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Situational efficiency of arm and leg techniques in a karate fight of top-level female karate competitors

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Abstract

Introduction: Structural characteristics of a sport fight represent a fundamental amount of information for a successful modelling of technical-tactical trainings and development of karate. Karate fight consists of a number of performed techniques and impression today is that the arm techniques are dominant and more important than the leg techniques. The aim of research is to analyse the ratio of scored and non-scored techniques in order to determine the difference in situational efficiency in a fight between arm and leg techniques of top-level female karate competitors.

Methods: The sample of participants consisted of a group of ten top-level senior female karate competitors, participants of one elite world tournament in a kumite competitor's discipline – open category.

The analysed **variables** for the evaluation were divided in three groups: non-scored techniques, scored techniques and variables of situational efficiency.

The fights were recorded with a DVD camera. Data were processed by the programme Statistics for Windows 7.0. using the descriptive parameters, K-S test and Student t-test.

Results and discussion: According to the results of the research, arm techniques: GT-*gyaku tsuki* and KT-*kizame tsuki* show the highest frequency of non-scored techniques. Leg techniques MG-*mawashi geri* and UMG-*ura mawashi geri* show lower values of frequency in a karate fight. The highest values of the scores achieved by techniques are ranked: GT-B-*gyaku tsuki scored*, KT-B-*kizame tsuki scored*, NT-B-*nage waza tsuki scored* and leg techniques MG-B-*mawashi geri scored* and UMG-B-*ura mawashi geri scored*. This approach to fight analysis indicates that it is tactically justified to use arm techniques more frequently in a karate fight, but the analysis of the difference between the efficiency of arm and leg techniques shows something else. On the basis of the obtained results one can notice that there is no statistically significant difference in partial or total situational efficiency between arm and leg techniques in a karate fight in the group of top-level female karate competitors. In other words, with smaller frequency of leg techniques one can have almost the same efficiency in a karate fight (because the scores obtained by leg techniques are higher). This information points to tactical justification of increased application of leg techniques in relation to arm techniques in a karate fight.

Conclusion: One can conclude that the usage of leg techniques as the more efficient ones must be intensified and this could increase the level of attractiveness of karate as a sport. The mentioned indicators of presented characteristics of karate fights at top-level female karate competitors should be followed by further research which should include a bigger sample of participants. Only with such an expert and scientific approach is it possible to ensure further progress of karate, which, according to the results of this research, shows potential to grow.

1. Introduction

Structural characteristics of a sport fight represents a fundamental amount of information for a successful modelling of technically-tactical trainings and development of karate. There is a small number of scientific papers in karate that contain the information of real indicators of technical and tactical efficiency of fighters in situational conditions.

Some authors [Koropanovski, Dopsaj, Jovanović 2008] have lately done research on situational, technical-tactical indicators of top-level, male karate competitors based on the scored techniques. Apart from these indicators, a karate fight also consists of a number of technical-tactical activities, such as body movement (*tai no ido*) and the performed but non-scored techniques. Precisely these indicators define the energetic [Iide *et al.* 2008; Beneke *et al.* 2004; Imamura *et al.* 2002], technical and tactical efficiency of the fighters [Vidranski 2009]. Therefore, the activity of the fighters, which consists of a number of the performed techniques, inevitably influences the definition of model characteristics of situational efficiency in a fight. To avoid the impression that arm technique is dominant in relation to the total score efficiency in a fight, it is necessary to observe all the performed techniques through the score system ratio, i.e. pondera (*ipon*) 1, (*nihon*) 2 and (*sanbon*) 3 points (Rulebook WKF). Such an analysis shows, on the one hand, the dominance of leg technique in relation to score potential, and on the other, a weaker frequency [Koropanovski, Dopsaj, Jovanović 2008], i.e. usage in the fight due to biometrically more complicated demands in relation to arm punches [Mudrić 2001].

Therefore, the object of this research is to indicate the characteristics of a karate fight in respect of the ratio of successfully and unsuccessfully performed arm and leg techniques.

The aim of research is to analyse the ratio of scored and performed techniques in order to determine the difference in situational efficiency in a fight between arm and leg techniques of top-level female karate competitors. This would give us the better insight into the situational conducts in a karate fight as also the opportunity to improve training process.

2. Methods

2.1. Participants

The sample of participants consisted of a group of ten (10) top-level, senior female karate competitors,

participants of one elite world tournament in a kumite competitor's discipline – open category. All competitors were at least 2nd dan black belt level and were involved in karate training for at least 10 years. All participants are European or World championship medal holders. One can conclude that the sample of participants was adequate for detecting the behaviour at the top level karate fight for women. Smaller sample of subjects was also the limitation of this paper but the authors' opinion is that the level of participants was valuable for this important analysis of a karate fight.

2.2. Variables

The analysed variables for the evaluation were divided in three groups:

- *Variables of non-scored techniques:* KT-kizame tsuki, GT-gyaku tsuki, MG-mawashi geri, UMG-ura mawashi geri, NT-nage waza tsuki, UK-FR-total frequency of non-scored techniques.
- *Variables of scored techniques noted as overall score gained by each technique:* KT-B- kizame tsuki scored, GT-B- gyaku tsuki scored, MG-B-mawashi geri scored, UMG-B- ura mawashi geri scored, NT-B- nage waza tsuki scored, BKP-given score penalty, UK.BOD.-sum of scored techniques.
- *Variables of situational efficiency:* KT-EF- kizame tsuki efficiency, GT-EF- gyaku tsuki efficiency, MG-EF- mawashi geri efficiency, UMG-EF- ura mawashi geri efficiency, NT-EF nage waza tsuki efficiency, UK-EF -total efficiency, UK-TS-EF- total tsuki efficiency, UK-GE-EF-total geri efficiency, UK-KUMITE-EF-total situational efficiency in a fight.

2.3. Methods of data acquisition

Data were collected based on the expert registration of the variables in 13 fights of the mentioned tournament. The fights were recorded with a DVD camera. Registration of data was performed by three educated surveyors from the Chair of Combat Sports of Faculty of Kinesiology University of Zagreb. Scored techniques represent the number of overall score achieved by particular technique in the fight. Non-scored techniques represent every technique that was not awarded with a positive score but was performed with full amplitude of movement. Performed non-scored techniques were noted only if all three surveyors agreed. Detailed description of structural technical units, i.e. variables, is shown in the works of Kuleš [1998] and Sertić [2004]. Data were processed by the programme for the statistical data processing Statistics for Windows 7.0.

2.4. Methods of data processing

Basic descriptive parameters of variables were calculated with standard statistical procedures: arithmetic mean (AS) and standard deviation (SD) of the results.

Situational efficiency of the technique ("technique"-EF) was calculated with the formula:

$$\text{„technique”-EF} = \frac{\sum \text{scores achieved by each technique}}{\text{Frequency of the non-scored techniques}} \cdot 100$$

Normality of distribution was tested with K-S test and in order to determine the difference in the situational efficiency in the fight between arm and leg techniques Student's t-test was used. The analysis was applied on results of the performed techniques and on the calculation of the total situational efficiency between arm and leg techniques respectively.

3. Results and discussion

Having examined table 1 in the value of standard deviation (SD) one can notice that the higher values of SD in the variables non-scored KT- *kizame tsuki* (6.29) and GT-*gyaku tsuki* (11.51) match the higher frequency of the application of these techniques in the fight. These results can indicate the tactics of a sport fight in karate. All variables, based on the shown values, point to a normal distribution of results according to K-S test.

Having examined table 2 one can notice the frequencies of non-scored techniques, scores achieved by each technique and the calculation of situational efficiency of the techniques. According to the results of research, arm techniques: GT-*gyaku*

tsuki (185) and KT-*kizame tsuki* (79) are the most used techniques in a karate fight. Leg techniques MG-*mawashi geri* (34) and UMG-*ura mawashi geri* (10) show lower values of frequency in a karate fight. The highest values of the scores achieved have the techniques: GT-B-*gyaku tsuki* scored (26), KT-B-*kizame tsuki* scored (12), NT-B-*nage waza tsuki* scored (12) and leg techniques MG-B-*mawashi geri* scored (6) and UMG-B-*ura mawashi geri* scored (6). The effectuated higher values of scored arm techniques are in accordance with the research so far which point to an increased usage and predominance of arm techniques [Koropanovski, Dopsaj, Jovanović 2008]. Arm techniques are considered to be technically, i.e. structurally and biometrically, less demanding in relation to leg techniques and therefore tactically "less risky" to use. But one can also notice that total efficiency of each technique gives much more credit for leg techniques which have higher score efficiency due to their smaller usage frequency.

Table 3 shows the results in partial situational efficiency of arm and leg techniques as also total arm (UK-TS-EF) and leg (UK-GR-EF) efficiency. It is therefore noticed that the highest average situational efficiency in a fight is realized with leg technique *ura mawashi geri*-UMG-EF (36). The average situational efficiency of this leg technique is almost three times higher than arm technique *gyaku tsuki*-GT-EF which comes second with the average situational efficiency 12.78 before the techniques *kizame tsuki* - KT-EF (9,04) and *mawashi geri*-MG-EF (5,72). This information shows a great score predominance and efficiency of the usage of the *ura mawashi geri*-UMG-EF technique. Furthermore, a low frequency of the usage of leg techniques and great efficiency in relation to the points gained, influenced average situational efficiency of total leg techniques UK-GR-EF (41,72) which is almost two

Table 1. Descriptive parameters of variables

Techniques	Mean	Minimum	Maximum	Standard deviation
KT	7,9	1	21	6,29
GT	18,5	4	44	11,51
MG	3,4	0	11	4
UMG	1	0	5	1,56
NT	1,7	0	12	3,71
KT-B	1,2	0	6	2,29
GT-B	2,6	0	10	3,13
MG-B	0,6	0	3	1,26
UMG-B	0,6	0	3	1,26
NT-B	1,2	0	6	2,52

Legend: KT-*kizame tsuki* non scored attempt, GT-*gyaku tsuki* non scored attempt, MG-*mawashi geri* non scored attempt, UMG-*ura mawashi geri* non scored attempt, NT-*nage waza tsuki* non scored attempt, KT-B-*kizame tsuki* scored, GT-B-*gyaku tsuki* scored, MG-B-*mawashi geri* scored, UMG-B-*ura mawashi geri* scored

Table 2. Frequency of scored and non-scored techniques and situational efficiency of techniques

SUBJ	KT	KT-B	KT-EF	GT	GT-B	GT-EF	MG	MG-B	MG-EF	UMG	UMG-B	UMG-EF
1	12	6	50	18	10	55,5	10	3	30	1	3	300
2	2	0	0	15	2	13,3	2	0	0	1	0	0
3	21	1	4,7	44	4	9,09	2	0	0	5	3	60
4	7	0	0	27	5	18,5	11	3	27,2	0	0	0
5	14	5	35,7	20	3	15	5	0	0	2	0	0
6	2	0	0	25	1	4	0	0	0	1	0	0
7	5	0	0	14	0	0	0	0	0	0	0	0
8	1	0	0	8	1	12,5	1	0	0	0	0	0
9	6	0	0	4	0	0	1	0	0	0	0	0
10	9	0	0	10	0	0	2	0	0	0	0	0
SUM	79	12	15,18	185	26	14,05	34	6	17,64	10	6	60
MEAN	7,9	1,2	1,5	18,5	2,6	1,4	3,4	0,6	1,76	1	0,6	6

Legend: SUBJ – subjects, SUM – total sum, KT-kizame tsuki, KT-B-kizame tsuki score, KT-EF- kizame tsuki efficiency, GT-gyaku tsuki, GT-B- gyaku tsuki score, GT-EF- gyaku tsuki efficiency, MG-mawashi geri, MG-B- mawashi geri scored, MG-EF-mawashi geri efficiency, UMG-ura mawashi geri, UMG-B-ura mawashi geri score, UMG-EF-ura mawashi geri efficiency

Table 3. Total, average and partial situational efficiency of arm (UK-TS-EF) and leg techniques (UK-GR-EF)

Subjects	KT-EF	GT-EF	MG-EF	UMG-EF	UK-TS-EF	UK-GR-EF
1	50	55,5	30	300	105,5	330
2	0	13,3	0	0	13,3	0
3	4,7	9,09	0	60	13,79	60
4	0	18,5	27,2	0	18,5	27,2
5	35,7	15	0	0	50,7	0
6	0	4	0	0	4	0
7	0	0	0	0	0	0
8	0	12,5	0	0	12,5	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
SUM	90,4	127,89	57,2	360	218,29	417,2
AS-EF	9,04	12,78	5,72	36	21,8	41,72

Legend: SUM – total sum of situational efficiency of the technique, AS-EF – arithmetic mean of situational efficiency of the technique, UK-TS-EF – total situational efficiency of arm techniques, UK-GR-EF – total situational efficiency of leg techniques, KT-EF - kizame tsuki situational efficiency, GT-EF - gyaku tsuki situational efficiency, MG-EF - mawashi geri situational efficiency, UMG-EF - ura mawashi geri situational efficiency, SUM-sum, AS-EF – arithmetic mean

times higher than arm technique UK-TS-EF (21,8).

Table 4 shows the relationship between performed arm and performed leg techniques. Performed techniques comprise the number of non-scored techniques and scored techniques. It shows that in almost all the variables of the performed arm and leg techniques there exists a statistically significant difference at the level of significance $p < .05$. The mentioned results of total frequency of each technique in karate fight point to a predominant usage of arm techniques in relation to leg techniques in a karate fight. Based on everything presented, we can ask a question – 'is such a "tactically safer" approach to a fight really justified'?

Having examined table 5 one can notice that there is no statistically significant ($p < .05$) difference in partial or total situational efficiency between the arm (UK-TS-EF) and leg techniques (UK-GR-EF) in

a karate fight of top-level female karate competitors. This information points to tactical justification of increased application of leg techniques in relation to arm techniques in a karate fight. Such a tactical approach in a fight has led to total victory of the competitor 1. who achieved by far the highest situational efficiency of leg techniques UK-GR-EF (table 2). This information shows that increased application of leg techniques would increase the situational efficiency of fighters and make the performed techniques in a karate fight more attractive. These findings are important for karate as sport and could make it more competitive in media, compared to other sports, especially combat sports. To make such an approach become reality, it is necessary to base the process of tactical training on the confirmed and reliable situational parameters of a karate fight and not only on trainer's experience.

Table 4. Difference in frequency between the performed arm (UK-TS) and leg techniques (UK-GR) $p < .05$

Techniques	Mean	Std.Dev.	t	df	p
KT-P	9,1	7,75			
MG-P	4,0	5,20	1,72	18	0,10
KT-P	9,1	7,75			
UMG-P	1,6	2,59	2,90	18	0,01
GT-P	21,1	13,11			
MG-P	4,0	5,20	3,83	18	0,00
GT-P	21,1	13,11			
UMG-P	1,6	2,59	4,61	18	0,00

Legend: Std.Dev. – standard deviation, t - t-value, df – number of degrees of freedom, p – error proportion, KT-P-performed *kizame tsuki*, GT-P- performed *gyaku tsuki*, MG-P- performed *mawashi geri*, UMG-P- performed *ura mawashi geri*

Table 5. Difference in situational efficiency between arm (UK-TS-EF) and leg techniques (UK-GR-EF) $p < .05$

Techniques	Mean	Std.Dev.	t	df	p
KT-EF	9,04	18,19			
MG-EF	5,72	12,07	0,48	18	0,63
KT-EF	9,04	18,19			
UMG-EF	36	94,65	-0,88	18	0,38
GT-EF	12,78	16,47			
MG-EF	5,72	12,07	1,09	18	0,28
GT-EF	12,78	16,47			
UMG-EF	36	94,65	-0,76	18	0,45
UK-GR-EF	41,72	103,19			
UK-TS-EF	21,82	33,02	0,58	18	0,56

Legend: AS Std.Dev. – standard deviation, t - t-value, df – number of degrees of freedom, p – error proportion, KT-EF *kizame tsuki efficiency*, GT-EF *gyaku tsuki efficiency*, MG-EF *mawashi geri efficiency*, UMG-EF *ura mawashi geri efficiency*, UK-TS-EF-total situational efficiency of arm techniques, UK-GR-EF-total situational efficiency of leg techniques

4. Conclusion

This research has confirmed that one can predict the final success in a karate fight of top-level female competition with the recommended analysis of technical-tactical indicators of situational efficiency. The analysis of the fight has confirmed a statistically significant difference between the performed arm and leg techniques but no statistically significant difference between the arm and leg techniques in total situational efficiency. In this manner, the usage of leg techniques as more efficient ones must be intensified and this could increase the level of attractiveness of karate as a sport. The mentioned indicators of presented characteristics of karate fights of top-level female karate competitors should be followed by further research which should include a bigger sample of participants. Only with such an expert and scientific approach is it possible to ensure further progress of karate which shows potential to grow.

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Sprawność sytuacyjna technik ramion i nóg w walce karate wśród najlepszych zawodniczek karate

Słowa kluczowe: sporty walki, techniki ramion, techniki kończyn dolnych, taktyczno-techniczna sprawność

Streszczenie

Walka karate, poza punktowanymi technikami, składa się także z pewnej liczby taktyczno-technicznych działań, takich jak ruch ciała (tai no ido) oraz wykonywanych, ale nie punktowanych technik. Wskaźniki te, z punktu widzenia

analizy antropologicznej, definiują fizjologiczne obciążenie zawodników, a z punktu widzenia analizy strukturalnej, techniczną i taktyczną sprawność walczących. Stąd aktywność zawodników, która składa się z liczby wykonywanych technik, nieuchronnie wpływa na definicję modelu charakteryzującego skuteczność sytuacyjną w walce. W celu uniknięcia wrażenia, iż techniki ramion są dominujące w stosunku do całościowego wyniku w walce, konieczna jest obserwacja wszystkich wykonywanych technik poprzez system współczynnika wyniku. Taka analiza pokazuje z jednej strony dominację technik kończyn dolnych w stosunku do potencjalnego wyniku, z drugiej strony słabszą częstotliwość tzn. zastosowanie w walce, dzięki biometrycznie bardziej skomplikowanym wymaganiom w stosunku do uderzeń kończynami górnymi. Zatem celem badania jest oznaczenie cech walki karate z punktu widzenia stosunku pomyślnie i niepomyślnie wykonanych technik kończyn górnych i dolnych w celu ustalenia ich ważności oraz wpływu na wynik całościowej sprawności sytuacyjnej w walce karate.

Badanie przeprowadzone zostało na grupie składającej się z 10 najlepszych senierek, uczestniczek elitarnych zawodów kumite w kategorii otwartej. Analizowane zmienne zostały podzielone na trzy grupy: niepunktowane techniki, punktowane techniki i zmienne sprawności sytuacyjnej. Walki zostały nagrane kamerą cyfrową i przetworzone za pomocą programu: Statistics for Windows 7.0., z użyciem parametrów opisowych K-S test i Student t-test.

Rezultaty badania wskazują, że nie ma statystycznie istotnej różnicy pomiędzy częściową a całkowitą sprawnością sytuacyjną, pomiędzy techniką ramion i nóg w walce karate wśród najlepszych zawodniczek, co oznacza, iż można osiągnąć prawie takie same rezultaty w walce przy rzadszym zastosowaniu technik nóg. Autorzy sugerują, iż częstsze użycie technik kończyn dolnych może przyczynić się do uatrakcyjnienia widowiskowości walki karate.