/tactical actions and the time percentage of motor actions with the average points per match.

	Spearman's rho	p-value
Blows launched	0.47	0,001
Blows landed	0.74	< .001
% Blows landed	0.58	< .001
Blows evaded	-0.54	< .001
% Dodges	0.49	< .001
Blocks	-0.63	< .001
% Block	-0.49	< .001
%T. Blows	0.49	< .001
%T. Block	-0.66	< .001
%T. Null	-0.53	< .001

Finally, multiple linear regression (Table 6) enables a possible causality between the average points per match, the technical/tactical actions and the time percentage of the motor actions analysed ($R^2 = 0.76$) to be determined.

Table 6. Results of the multiple linear regression that explains the average points based on the technical/tactical actions and the time percentage of the motor actions.

actions and the time percentage of the motor actions.

Model Summary						
Model		R	R ²	Adjusted R ²	RMSE	
0		0.87	0.76	0.70	2.75	
Predictor variables: Blows launched, Blows evaded, Blocks, % Blows landed, % Dodges, %T. Blows, %T. Blocks, %T. Null.						
Dependent variable: Average points per match.						
ANOVA of the equation						
Model		Sum of Squares	Df	Mean square	f	p
0	Regression.	786.3	8	98.29	12.98	< .001
	Residual	250.0	33	7.57		
	Total	1036.3	41			
Model 0 includes: Blows launched, Blows evaded, Blocks, % Blows landed, % Dodges, %T. Blows, %T. Blocks, %T. Null.						
Coefficients						
Model		Unstandardized	Standard Error	Standardized	t	p
0	(Intercept)	-6.10	6.81		-0.89	0.37
	Blows launched	-0.03	0.07	-0.17	-0.45	0.65
	Blows evaded	-0.28	0.09	-1.34	-3.07	0,004
	Blocks	0.62	0.17	2.15	3.52	0,001
	% Blows landed	0.25	0.04	0.62	6	< .001
	% Dodges	0.26	0.10	0.68	2.58	0.01
	%T. Blows	0.43	0.33	0.48	1.28	0.20
	%T. Blocks	-0.74	0.46	-0.46	-1.62	0.11
	%T. Null	-0.35	0.22	-0.17	-1.61	0.11

Discussion

The most important finding of this research is that during the round, more time is spent on motor actions with the lower body than on other actions such as the time the boxers spend launching blows. At the same time, greater motor action activity and better blow landing precision is positively related to the score awarded by the judges.

Regarding the motor action time percentage, the effective time of the travel with lower body represented 56% of the total time of the round. On the other hand, the boxers were launching blows 16.07% of the total time of the round, 15.44% they were dodging, 6.35% blocking and 6.35% of the time they did not perform any type of action. The value of travel with lower body and blocks is similar to Merlo (2012), which indicates that the boxers were moving around the ring in 53% of the round and were blocking in 7% of the total round, although very different in terms of blow and dodge percentage with 10% and 30% respectively. These results enable interpretation that the actions carried out using the lower body stand out over those of the upper body. When a boxer is held against the ropes and his work area is reduced, his energy demands increase because he has to increase his offensive and defensive actions (Thomson, 2015), so there is special emphasis on the ability to move around the ring, which favours control of the rhythm of the match and limits attacks from the opponent when the boxers are controlling the directions and pace changes (Ruddock et al., 2016), as well as the work of the oxidative metabolic pathways, since most of the energy demands come from the oxidative system (Davis et al., 2014; Thomson & Lamb, 2017), contributing to recovery from the most intense activities (Bishop et al., 2004; Slimani et al., 2017).

As for the main technical/tactical actions, the boxers also launch an average of 82.21 blows per round, of these blows launched, an average of 28.62% land in the valid zone, they evade an average of 58.64 blows per round, of which 52.2% are by dodging and 47.8% by blocking, somewhat disparate values compared to records compiled in the literature (Kruszewski et al., 2016; Merlo, 2012), since the studies were conducted with subjects of different categories and of different weights (Thomson, 2015). Herrera et al. (2018) showed different results in terms of resistance to blows in relation to different weight categories and in other contact sports, significant differences were observed regarding the technical/tactical actions performed and the intensities in relation to the individuals' weight (Miarka et al., 2015; Tabben et al., 2015).

Although the differences between boxers could have been analysed with respect to the victory by match, the average points per match achieved with respect to the other variables was taken as a dependent variable because otherwise only the victory with two boxers would have been related, the gold medal and silver medal. The boxers' average points per match (Table 2) indicate that there may be differences between the various boxing actions between the gold medal and the other boxers. His average of 20.50 points per match with respect to the central trend (13.57) and the silver medal (11.25) is extremely superior, so he could indicate that there are some patterns that are related to performance. When the descriptive statistics of the technical/tactical actions and the time percentage of the motor actions (tables 3 and 4) are analysed, it is also observed that the average of launched blows and %T. Gold medal blows is superior to that of the other boxers. The gold medallist launches more blows during the round and creates more time for attack actions, so that the opponents' offensive actions are inhibited because they become defensive (Wąsik et al., 2014), which would justify the reason for his lower records minors in terms of: Blows evaded, Blocks, % Blocks, %T. Blocking and %T. Null. Gold medallists' average Blows landed and % Blows landed is also higher, he launches more blows and so have more chances of hitting the valid scoring zone, because he maintain a higher frequency of attack manoeuvres (Ashker, 2011; Davis et al., 2013) and because his accuracy in striking is more efficient (Davis et al., 2016). Finally, it is also observed that, even having a lower average of evaded blows, his average of % Dodges is higher. Opting for evasive manoeuvres by dodging plays another point in favour with respect to the score awarded by the judges, when using this type of defensive action is less likely to be interrupted by counterattack actions (Ibarra et al., 2015).

In turn, the correlation test (Table 5), would provide information that would definition of which variables are most relevant in competition boxing and specifically in this category. Five variables stand out over the others in relation to the average points per match; that is, the result: Blows landed ($\rho = 0.740$) and % Blows landed ($\rho = 0.581$) that would indicate that at higher proportions higher performance, and Blocks ($\rho = -0.635$), %T. Blocks ($\rho = -0.661$) and evaded blows ($\rho = -0.540$) that would indicate that the lower the proportions the higher the performance.

Finally, and based on the results of the multiple linear regression (Table 6), with respect to the R^2 value = 0.76, the average value of points per match needed to win in this category from known values of the predictor variables could be predicted; Blows launched, Blows evaded, Blocks, % Blows landed, % Dodges, %T. Blows, %T. Blocks and %T. Null. With this statistical test, a winning profile could also be assessed, in this case of the Olympic champion, which would provide a guide for the specific training for this category and for the match against this boxer under specific training guidelines.

Study limitations

Despite the findings, this study has certain limitations. Since an analysis of a boxing competition that would have been played under the criteria of current regulations should have been carried out, taking into account that changes may have occurred in the strategies and tactics used by the technical team and the boxers due to the new scoring criteria and removing the protective helmet. The multiple linear regression model presented would also describe this competition in particular with respect to the matches that have been analysed and, although it could indicate optimal proportions of these parameters attending to their causality with respect to the average points per match, and that would help to describe these profiles to prepare possible boxing events

(Pic-Aguilar et al., 2016), this would not indicate that they were always to be fulfilled since the sport is multifactorial (Hughes & Bartlett, 2002) and depends on multiple variables. And finally, more samples would be needed to determine possible causalities to reduce the number of variables.

Conclusions

This work affirms that an observation methodology has been constructed that enables analysis of the most characteristic boxing patterns. The statistical analyses have enabled the profile of an Olympic champion to be defined and seem to reflect criteria in the application of the average points per match awarded by the judges. With the time analysis of the motor actions, it has also been possible to identify time patterns that would help to specify the technical, tactical and physiological requirements of this sports discipline for subsequent planning, with the aim of improving results. With these results, there may already be indicators that could be used to adopt winning strategies. It is now known that, in this particular category, the boxers move around the ring for more than half of the round, so lower body work is of utmost importance, and that boxers have to develop a high offensive and defensive activity, also involving a lot of work on the waist, neck, abdominal area and optimal precision during blows.

Practical applications

This is an ecological observational analysis methodology that does not require excessive cost of media or materials. It offers technicians the possibility to analyse boxing events and boxers in particular of any category in order to be able to design training plans according to the achievement of the desired result in combat or competition.

Future perspectives

In the future, it would be of interest to undertake an analysis exclusively with the current regulations to verify whether the evaluation methodology used in this study produces results with the same characteristics or if conclusions differ. The results of the technical/tactical actions and the time percentage of the motor actions analysed are also indicators that have been determined through observational methodology. It would be appropriate to make these records using more efficient methods such as the accelerometer, especially to more effectively determine the values of the lower body work, since this could contribute to the other driving actions through the kinetic chains (Cheraghi et al., 2014; Stanley et al., 2018; Turner et al., 2011).

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