

FRONT-HAND-PUNCH SPEED IMPROVEMENT EXPERIMENTAL METHODOLOGY IN KARATE

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ABSTRACT

This article presents the development of an experimental methodology that aims to improve the speed of the front-hand punch in karate. The rationale behind developing this methodology is that the speed of the front-hand punch in karate is one of the most important criteria for the successful defeat of the opponent. In addition, the front-hand punch is one of the most commonly used punches during matches. The objective that we set was to study the effect of the application of the methodology we developed for the purpose of improving the speed of the front-hand punch (Kizami Tsuki) in karate. To accomplish this study, we used a computerized video system to register and analyze the speed of karate punches performed by the participants in the experiment. The results regarding the speed of the straight-hand punch were measured in the same way in order to provide identical conditions. Input data was processed by means of applied software for kinematic analysis. To prove the credibility of the registered data, we used statistical analysis methodology. We hope that by presenting our methodology in this article, more coaches will begin to use modern tools and methods in order to improve the quality of training in karate.

Key words: methodology, karate, punch, front hand, speed

INTRODUCTION

There is a large number of hand punches used in modern karate, as these punches are also specific for this sport. These punches are aimed at three body levels: low, middle, and high (Gedan, Chudan, and Jodan). Using these punches in high maneuverability and dynamics demands highly specialized technical preparation and physical and psychical stability on the competitor's part (Bishop, 1989, Higaonna, 1985).

Hand punches are easier to perform than kicks because they allow for keeping balance, which provides a more stable support. If the technique is performed correctly, its power, speed, precision, and the damage on the opponent cannot be denied (Habersetzer 1998, Bogdanov, Ivanov 1972).

Karate is a successful fighting sport, because the punches performed during a fight are with high speed, power and accuracy

(Chaabène et. al, 2015). A prerequisite for the high quality of assault technique is the exercises practiced in karate, which increase the speed of the punches (Marqueset. al., 2013). The most commonly used offensive techniques in karate used during a fight are strikes such as (gyakuzuki is the reverse punch, kizami zuki is the jab punch and oi zuki is the lunge punch) and the kicks (maegeri is the front kick and mawashi geri is the semicircular kick) (Chaabène et. al, 2014). But punches are more likely to be applied because they offer better opportunities for successful striking (Marques, 2013).

According to Marquez Junior (Marques, 2014), the speeds which karate hand-fighting techniques are performed, as well as the fact that they are executed with a person facing the opponent, increase the chance of successful strikes.

According to Nakayama (Nakayama, 2012),

speed is particularly important for offensive techniques in karate because the high-speed attack is difficult to defend.

After a systematic review of the speed of punch techniques in karate, we found that it is of paramount importance to the fighter who must choose the best attack during the bout. (Barbanti, 2010)

There is little information on this topic (Marques, 2012) and there is no systematic review of velocity of the offensive techniques of the karate in combat sports literature (Franchini, Del Vecchio, 2011)

In order to improve and perfect karate techniques, trainees need to perform multiple repetitions with maximum concentration and dedication. This, however, will not be enough if the training does not rely on proper physical and physiological principles (Marques, 2014).

Study Objective:

Studying the effects of the application of the methodology for targeted improvement of the speed of the front-hand punch (Kizami Tsuki) in karate.

Study Goals:

To reveal the importance of the speed of the punch as inherent to technical mastery in karate-do.

To develop a methodology specifically aimed at developing the speed of the punch.

To analyze the effect of using this specific training method.

METHODOLOGY

The study was conducted by means of a computerized video system for registration and analysis of the karate punch speed. Ten

male competitors from National Sports Academy “Vassil Levski” took part in the study. The average age of the participants was 22 years, ranging from 19 to 26. Ranks in karate varied from 5th Kyu to 1st Dan.

Competitors (surveyed):

1. Ivaylo S. – Republican champion for 2017, 3 kyu, brown belt.

2. Denis N. – Republican champion for 2017, 3 dan, black belt.

3. Martin M. – Republican champion 2018, 2 dan, black belt.

4. Emre K. – third place Republican Championship 2017, blue belt.

5. Nikolay N. – Republican champion – Team 2017, 5 kyu, blue belt.

6. Antoine T. – Republican champion for 2014, 1 dan, black belt.

7. Stancho S. – Republican champion 2017, 1 dan, black belt.

8. Vadim G. – Republican champion 2016, 3 dan, black belt.

9. Miroslav M. – Republican champion 2012, 1 dan, black belt.

10. Georgi A. – Republican champion 2013, 1 dan, black belt.

To complete the tasks, the participants were divided into two groups: a test group and a control group. Both groups delivered a straight-hand punch onto the target, and the results achieved were diligently recorded. We applied the specialized methodology aiming to develop the speed of the front hand punch onto the test group for a period of five months. The methodology applied is shown in Table 2 and Table 3.

The distribution of the persons surveyed by us in two groups is shown in Table 1.

Table 1. *Groups organization*

Control group	Test group
I. S.	A. T.
D. N.	M. M.
N. N.	V. G.
S. S.	E. K.
G. A.	M. M.

Table 2. *Applied methodology for the test group:*

Months	I	II	III	IV	V
Mandatory exercises used to build speed for the "Kizami tsuki" hand-punch					
1. 10-Meter spring / reps.	dosage	dosage	dosage	dosage	dosage
Week 1	4X10	6X10	10X10	12X10	10X10
Week 2	6X10	8X10	12X10	10X10	8X10
Week 3	6X10	10X10	12X10	10X10	8X10
Week 4	8X10	10X10	12X10	10X10	8X10
2. 20-Meter spring / reps.					
Week 1	2X20	6X20	9X20	10X20	8X20
Week 2	4X30	7X20	10X20	8X20	6X20
Week 3	6X20	9X20	10X20	8X20	6X20
Week 4	7X20	9X20	10X20	8X20	6X20
3. 30-Meter spring / reps.					
Week 1	6X30	7X30	8X30	7X30	6X30
Week 2	4X30	6X30	6X30	6X30	4X30
Week 3	2X30	3X30	4X30	3X30	2X30
Week 4	2X30	3X30	4X30	3X30	2X30
4. 50-Meter spring / reps.					
Week 1	2X50	3X50	4X50	3X50	2X50
Week 2	3X50	4X50	5X50	4X50	3X50
Week 3	4X50	5X50	6X50	5X50	4X50
Week 4	4X50	5X50	6X50	5X50	4X50
5. 100-Meter spring / reps.					
Week 1	3X100	4X100	5X100	4X100	3X100
Week 2	2X100	3X100	4X100	3X100	2X100
Week 3	2X100	2X100	3X100	2X100	2X100
Week 4	1X100	1X100	2X100	1X100	1X100
6. Shuttles 3-6-9 meters/ reps.					
Week 1	2X3-6-9	3X3-6-9	4X3-6-9	5X3-6-9	4X3-6-9
Week 2	3X3-6-9	4X3-6-9	5X3-6-9	4X3-6-9	3X3-6-9
Week 3	3X3-6-9	4X3-6-9	5X3-6-9	4X3-6-9	3X3-6-9
Week 4	3X3-6-9	4X3-6-9	5X3-6-9	4X3-6-9	3X3-6-9

7. "Kizami tsuki" hand-punch 10 seconds/ reps.					
Week 1	2X10	2X10	3X10	4X10	3X10
Week 2	2X10	3X10	4X10	3X10	2X10
Week 3	2X10	3X10	4X10	3X10	2X10
Week 4	2X10	3X10	4X10	3X10	2X10
8. Kizami tsuki hand-punch and change of guard 10 seconds / reps.					
Week 1	2X10	2X10	3X10	4X10	3X10
Week 2	2X10	3X10	4X10	3X10	2X10
Week 3	2X10	3X10	4X10	3X10	2X10
Week 4	2X10	3X10	4X10	3X10	2X10
9. "Kizami tsuki" hand-punch and a feint technique for Mawashi geri 10 seconds / reps.					
Week 1	2X10	2X10	3X10	4X10	3X10
Week 2	2X10	3X10	4X10	3X10	2X10
Week 3	2X10	3X10	4X10	3X10	2X10
Week 4	2X10	3X10	4X10	3X10	2X10
10. Shot-putting a heavy ball against a wall punch-bag reps.					
Week 1	2X10	3X10	4X10	5X10	4X10
Week 2	3X10	4X10	5X10	4X10	3X10
Week 3	3X10	4X10	5X10	4X10	3X10
Week 4	3X10	4X10	5X10	4x10	3X10
11. "Kizami tsuki" hand-punch against elastic resistance.					
Week 1	3X10	4X10	5X10	6X10	5X10
Week 2	4X10	5X10	6X10	5X10	4X10
Week 3	4X10	5X10	6X10	5X10	4X10
Week 4	4X10	5X10	6X10	5X10	4X10

Description of exercises used by the test group for the development of speed when performing "Kizami tsuki" hand-punch.

10-Meter sprint – This exercise aims to develop the quality of speed. It is performed from a low-start position upon the coach's signal at the maximum speed possible. The exercise is performed in series with a 30-second break between the series. The exercise is performed after a very good general and special warm-

up. It is evident from the table with the dosage of this exercise that from January to March the number of the series increases and from April to May the overall amount decreases.

20-Meter sprint – This exercise aims to develop the quality of speed. It is performed from a low-start position upon the coach's signal at the maximum speed possible. The exercise is performed in series with 30-45 seconds of break between the series. The exercise is

performed after a very good general and special warm-up. From the table with the dosage of this exercise, it is evident that from January to March the number of the series increases and from April to May the overall amount decreases.

30-Meter sprint – This exercise aims to develop the quality of speed. It is performed from a low-start position upon the coach's signal at the maximum speed possible. The exercise is performed in series with 45-seconds to 1-minute breaks between the series. The exercise is performed after a very good general and special warm-up. From the table with the dosage of this exercise, it is evident that during the first week of each month this exercise is done in more series and the number of series decreases in each of the following weeks.

50-Meter sprint – This exercise aims to develop the quality of speed. It is performed from a low-start position upon the coach's signal at the maximum speed possible. The exercise is performed in series with a 1-minute break between the series. The exercise is performed after a very good general and special warm-up. It is evident from the table with the dosage of this exercise that from January to March the number of the series increases and from April to May the overall number decreases.

100-Meter sprint – This exercise aims to develop the quality of speed. It is performed from a low-start position upon the coach's signal at the maximum speed possible. The exercise is performed in series with 1,5-minute breaks between the series. The exercise is performed after a very good general and special warm-up. From the table with the dosage of this exercise, it is evident that during the first week of each month this exercise is done in more series and the number of series decreases in each of the following weeks.

3-6-9 Shuttle running. This exercise of shuttle running is performed from low-start

position upon the coach's signal. The athlete sprints from the starting point to the 3-meter mark, then sprints back to the starting point, sprints to the 6-meter mark, sprints back to the starting point, and sprints to the 9-meter marker and back. This exercise develops speed and agility. It is performed after a very good general and special warm-up. The break between the series is 2 minutes. It is evident from the table with the dosage of this exercise that from January to March the number of the series increases and from April to May the overall number decreases.

“Kizami tsuki” hand-punch for 10 seconds – This is one of the specialized exercises for developing speed of the upper limbs, and more particularly, it is the straight punch with the front hand. This exercise is performed in pairs, as one participant holds a pinching pad at the level of the head and the other participant performs “Kizami tsuki” and aims to perform as many techniques as possible within the 10-second interval. The coach measures the time and signals the beginning and the end of the interval. The intermission between the series is 1 minute. From the table with the dosage of this exercise, it is evident that the number of the series increases from January to March and that it decreases from April to May.

“Kizami tsuki” hand-punch with change of guard for 10 seconds – This is a specialized exercise for developing speed of both the upper and the lower limbs. This exercise is performed in pairs, as one participant holds a pinching pad at the level of the head and the other participant performs “Kizami tsuki”, then switches the guard position and the punching hand and performs “Kizami tsugki” again from the newly assumed guard. The athlete aims to perform as many techniques as possible within the 10-second interval. The coach measures the time and signals the beginning and the end of the interval. The inter-

mission between the series is 1 minute. From the table with the dosage of this exercise, it is evident that the number of the series increases from January to March and that it decreases from April to May.

“Kizami tsuki” hand-punch and a feint technique for “Mawashi geri” – This is a specialized exercise for developing speed of both the upper and the lower limbs. This exercise is performed in pairs, as one participant holds a pinching pad at the level of the head and the other participant performs a feint technique for “Mawashi” Geri after which performs “Kizami tsuki”, then switches the guard position and the punching hand. The athlete aims to perform as many techniques as possible within the 10-second interval. The coach measures the time and signals the beginning and the end of the interval. The intermission between the series is 1 minute. From the table with the dosage of this exercise, it is evident that the number of the series increases from January to March and that it decreases from April to May.

Shot-putting a heavy ball against a wall punch-bag – This exercise aims to develop the explosive power of the upper limbs. It is performed after a very good general and special warm-up. The weight of the heavy ball is 3

kilograms. The athlete assumes “guard” position facing the wall punch-bag at a 3-meter distance and shot-puts the heavy ball towards the punch-bag. It is essential the push should resemble biomechanically the “Kizami tsuki” pinch as much as possible. The intermission between the series is 30 seconds. From the table with the dosage of this exercise, it is evident that the number of the series increases from January to March and that it decreases from April to May.

“Kizami tsuki” hand-punch against elastic resistance – This exercise aims to develop the explosive power of the upper limbs. It is performed after a very good general and special warm-up. An elastic band is used to provide elastic resistance. The athlete stands with his/her back towards a horizontal bar or a wall bar, to which one end of the elastic band is tied. The athlete holds the other end of the elastic band with the punching hand and performs “Kizami tsuki”. The exercise is repeated 10 times at maximum speed and the intermission between the series is 1 minute. From the table with the dosage of this exercise, it is evident that the number of the series increases from January to March and that it decreases from April to May.

Table 3. *Applied methodology for control group:*

Months	I	II	III	IV	V
Exercises used to build speed for the “Kizami tsuki” hand-punch in the control group					
1. 50-meter sprint					
Week 1	2X50	4X50	5 X50	6X50	7x50
Week 2	3X50	5X50	6X50	7X50	8x50
Week 3	4X40	5X50	6X50	7X50	8x50
Week 4	4X50	5X50	6X50	7X50	8x50

2. Standing long jump						
Week 1	2x10	3x10	4x10	5x10	6x10	
Week 2	3x10	4x10	5x10	6x10	7x10	
Week 3	3x10	4x10	5x10	6x10	7x10	
Week 4	3x10	4x10	5x10	6x10	7x10	
3. "Kizami tsuki" hand-punch – maximum number per 20 seconds						
Week 1	2X20	3X20	4X20	5X20	6X20	
Week 2	2X20	3X20	4X20	5X20	6X20	
Week 3	2X20	3X20	4X20	5X20	6X20	
Week 4	2X20	3X20	4X20	5X20	6X20	
4. 6-9-12 Shuttle running						
Week 1	2X6-9-12	3X6-9-12	4X6-9-12	5X6-9-12	6X6-9-12	
Week 2	2X6-9-12	3X6-9-12	4X6-9-12	5X6-9-12	6X6-9-12	
Week 3	2X6-9-12	3X6-9-12	4X6-9-12	5X6-9-12	6X6-9-12	
Week 4	2X6-9-12	3X6-9-12	4X6-9-12	5X6-9-12	6X6-9-12	

Description of exercises used by the control group for the development of speed when performing "Kizami tsuki" hand-punch.

50-Meter sprint – This exercise aims to develop the quality of speed. It is performed from a low-start position upon the coach's signal at the maximum speed possible. The exercise is performed in series with a 1-minute break between the series. The exercise is performed after a very good general and special warm-up. It is evident from the table with the dosage of this exercise that from January to May the number of the series increases.

Standing long jump – This exercise develops the explosive power of the lower limbs. It is performed after a very good general and special warm-up. One series includes 10 repetitions. The intermission between series is 1 minute. The athlete performs a long jump from the starting position, then faces backwards and performs another long jump towards the starting position. A total of 10 repetitions are performed. As the dosage table indicates for this exercise, from January to May the number of the series increases.

"Kizami tsuki" hand-punch – maximum number of repetitions for 20 seconds. This is a specialized exercise for developing speed of both the upper and the lower limbs. This exercise is performed in pairs, as one participant holds a pinching pad at the level of the head and the other participant performs "Kizami tsuki", then switches the guard position and the punching hand and performs "Kizami tsugi" again from the newly assumed guard. The athlete aims to perform as many repetitions as possible in 20 seconds. The coach measures the time and signals the beginning and the end of the interval. The intermission between the series is 2 minutes. From the table with the dosage of this exercise, it is evident that the number of the series increases from January to May.

6-9-12 Shuttle running. This exercise is performed from low-start position upon the coach's signal. The athlete sprints from the starting point to the 6-meter mark, then sprints back to the starting point, sprints to the 9-meter mark, sprints back to the starting point, and sprints to the 12-meter marker and back. This

exercise develops speed and agility. It is performed after a very good general and special warm-up. The break between the series is 3 minutes. It is evident from the dosage table about this exercise that from January to May the number of the series increases.

The results received regarding the speed straight-hand punch of both groups were measured in identical ways in order to provide the same test conditions for both groups. The data received were discussed with specialists in order to eliminate possible mistakes. The speed of the punch was recorded by means of Sony PJ740 video camera, at 50 frames per second. The camera was positioned perpendicularly to the sagittal axis of the punches, and the point of view was at the height of the punches. The video recordings were further processed by Kinovea video computer software for cinematic analysis. Only attempts that met the requirements for the speed of the punch were analyzed. The data were further analyzed and averaged with regard of the phase periods (Rathee, Magnes, Davis, 2014). The results received through video recording were processed by means of statistical method – descriptive statistics:

Average values of indicators – X mean. The sample mean formula is:

$$\bar{x} = (\Sigma xi) / n$$

\bar{x} just stands for the “sample mean”;

Σ means “add up”;

xi “all of the x-values”;

n means “the number of items in the sample”.

Standard deviation – S. The formula for standard deviation (SD) is

$$s = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$$

Where Σ means “sum of”, X is a value in the data set, μ is the mean of the data set, and N is the number of data points.

Coefficient of variation - V%. The formula for the coefficient of variation is:

Coefficient of Variation = (Standard Deviation / Mean) * 100.

In symbols: $CV = (SD/x \text{ mean}) * 100$.

RESULTS

The punch-speed in karate depends on the correct performance of all phases included in their execution. Figure 1 illustrates all the phases of the punch that were videotaped. Eventually, all punches performed were compared with their correct execution.



Figure 1. *Punch phases*

After the first and the second measurements, regarding the speed parameters of the punch, we received the following results for

the control group. The results are shown in Figure 2 and Figure 3.

Results of first measurement in meters per second for the control group

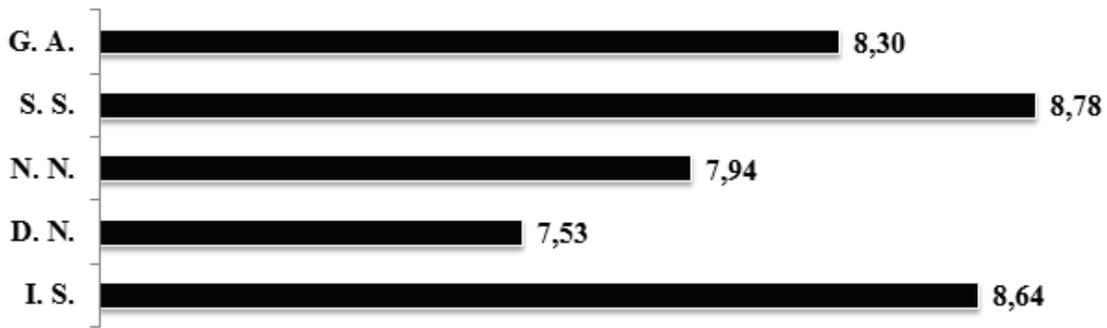


Figure 2. Average speeds of punches for the first measurement

Results of second measurement in meters per second for the control group

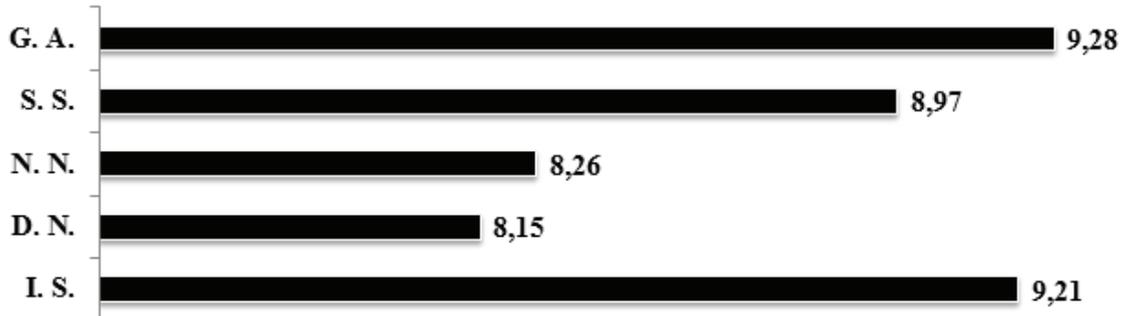


Figure 3. Average speeds of punches for the second measurement

After the first and the second measurements, regarding the speed parameters of the punch, we received the following results for the test group. The results are shown in Figure 4 and Figure 5.

Results of first measurement in meters per second for the test group

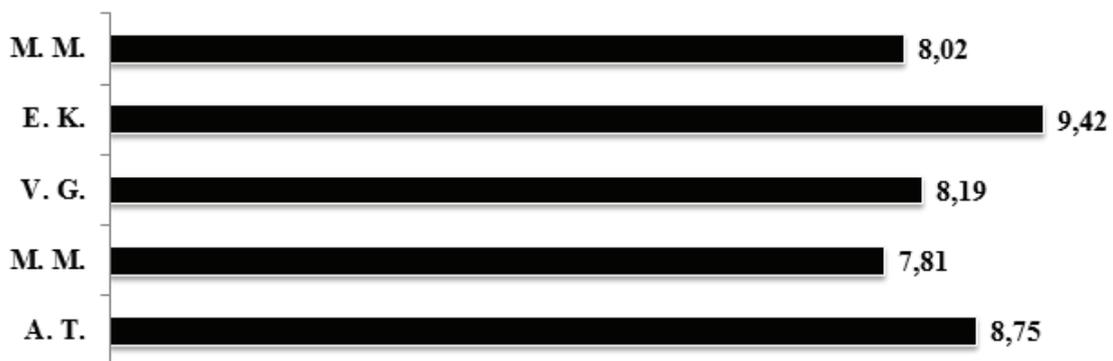


Figure 4. Average speeds of punches for the first measurement

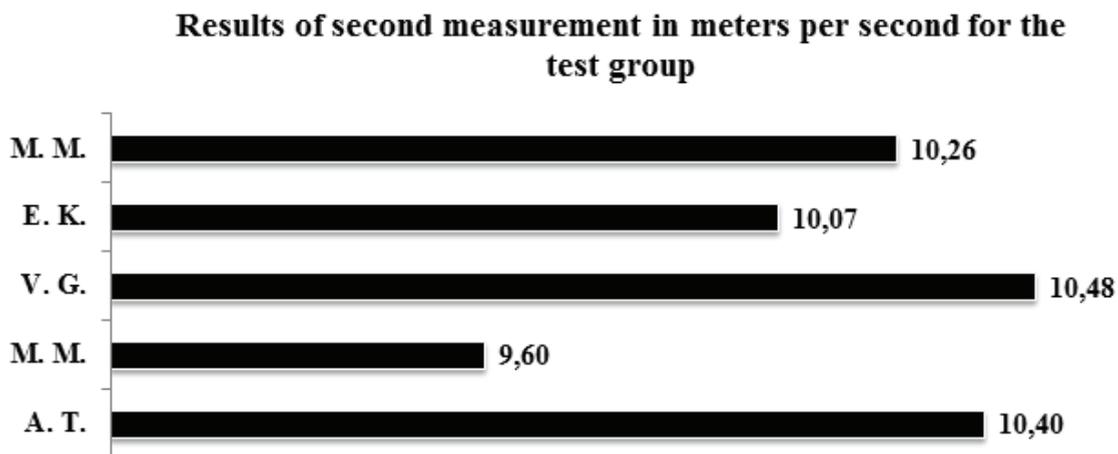


Figure 5. Average speeds of punches for the second measurement

Studying the speed of the Kizami Tsuki punch in karate is an important part of the training process and is connected to the correct execution of the punch as well as with the inability of the opponent to perform the respective defensive techniques. Therefore, it was important to us to prove that the methodology we created leads to improving the speed of the front-hand punch (Kizami Tsuki) in karate.

As a result of the training process we applied, indeed, we achieved improvements of the speed parameters of the punch. The results we received are provided in the materials to follow.

For the past period of training in the control group we observed no significant increases in the average maximum impact velocity by 0.53 m/s. These results are shown in Figure 6.

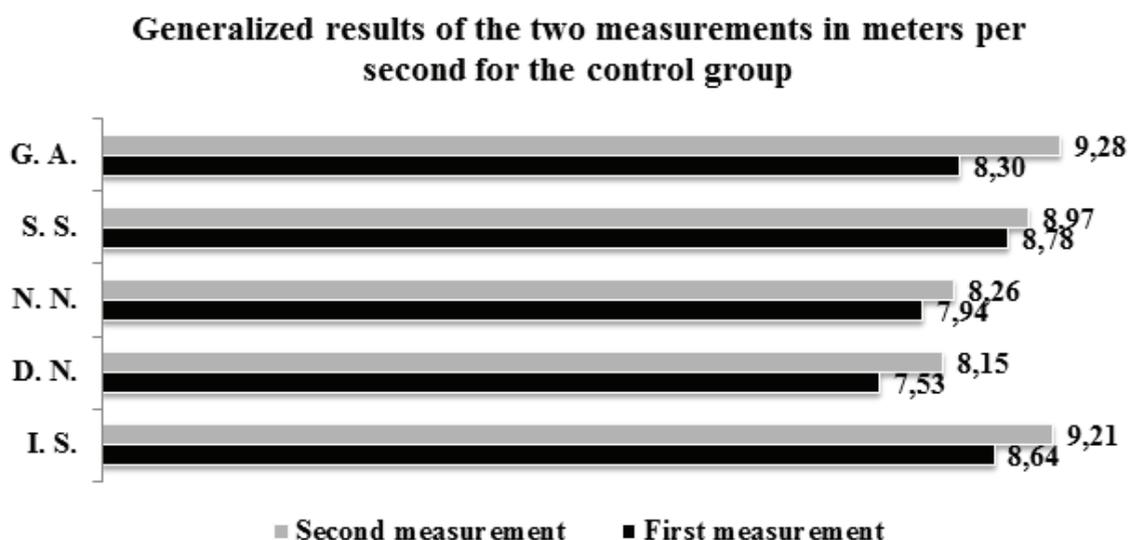


Figure 6. Generalized results of the two measurements for the control group

Figure 7 presents the generalized values of speeds measured for the test group before and after applying the methodology. Here, we observe a significant improvement in the average maximum punch velocity by 1,72 m/s.

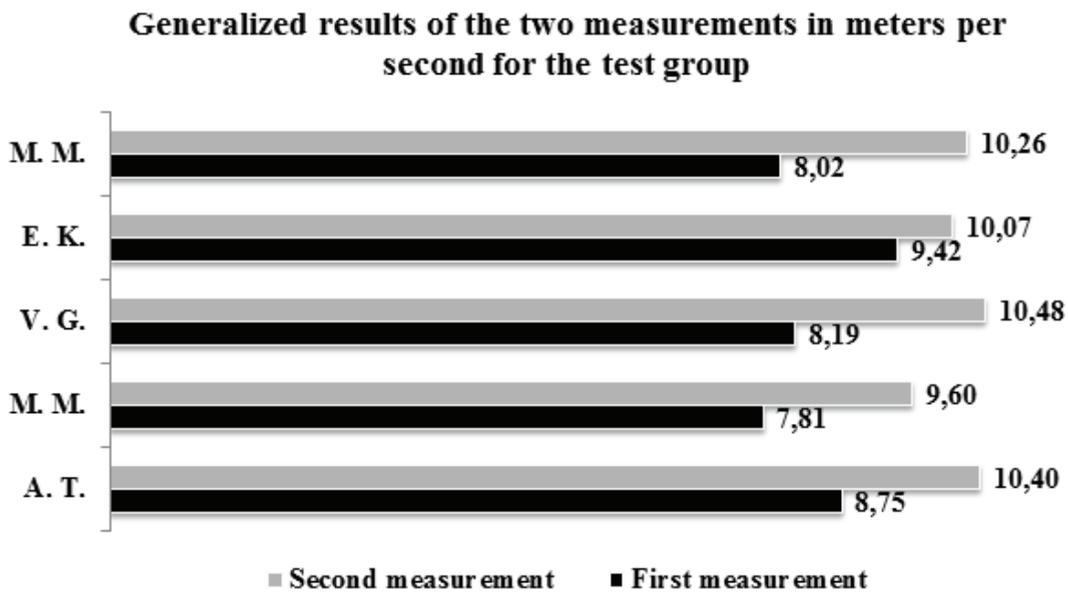


Figure 7. Generalized results of the two measurements for the test group

In order to illustrate the progress of the two groups more clearly, a comparison between the achieved results of the two groups for the period of training is presented in Figure 8.

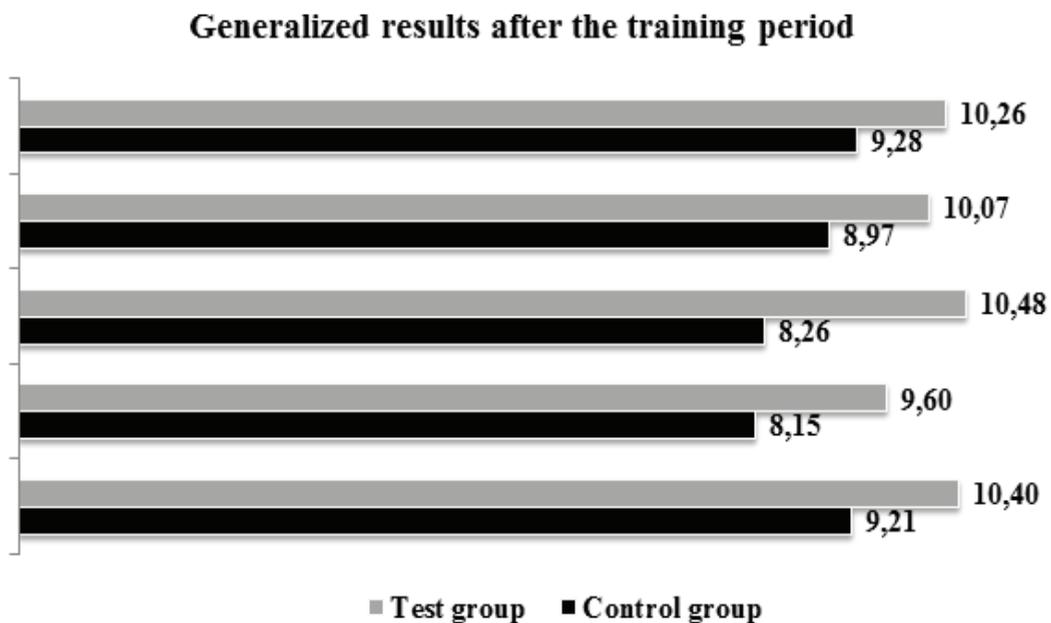


Figure 8. Generalized results after the training period

As Table 4 indicates, the average speed of the test group is significantly higher than that of the control group. Respectively, the difference between the average maximum speeds

of the two groups is 1,40 m/s in favor of the group that used the experimental methodology.

Table 4. *Statistical analysis*

Indicator/Group	Control Group	Test Group
X	8.773	10.162
S	0.534	0.350
V%	6.086	3.448

To calculate V% (the coefficient of variation) we needed to calculate the standard deviation S. The variation coefficient was obtained by $V = \frac{S}{X}$ using the following formula:

The coefficient for the control group was 6,086 %.

The coefficient for the test group is 3,488 %.

It may be concluded that the survey is highly uniform, since V% does not exceed 10-12%.

DISCUSSION

After examination of several studies that affect the measurement of parameters of punch velocity, we determined what is the registered punch velocity measured by the other authors.

The linear velocity of the *kizamizuki tchudan* (jab punch in the trunk) was of 5,8 to 7,1±1,88 m/s (Marques, 2012), the *kizami zuki* without information about the target of the attack was of 5,7 to 9,8 m/s (Diacu, 2013), the *gyakuzuki tchudan* (reverse punch) had linear velocity of 6,58 to 13 m/s (Rathee, Magnes, Davis 2014), but the *gyakuzuki* without information about the target of the attack was of 14 m/s (Cynarski, Wajs, Vencesbrito 2014). The *oi zuki* (lunge punch) was the last punch that the researcher detected the linear velocity. The *oi zuki tchudan* had lin-

ear velocity of 5,83±2,54 to 10 m/s (Marques, Gianino, 2010), but the *oi zuki* without information about the target of the attack was of 5,52 to 12,64 m/s (Fernandes et.al., 2011). The best linear velocity was the *gyaku zuki tchudan*, the 2nd best linear velocity was the *oi zuki tchudan* and the last position was the *kizami zuki tchudan*.

The linear velocity of the punches (*kizami zuki*, *gyakuzuki* and *oi zuki*) in this systematic review was of 5,52 to 14 m/s. According to Ning (Ning et.al., 2011), the karate punch is very fast because this type of combat needs this motor capacity. The kung fu attack with technique similar to the punch, but with the open hand (*yau-man* in Chinese), the linear velocity was of 5,3 to 8,33 m/s (Neto, Magini, Saba, 2007). Then, the result of the karate punch was better than the *yau-man*. The motive is the characteristics of the karate fight, in a few seconds the combat can finish with a precise attack (Tabben et.al., 2015). For example, Nakayama (Nakayama, 2012) informed that the Shotokan karate has the objective to finish the fight with an attack (*ikkenhissatsu* in Japanese). Therefore, the karateka usually trains the precision of the attack (Stevens, 2013)

In conclusion, we can state that, based on the literature related to the topic of the thesis, the speed of execution with the right arm in karate is one of the basic criteria for success-

ful overcoming of the opponent. This gave us the good reason to do research on this subject.

CONCLUSIONS

The parameter analysis of the speed of the front-hand punch, as well as the application of the experimental methodology aimed at improving the speed of this punch have brought about observable positive results.

Improving the speed of punches in karate is of great significance in offensive techniques because attacks at higher speeds are harder to block by the opponent, which in turn, leads to winning the match.

Following the analysis of the front-hand punch speed (Kizami Tsuki), we observed that this speed is of great importance for the contender, who needs to choose the best attack during the sports match.

The improvement of the speeds between the attempts of both groups is credible, which proves that the speed measurement and the video analysis applied can be used in the sports training of karate practitioners and will contribute to improving their sports skills.

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