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Correlation between Plantar Pressure and Striking Speed in Karate-do

Teodoru Marian Daniel^{a*}, Petre Răzvan-Liviu^a^a National University of Physical Education and Sport, 140 Constantin Noica Street, sector 6, Bucharest, 060057, Romania

Abstract

The present paper focuses on a topic that represents a permanent concern for the authors. The correlation between plantar pressure and execution speed in Karate-do is a major issue for achieving competition objectives. A correlation was established between maximal pressure values (on the left and right feet - the correct stance) and execution speed while performing the strikes specific to Karate-do. We found that the correlation coefficients achieved high to very high values, which proves that the striking speed is strongly influenced by maximal pressure (the correct stance) on each foot. At the same time, we noticed that all the correlation coefficients had positive values, which means that any of the couples of variables we have considered acts in the same direction. Therefore, if one of the variables is on a descending trend, the other will also be on a descending trend, while if a variable is on an ascending trend, the other will also be on an ascending trend.

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Keywords: plantar pressure, striking speed, Karate-do

1. Introduction

The increase in the number of participants and the improvement of sports performances in the Karate-do field have intensified the preoccupations related to the sports training approach from strictly scientific perspectives (Amălinei, 1998; Martin, 2007; Crof, 2001). That is why our enterprise wasn't easy at all: we started developing a study that allowed us to configure the main technical elements extracted from both the specialty literature and the discussions with some technicians and athletes. In this sense, we considered it would be important for us to analyze the studies issued by a series of specialists in the field, but, at the same time, to start a research based on our own previous studies and on our permanent concern with all the Karate-do aspects, among which those related to its specific technique (Petre, 2011). Thus, we initiated a research on the plantar pressure, respectively on the way in which it influences the execution speed while performing the strikes specific to the domain.

2. Research design

2.1. Objectives

We mention that, initially, we conducted some studies focused on both the plantar pressure and the striking speed [4]. This time, we are interested in making a correlation between the two elements that compose the Karate-do technique and lead to efficiency (scoring the expected number of points).

2.2. Hypothesis

* Corresponding author. Tel.: 0040723362499
E-mail address: teomarian@yahoo.com

Plantar pressure influences the execution speed.

2.3. Methods

In order to reach our goal, we initiated a research developed on many stages. In the beginning, our studies were focused on the aspects related to the plantar pressure, respectively on the execution speed. To achieve these desiderata, we used two objectivization systems, as follows:

- for the plantar pressure, the Pedar-X plantar pressure measurement system (we were the first to use it in the Romanian Karate-do field);
- for the strike execution speed, the Quintic information system (for the motion analysis and evaluation).

All the facilities necessary to our research were made available to us by the Laboratory of Biomechanics and Biomechatronics of the Department of Mechatronics and Fine Mechanics, Faculty of Mechanical Engineering and Mechatronics within the Polytechnic University of Bucharest. Athletes' technical training was performed in the Karate-do gym of the Suiko Sports Club of Lungulețu (a locality in Dâmbovița County), equipped with all the facilities required by this discipline.

The subjects of our research are performance athletes within the Suiko Sports Club, practitioners of Karate-do, with excellent competitive results: all of them reached the "podium" at least once in the national championship (for children, mini-cadets, cadets, juniors or youth). The 10 athletes of our sample were selected depending on each one's qualities and sports results obtained prior to the research initiation, therefore we firstly had in view the performance-related criterion and, last but not least, the age-related criterion (seniors aged 21 to 24 years old) and the gender-related criterion (males, rural environment), competitors in many weight classes.

The research took place between *1 September 2010 and 30 June 2011*, when we developed the following stages: subject evaluation – constitution of the working group; initial testing; implementation of the training program specific to the chosen theme; development of the specific training program; final testing.

2.4. Results

We made a correlation between the maximal pressure values (on left foot and on right foot – the correct stance) and the anthropometric parameters (weight, height, upper limb length, lower limb length), on the one hand, and the execution speed of the Karate-do strikes, on the other hand.

We found out that the coefficients of correlation had high to very high values, which proves that the striking speed is strongly influenced by the maximal pressure (the correct stance) on each foot. At the same time, we noticed that all the coefficients of correlation had positive values, which means that any of the couples of variables taken into consideration by us acts to the same direction. Therefore, if one of them has a descendent trend, the other will also have a descendent trend, and if one of them has an ascendant trend, the other will also have an ascendant trend.

Table 1. Subjects of the research

Crt. no.	Surname and name	Age	Weight	Height
1.	M.M.	22 years old	70 kg	1.84 m
2.	B.L.	21 years old	64 kg	1.68 m
3.	V.V.	21 years old	70 kg	1.75 m
4.	V.M.	23 years old	84 kg	1.83 m
5.	M.L.	23 years old	70 kg	1.73 m
6.	Z.V.	24 years old	70 kg	1.73 m
7.	M.N.	23 years old	86 kg	1.78 m
8.	M.S.	23 years old	80 kg	1.83 m
9.	S.V.	23 years old	63 kg	1.68 m

10.	A.M.	21 years old	72 kg	1.76 m
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Table 2. Coefficients of correlation

Measured parameters	KizamiTsuki	GyakuTsuki	UraMawashi Geri	Mawashi Geri
Maximal pressure on left foot	0.92	0.14	0.86	0.75
Maximal pressure on right foot	0.93	0.19	0.88	0.81
Weight	0.26	0.60	0.46	0.40
Height	0.73	0.61	0.86	0.74
Upper limb length	0.60	0.53	0.70	0.63
Lower limb length	0.61	0.46	0.75	0.62

Table 3. Statistics of the specific parameters

Measured characteristics	Test	Mean	Diff. F-I	Std. dev.	Cv	Effect size	t	P	Null hypothesis																																																																						
Maximal pressure on left foot	I	202.45		62.10	31%	high to very high	6.51	P<0.05	rejected																																																																						
	F	226.75	24.30	64.85	29%					Maximal pressure on right foot	I	229.75		61.56	27%	high to very high	4.07	P<0.05	rejected	F	243.75	14.00	63.43	26%	Lunging punch Kizami-Tsuki	I	6.24		0.29	5%	high to very high	7.55	P<0.05	rejected	F	6.83	0.59	0.49	7%	Reverse punch Gyaku-Tsuki	I	7.49		0.27	4%	high to very high	4.18	P<0.05	rejected	F	8.23		0.35	7%	Reverse roundhouse kickUra-Mawashi-Geri	I	8.39		0.27	3%	high to very high	18.73	P<0.05	rejected	F	9.17	0.78	0.35	4%	Roundhouse kick Mawashi-Geri	I	11.59		0.36	3%	high to very high	11.39	P<0.05	rejected
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2.5. Interpretation and discussion

The data obtained after the statistical-mathematical processing reveal the following aspects:

Measurements for the characteristic MAXIMAL PRESSURE ON LEFT FOOT: the sample is non-homogeneous in the initial testing and also non-homogeneous in the final testing. Cohen's effect size index shows that the differences between the two means are high to very high. The statistic hypothesis checking performed with the dependent t test highlights a statistically significant difference between means, $P < 0.05$. The null hypothesis is rejected and the (alternative) hypothesis of the research is accepted.

Measurements for the characteristic MAXIMAL PRESSURE ON RIGHT FOOT were performed on the 10 athletes in the initial testing and the final testing. The obtained arithmetical means were 229.75, respectively 243.75 kPa. We notice an average increase by 14.00 kPa. The sample is non-homogeneous in the initial testing and also non-homogeneous in the final testing. Cohen's effect size index shows that the differences between the two means are high to very high. The statistic hypothesis checking performed with the dependent t test highlights a statistically significant difference between means, $P < 0.05$. The null hypothesis is rejected and the (alternative) hypothesis of the research is accepted.

Measurements for the characteristic LUNGING PUNCH - KIZAMI-TSUKI. The obtained arithmetical means were 6.24, respectively 6.83 m/s. We notice an average increase by 0.59 m/s. The sample is homogeneous in the initial testing and also homogeneous in the final testing. Cohen's effect size index shows that the differences between the two means are high to very high. The statistic hypothesis checking performed with the dependent t test highlights a statistically significant difference between means, $P < 0.05$. The null hypothesis is rejected and the (alternative) hypothesis of the research is accepted.

Measurements for the characteristic REVERSE PUNCH - GYAKU-TSUKI. The obtained arithmetical means were 7.49, respectively 8.23 m/s. We notice an average increase by 0.74 m/s. The sample is homogeneous in the initial testing and also homogeneous in the final testing. Cohen's effect size index shows that the differences between the two means are high to very high. The statistic hypothesis checking performed with the dependent t test highlights a statistically significant difference between means, $P < 0.05$. The null hypothesis is rejected and the (alternative) hypothesis of the research is accepted.

Measurements for the characteristic REVERSE ROUNDHOUSE KICK - URA-MAWASHI-GERI. The obtained arithmetical means were 8.39, respectively 9.17 m/s. We notice an average increase by 0.78 m/s. The sample is homogeneous in the initial testing and also homogeneous in the final testing. Cohen's effect size index shows that the differences between the two means are high to very high. The statistic hypothesis checking performed with the dependent t test highlights a statistically significant difference between means, $P < 0.05$. The null hypothesis is rejected and the (alternative) hypothesis of the research is accepted.

Measurements for the characteristic ROUNDHOUSE KICK - MAWASHI-GERI. The obtained arithmetical means were 11.59, respectively 12.29 m/s. We notice an average increase by 0.70 m/s. The sample is homogeneous in the initial testing and also homogeneous in the final testing. Cohen's effect size index shows that the differences between the two means are high to very high. The statistic hypothesis checking performed with the dependent t test highlights a statistically significant difference between means, $P < 0.05$. The null hypothesis is rejected and the (alternative) hypothesis of the research is accepted.

3. Conclusions

Modern evaluation means can be a valuable tool for the specialists in the field and they involve a new way of approaching the training process, which require a concrete identification of the major elements necessary to the goal fulfilment. The permanent emphasis on the corroboration between stances and strikes can contribute to the achievement of any performance-related goal. To impose the plantar pressure in the athletes' training program and, obviously, in the Karate fighter's model construction, may represent one of the prerequisites for an efficient competitive fighting.

Results in the final testing validated the hypothesis of our research, according to which "plantar pressure is a deciding factor to achieve the strike efficiency in relation to the performer's stance during a Karate-do competition, being materialized in the execution speed increase".

Striking speed is strongly influenced by the maximal pressure on each foot, but also by the analyzed anthropometric parameters. All the coefficients of correlation have positive values, which means that any of the couples of variables taken into consideration by us acts to the same direction.

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