ORIGINAL ARTICLE

The effectiveness of kickboxing techniques and its relation to fights won by knockout

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C Statistical Analysis
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Abstract

Background and Study Aim: Ratio of fights won is important to kickboxers on professional and amateur levels. Knockout is the most economical way of winning the fight. The objective of the paper is the effectiveness of kickboxing techniques and their impact on winning the fight by knockout.

Material and Methods: There were 156 participants in the study (61 amateurs and 95 professionals). Their total number of fights won by knockout was 188 and the amateur competitions they participated in complied with the K-1 ruleset. Fighters were 19 to 32 years old and their training experience was on the average 7.36 yrs. ±3.24 yrs. The shortest training lasted 3 yrs. and the longest one 18 yrs. The study was conducted using the analysis of videos of professional fights as well as diagnostic survey conducted in a group of amateur fighters. The survey included questions about training experience and techniques used in a fight won by knockout. The video analysis also included the techniques used in a fight won by knockout.

Results: *Hook high* and *roundhouse kick high* were the most effective kickboxing techniques in winning fights by knockout. The comparison of techniques used in a knockout between amateur and professional fighters did not bring any statistically significant differences. It was shown however that professional fighters used the most effective techniques: more often than amateurs.

Conclusions: During the training the fighters should pay special attention to constructing combinations of punches and kicks using *hook high* and *roundhouse kick high* techniques. Using proper techniques as well as numerous repetitions of the most effective techniques should be a part of any training of a kickboxing fighter.

Key words: amateur fighters • kicks • professional fighters • punches

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Knockout – *noun* **1.** (*in boxing*) a punch that knocks an opponent down for a count of ten and so wins a contest **2.** A sports competition in which a person or team beaten in one game or match is eliminated from the entire competition [25].

Kick – *verb* **1**. to strike a ball with the foot **2.** to strike something or somebody with the foot, e.g. in martial arts **3.** to make a thrashing movement with the legs, e.g. when fighting or swimming **4.** (*in cricket*) to bounce up high and quickly [25].

Kick – *noun* **1.** a blow with the foot, e.g. in martial arts **2.** a thrashing movement with the leg when swimming **3.** the striking of a ball with the foot [25].

Roundhouse kick – a type of kick executed into three height zones (low, middle, high) by the change position in the hip joint.

Punch *verb* to strike someone or something with the fist, e.g. in boxing or martial arts [25].

Fighter – *noun* a competitor in a full-contact sport such as boxing or taekwondo [25].

Technique– *noun* a way of performing an action [25].

Tactics – *plural noun* the art of finding and implementing means to achieve immediate or short-term aims [25].

Skill – *noun* an ability to do perform an action well, acquired by training [25].

INTRODUCTION

Kickboxing is a combat sport where two types of fights occur: light-contact and full contact. There is no limitation on the strength of kicks and punches in the latter type. Full contact kickboxing has a number of different rulesets such as: full contact (or American kickboxing), Low Kick or K-1 [1]. Fighters competing in this type of sports have a number of possible events both in amateur or professional level. The best fighters collect the titles and have a good ratio of the fights won. Depriving the competitor the possibility of continuing the fight (aka knockout) is the most economical way of ending the fight. It is also a spectacular show of fighter's skills [2]. The quick ending of a fight can be achieved by both punching or kicking techniques. The adequate launching of attack requires mastering of techniques as well as proper flexibility and perfect fitness [3]. Comprehensive movement and adjusting the tactics to competitor's skills are priorities [4]. Kickboxing techniques include kicks and punches according to the rules [5]. Punches include jabs, crosses and hooks, flying punches or spinning back-fists. Kicks used in the fight include front kicks, side kicks, roundhouse kicks, axe kicks, heel kicks and knee kicks [6]. The effectiveness of the attack depends not only on mastering the technique but also strength, velocity and endurance of the combatant. Psychological aspects as well as proper motivation of the fighters are also very important. On particular occasions (like during the fight) fighters can behave aggressively, which is quite often [7].

To develop a solid training plan for a kickboxer it is necessary to use own experience resulting from the analysis of a sport combat and the effectiveness of used techniques. To assess and analyse the fight a regular observation, which gives information on the level of mastering the fight techniques, is necessary. The level of technical skills used in a fight and the level of fitness matching the model characteristic of a kickboxing fight are assessed. The necessary data are collected by monitoring of the most effective techniques used in a fight, their value in the final scoring and their impact on the result of the fight.

Studies done during World Championships in kickboxing in 2009 and 2011 proved that jabs are the most common punches while roundhouse kicks were the most common kicks [8]. Other study concerning professional mixed martial arts fighters proved that knockout was usually a result of a direct fist hit on the head [9]. Analysis of 40 boxing bouts proved the hooks were most common punches [10]. Another analysis of boxing fights proved that hooks were most common punches and uppercuts were the best scoring punches [11]. Machado et al. [12] analysed the strength of kicks of kickboxing and taekwondo fighters. The results proved similar strength of kicks in fighters of both combat sports [12]. A study of elite karate fighters proved that punching techniques were much more effective than kicking ones. Moreover the duration of an attack in a karate fight was assessed. It was equal to less than 2 seconds on average [13].

The objective of the paper is the effectiveness of kickboxing techniques and their impact on winning the fight by knockout.

MATERIAL AND METHODS

There were 156 participants in the study (61 amateurs and 95 professionals). Their total number of fights won by knockout was 188 and the amateur competitions they participated in complied with the K-1 ruleset. Fighters were 19 to 32 years old and their training experience was on the average 7.36 yrs. ±3.24 yrs. The shortest training lasted 3 yrs. and the longest one 18 yrs.

The training experience of the half of the participants was at least 6 years. Fighters who took part in European Championship as the most prestigious event they participated in had the longest training experience (8.67 yrs. ±1.72 yrs.). Subsequentially fighters participating in Polish Championships had the training experience of 7.75 yrs. ±5.13 yrs. and those participating in World Championships had 6.55 yrs. ±1.4 yrs. 29 fighters (47.5% of the respondents) participated in World Championships, 12 fighters (19.7% of the respondents) participated only in European Championships and 20 fighters (32.8% of the respondents) participated only in Polish Championships (Table 1).

The video analysis of 95 professional fights complying with the K-1 ruleset which ended with knockout was made. The study included fight in the following federations: Glory, K1 World Grand Prix, DSF Kickboxing Challenge and HFO. The results of the study and the video analysis were compared.

Table 1. Training experience (2013-2019).

Kind of experience training	Statistics indicators								
	n	%	$\overline{x}$	Me	Min.	Max.	Q1	Q3	SD
World Championships	29	47.5	6.55	6.00	6.00	10.00	6.00	6.00	1.40
European Championships	12	19.7	8.67	8.00	7.00	12.00	7.50	9.00	1.72
Polish Championships	20	32.8	7.75	4.00	3.00	18.00	4.00	12.50	5.13
Total	61	100.0	7.36	6.00	3.00	18.00	6.00	9.00	3.24

Statistical Analysis

The statistical analysis of the collected data was conducted with the use of Statistica 13.1 by StatSoft. The two-sided significance test of structural indicators was used to compare number and percentage of fights won by knockout using different techniques to determine whether some of them occurred more or less often than others. Spearman's test was used to assess the relation between two numerical variables (training experience and numbers of fights won by knockout) and test was used to assess the differences in the distribution of the qualitative data in two groups. The tests used in the analysis were non-parametric. They were chosen because the distributions of studied variables were not normal (verified with Shapiro-Wilk test).

The basic statistical description included: number of observations (n); mean ($\overline{x}$); median (Me); minimum (Min.); maximum (Max.); lower quartile (Q1); upper quartile (Q3); standard deviation (SD or ±). The level of statistical significance was set at $p<0.05$.

Table 2. The frequency of winning the fight by knockout using some kickboxing techniques in the groups of amateur and professional fighters.

Kickboxing techniques	Amateurs (n =61)		Professionals (n = 95)		Total	
	n	%	n	%	n	%
Jumping kick	0	0.0	1	1.1	1	0.4
Side kick middle	0	0.0	1	1.1	1	0.4
Jumping punch	3	1.6	0	0.0	3	1.1
Axe kick	5	2.7	0	0.0	5	1.8
Roundhouse kick middle	0	0.0	5	5.3	5	1.8
Heel kick	2	1.1	5	5.3	7	2.5
Knee kick middle	6	3.2	3	3.2	9	3.2
Front kick high	8	4.3	3	3.2	11	3.9
Side kick high	9	4.8	2	2.1	11	3.9
Front kick middle	11	5.9	1	1.1	12	4.2
Chop high	7	3.7	6	6.3	13	4.6
Back fist	11	5.9	4	4.2	15	5.3
Chop middle	17	9.0	1	1.1	18	6.4
Roundhouse kick low	18	9.6	3	3.2	21	7.4
Turning kick middle	15	8.0	6	6.3	21	7.4
Punch high	14	7.5	8	8.4	22	7.8
Roundhouse kick high	26	13.8	15	15.8	41	14.5
Hook high	36	19.2	31	32.6	67	23.7
Total	188	100.0	95	100.0	283	100.0
p	$\chi^2(17) = 43.59$ $p<0.001$					

RESULTS

The training experience was not a statistically significant factor influencing the number of fights won by knockout (Spearman correlation 0.16; p = 0.205).

All studied competitors had flexibility sufficient to using high kicks. The total number of fights won by knockout according to K-1 rulesets was 188. The study was compared to 95 professional fights organized by most popular kickboxing federations.

The kickboxing techniques were arranged from the least to the most often used (for both amateur and professional fighters) when finishing the fight with a knockout. In the amateur group *heel kick* was the least often (2 times 1.1%) and *hook high* was the most often (36 times 19.2%) used to win the fight by knockout. Other effective techniques included *roundhouse kick high* (26 times 13.8%), *roundhouse kick low* (18 times 9.6%) and *chop middle* (17 times 9.0%). Amateur fighters have never used *jumping kick*, *side kick middle* or *roundhouse kick middle* to win the fight by knockout. In the professional group *jumping kick*, *side kick middle* and *roundhouse kick middle* were the least often used techniques (1 time 1.1%) of winning by knockout. *Hook high* was the most often used technique (31 times 32.6%). Other effective techniques in this group included *roundhouse kick high* (15 times 15.8%) and *punch high* (8 times 8.4%). Professional fighters have never used *jumping punch or axe kick* to win the fight by knockout. Most of the differences in frequencies of using different techniques occurred for less often used techniques. Despite the fact that *hook high* was the most often used technique in both groups, it was used almost twice as many more often in the group of professional fighters than in the group of amateur competitors (32.6% vs. 19.2%). Types of techniques used to win the fight by knockout differed significantly in both groups (Table 2).

In the tables below (Table 3 and Table 4) the statistical significance of the differences in frequencies of winning by knockout with the use of different techniques was computed for both groups separately in order to find out whether some techniques are more or less effective than others. It was proven that the differences are not statistically significant in neither group (p>0.05).

Table 3. Significance of the differences in the frequencies of winning fights by knockout when using different techniques in the group of amateur fighters (n = 61).

Kickboxing techniques	*Heel kick*	*Jumping punch*	*Axe kick*	*Knee kick middle*	*Chop high*	*Front kick high*	*Side kick high*	*Back fist*	*Front kick middle*	*Punch high*	*Turning kick middle*	*Chop middle*	*Roundhouse kick low*	*Roundhouse kick high*
Heel kick														
Jumping punch	0.309													
Axe kick	0.738													
Knee kick middle	0.873	0.347	0.652											
Chop high	0.397	0.292	0.840	0.758										
Front kick high	0.708	0.445	0.859	0.660	0.763									
Side kick high	0.400	0.292	0.840	0.758	1.000	0.760								
Back fist	0.548	0.581	0.459	0.635	0.486	0.545	0.486							
Front kick middle	0.799	0.296	0.917	0.696	0.917	0.806	0.917	0.463						
Punch high	0.734	0.518	0.848	0.697	0.777	0.959	0.777	0.603	0.810					
Turning kick middle	0.957	0.319	0.708	0.914	0.834	0.691	0.834	0.574	0.763	0.721				
Chop middle	0.702	0.359	0.919	0.635	0.783	0.922	0.783	0.481	0.846	0.896	0.679			
Roundhouse kick low	0.832	0.364	0.627	0.957	0.722	0.645	0.722	0.670	0.665	0.685	0.872	0.615		
Roundhouse kick high	0.717	0.333	0.958	0.640	0.808	0.888	0.808	0.467	0.879	0.871	0.689	0.958	0.617	
Hook high	0.766	0.304	0.957	0.672	0.877	0.831	0.877	0.459	0.958	0.828	0.733	0.880	0.643	0.917

Table 4. Significance of the differences in the frequencies of winning fights by knockout when using different techniques in the group of professional fighters (n = 95).

Kickboxing techniques	*Jumping Kick*	*Side Kick Middle*	*Front Kick Middle*	*Chop Middle*	*Side Kick High*	*Knee Kick Middle*	*Front Kick High*	*Roundhouse Kick Low*	*Back Fist*	*Roundhouse Kick Middle*	*Heel Kick*	*Chop High*	*Turning Kick Middle*	*Punch High*	*Roundhouse Kick High*
Jumping kick	-														
Side kick middle	1.000	-													
Front kick middle	1.000	1.000													
Chop middle	1.000	1.000	-												
Side kick high	0.908	0.908	0.908	0.908	-										
Knee kick middle	0.879	0.879	0.879	0.879	0.941	-									
Front kick high	0.879	0.879	0.879	0.879	0.941	1.000	-								
Roundhouse kick low	0.879	0.879	0.879	0.879	0.941	1.000	1.000	-							
Back fist	0.838	0.838	0.838	0.838	0.895	0.945	0.945	0.945	-						
Roundhouse kick middle	0.800	0.800	0.800	0.800	0.851	0.889	0.889	0.889	0.938	-					
Heel kick	0.800	0.800	0.800	0.800	0.851	0.889	0.889	0.889	0.938	1.000	-				
Chop high	0.770	0.770	0.770	0.770	0.817	0.844	0.844	0.844	0.886	0.943	0.943	-			
Turning kick middle	0.770	0.770	0.770	0.770	0.817	0.844	0.844	0.844	0.886	0.943	0.943	1.000	-		
Punch high	0.716	0.716	0.716	0.716	0.757	0.763	0.763	0.763	0.788	0.833	0.833	0.882	0.882	-	
Roundhouse kick high	0.574	0.574	0.574	0.574	0.602	0.562	0.562	0.562	0.544	0.547	0.547	0.559	0.559	0.617	-
Hook high	0.349	0.349	0.349	0.349	0.365	0.288	0.288	0.288	0.240	0.211	0.211	0.190	0.190	0.172	0.229

DISCUSSION

The assessment of the effectiveness of techniques of kickboxing in winning by knockout did not show statistically significant differences between the different techniques neither in the group of amateur nor in the group of professional fighters. The most popular techniques used in winning the fight by knockout were hook *high punch* and *roundhouse high kick*. The effectiveness of both techniques results from a direct hit on the head which causes loss of balance because of probable hit of the brain on the skull [15]. Chronic traumatic brain injury or encephalopathy was considered by the experts to be the most serious health problem in modern boxing [16]. According to the analysis of the distribution of punches of heavyweight boxers the knockout was mostly caused by chop high punch directed into the head [17]. Lystad [18] conducted a study diagnosing the most common traumas in kickboxing. The results of his study showed that the head is the part of a body exposed the most to punches and kicks which cause numerous traumas [18]. Garland et al. [19] who studied muay thai and kickboxing fighters came to similar results. The video analysis of mixed martial arts fights of elite federation UFC proved that all knockouts were caused by a direct hit on the head, the most often on the jaw [20]. Garcia et al. [21] assessed the strength of handshakes of boxers and proved that the strength of the upper limbs is well developed which can result in high effectiveness of winning the fight by knockout. During the training and the kickboxing fight itself punches play a key role and that is why the strength of the upper limbs should be developed above average.

According to own study *roundhouse kick low* (9.6%) and *chop middle* (9.0%) were also effective in winning the fight by knockout. Low kicks are mostly directed at thigh muscles and the knockout is often caused by often repeated hitting the same place. Numerous hits can cause the loss of balance because the lower limb is no longer able to carry the body. The analysis of traumas in contact karate proved that 35% of the traumas in the lower limbs are caused by numerous kicks on the same place [22]. The kicking techniques are also very effective also in taekwondo, studies show that the effectiveness of the kick results from the

appropriate strength of the thigh muscles [23]. The effectiveness of *chop middle* can be a result of a clean hit on the liver which is closely connected to autonomic nervous system. The effectiveness of the punch is additionally increased by the location of the organ which is not guarded by the ribs [24]. This may also be a reason why 8% of the fights ended by knockout were a result of a *turning kick middle* which was directed at the liver or the celiac plexus.

There were also some knockouts caused by *punch high* and *back fist*. Both techniques when used properly are very strong hits directed at the head. *Back fist* is also preceded by a turn which additionally increases the strength of the hit. *Front kick middle* directed at the liver or the celiac plexus was equally effective as *back fist*. Also *side kick*, *knee kick*, *axe kick*, *jumping punch* and *heel kick* had more than 5% of frequency in winning the fight by knockout.

CONCLUSIONS

The analysis of the study showed that the knockout was the most often caused by a hit on the head. That was the reason of high effectiveness of techniques such as *roundhouse kick high* or *hook high*. Moreover techniques directed at the stomach and thigh were also effective in winning the fight by knockout. The least effective techniques included *heel kick* and *jumping punch*.

The comparison of techniques used in a knockout between amateur and professional fighters did not bring any statistically significant differences. It was shown however that professional fighters used the most effective techniques: *hook high* and *roundhouse kick high* more often than amateurs. Especially in the case of the former of the two techniques the difference in the frequency of winning the fight by knockout was 32.6% to 19.2% in favour of professional fighters. Relatively small number of studied fights could be the reason for a lack of statistical significance of observed differences.

The study shows that during the training the fighters should pay special attention to constructing combinations of punches and kicks using *hook high* and *roundhouse kick high* techniques. Using proper techniques as well as numerous repetitions of the most effective techniques should be a part of any training of a kickboxing fighter.

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