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EFFECT OF PLYOMETRIC EXERCISES ON BALANCE ABILITY FOR *ASHIHARA* KARATE PRACTITIONERS

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Abstract: *This research adopts a predictive approach to forecast the evolution of events. Ashihara Karate is a contemporary, full-contact fighting style that emphasises Sabaki, utilising the opponent's footwork and attacking techniques to gain an advantage by positioning oneself in the opponent's "blind" spot. Maintaining balance is often essential for mastering situations that require quick and rational action, and it also holds great value in preventing accidents. Purpose: This study aims to highlight statistically significant differences in improving dynamic balance capacity for the lower limbs after implementing a programme that includes plyometric exercises. Methods: Twenty performance athletes from the Sen Craiova Sports Club aged between 20 and 35 participated in this study. The dynamic balance capacity was assessed using the Y-Balance platform (Functional Movement, 2016), a dynamic test performed in a single-leg stance requiring strength, flexibility, central control, and proprioception. Results: A comparison of the descriptive statistics obtained with the Y-Balance platform from the initial and final tests reveals significant positive differences in favour of the experimental group that underwent plyometric exercises during training.*

Key words: *Ashihara; karate; balance; sports training; sports performance.*

1. Introduction

Postural stability and dynamic balance can be gradual indicators of motor skills or for special professions [15]. The trivial form of equilibrium is closely related to gravity.

According to DEX (2009) balance ability is the state of maintaining the body in a balanced position or restores its balance after various movements or high-amplitude demands [3].

The notion of balance comes from "aequilibrium" in Latin, which refers to a perfect equality. This refers, theoretically and mechanically, to the state of rest of a body stressed by forces that tend to disturb it, disturb it, producing motion [5].

Balance is decisive in sports involving travel, variations in support or direct contact with the opponent [17]. This ability to balance is mutually related to the other basic motor skills, speed, strength, endurance and mobility, being essential both in acquiring and perfecting

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technique and tactics [9] and in competition, kumite (fighting) and Kata (form) [10]. Thus, karate is based on two elements: Kumite focuses on dynamic postural control, and Kata focuses on dynamic and static postural control [7].

In biomechanics, equilibrium refers mainly to internal forces generated by muscle contraction. Even in the "sitting" position we cannot speak of perfect equilibrium, because there will be oscillations of the position of the center of gravity, because the balance command and control system is based on feedback corrections of consciously imperceptible involuntary movements. All the more so during a technical action, which involves voluntary change of position of body segments or body, changes the position of the center of gravity and, implicitly, the quality of balance; The most unfavorable instability is given by technical actions in martial arts executed with lower limbs [13]. The competitive success of karate athletes depends very much on balance and basic strength [16].

Postural instability for athletes varies from individual to individual (genotypic conditioning), depending on age, experience and training, fatigue, psychological influences, etc. [4]. Some researchers like Yamamoto et. All, 2015 [18], considered the period with the greatest postural stability to be between 20 and 30 years, instability increases with age and differences between the sexes are insignificant. Both in initiations, for learning technical actions, and in performance preparation, it is essential to systematically interpret the criterion of instability of oscillations of the projection of the center of gravity in the support polygon [13]. It is very difficult to correct a poor balance, for techniques performed with the lower limbs, once it becomes a habit, so if it can develop without the help of the upper limbs, then you will easily be able to hit and defend yourself in time; For those who have problems with balance, they must first ensure that they master the chain of the correct deployment of the technique by providing with support on the partner or a fixed point until the sense of balance gradually develops [11], [21].

Current research in this context [19, 6, 8] has focused on postural control that was assessed in orthostatism, in particular, in a position on one or both legs, with eyes open and closed, on a hard surface. In some studies, the karate group has been compared with groups of subjects performing various physical activities [12, 20], while in other studies, they have been reported in subjects who do not exercise regularly [6], [19].

The role of the coach is very important in training, including the preparation of motor (physical), technical, tactical and psychological skills of athletes (Clark et al., 2018) [1]. Thus, plyometric exercises in general, if a specific number of repetitions is not indicated, are performed for 8 seconds in 5-6 series, with a break of 30 seconds with an execution rhythm that tends to the maximum; It is up to the coach to adjust these characteristics according to the needs and age of the athletes [14].

2. Research Methods

In this research, the objective assessment of the balance capacity in ashihara karate was carried out with the help of the Y-Balance platform (Figure 1) (Cosma, Rusu, Ilinca, and Nanu, 2016) [2]. This assessment is performed in the form of a dynamic test performed in the

position on one leg, which requires strength, flexibility, central control and proprioception. The three directions of movement are: anterior, postero-median and postero-lateral, executed on each limb. For the name of the sample, executed with the right or left limb, we took into account the support leg. The research consisted of initial balance testing and a final test after six months of preparation.

Fig. 1. *The Y-Balance Test*

2.1. Participants and procedure

The research was conducted on a number of 20, performance athletes' members of the Sen Craiova sports club, practitioners of Ashihara Karate style, aged between 20 and 35. They were divided into two groups with 10 athletes each. Physiological characteristics of the subjects are presented in table 1. The experimental group (Group 1) will participate in a training program that will include plyometric exercises, both for physical training and for technical improvement. The second group, the control group (Group 2), will participate in a normal training programme.

The assessment of balance capacity for both groups was performed from the starting position by standing on one foot on the board, with the toes of the foot at the red line, the other foot touching, gently with the fingertips, the red side of the plate. The free leg is taken in turn in the three directions, pushing the indicator as far as possible while maintaining balance. The free leg must be returned to the starting position, under control, without touching the ground.

Table 1

T-test for paired comparison of samples for the two control group tests (G2)

Variables	Group 1 (experimental)	Group 2 (control)
Age (years)	26.3±2.4	26.8±2.3
Height (m)	180.6±5.1	180.5±5.2
Body mass (kg)	81±5.6	80.1±5.5

2.2. Purpose and hypothesis

The aim of the research is to improve sports performance by improving capacity for dynamic equilibrium. The application of a program containing plyometric exercises can cause significant changes in balance capacity for *Ashihara* Karate practitioners.

3. Results

Comparison of results obtained in the two tests (initial and final) For this data analysis, in order to assess the statistical significance of the difference between the averages of two sets of scores, the t-test for paired samples was used, using IBM SPSS Statistics 23 software. When we measure the same sample twice, we end up with more control over the variation of the data.

Table 2

T-test for paired comparison of samples for the two control group tests (G2)

	Test	Mean	Std. Deviation	Std. Error Mean	*t* - Test	Mean Diference (cm)	95% Confidence interval of the Difference	
							Lower	Upper
Right-Anterior	T.initial	70.8	2.7	0.879	11.6	10.2	8.21	12.18
	T.final	81						
Right Postero-Lateral	T.initial	111.7	1.61	0.512	29.68	15.2	14.04	16.35
	T.final	126.9						
Right Postero-Medial	T.initial	104.2	2.01	0.636	24.53	15.6	14.16	17.03
	T.final	119.8						
Left -Anterior	T.initial	71	1.39	0.442	26.68	11.8	10.8	12.8
	T.final	82.8						
Left Postero-Lateral	T.initial	104.8	1.61	0.512	28.9	14.8	13.64	15.95
	T.final	119.6						
Left Postero-Medial	T.initial	106	3.09	0.98	16.73	16.4	14.18	18.61
	T.final	122.4						

This test was applied to assess the statistical significance of the difference between the mean initial and final testing for the six samples. From the table above it appears that the average t-value for the three tests with support on the right leg is 21.93, and for the left leg 24.1. The averages of the two tests differ significant in the anticipated direction, with the independent variable (variation between the two media) for all 14 cm samples having 9 degrees of unidirectional freedom. Thus, the subjects' results improved on average by about 14.3% for the right limb and 15.25% for the left limb compared to the initial test, having the

threshold significant in the anticipated direction, with the independent variable (variation between the two media) for all 14 cm samples having 9 degrees of unidirectional freedom. Thus, the subjects' results improved on average by about 14.3% for the right limb and 15.25% for the left limb compared to the initial test. Having the threshold of p< 0.001, and the 95% confidence interval for this difference varies on average from 12.5 to 15.48. Since the confidence interval does not pass through the value 0.00, the difference is statistically significant at a two-tailed significance level of 5% (Table 2).

Table 3

T-test for paired comparison of samples for the two control group tests (G2)

	Test	Mean	Std. Deviation	Std. Error Mean	*t* - Test	Mean Diference (cm)	95% Confidence interval of the Difference	
							Lower	Upper
Right-Anterior	T.initial	70.9	0.67	0.213	10.77	2.3	1.81	2.78
	T.final	73.2						
Right Postero-Lateral	T.initial	110.2	0.69	0.221	15.37	3.4	2.9	3.9
	T.final	113.6						
Right Postero-Medial	T.initial	104.2	0.52	0.167	21	3.5	3.12	3.87
	T.final	107.7						
Left -Anterior	T.initial	71.2	0.84	0.153	17.67	2.7	2.35	3.04
	T.final	73.9						
Left Postero-Lateral	T.initial	106	0.69	0.221	15.37	3.4	2.9	3.9
	T.final	109.4						
Left Postero-Medial	T.initial	105.9	0.42	0.133	24	3.2	2.8	3.5
	T.final	110.5						

The t-test applied to assess statistical significance for the control group indicates that the average t-value for the three samples with support on the right leg is 15.71 and for the left leg 19.01. The averages of the two tests differ slightly in the anticipated direction, with the independent variable (variation between the two means) for all samples of 3.08 cm having 9 degrees of unidirectional freedom. Thus, the results Subjects have limited growth on average by about 3.21% for the right limb and 3.92% for the left limb compared to the initial test. Having the materiality threshold p< 0.001, and the 95% confidence interval for this difference ranges on average from 3.43 to 3.49. Since the confidence interval does not pass through the value 0.00, the difference is statistically significant at a two-tailed significance level of 5% (Table3).

- **Comparison of results obtained by the two groups (experiment and control)**

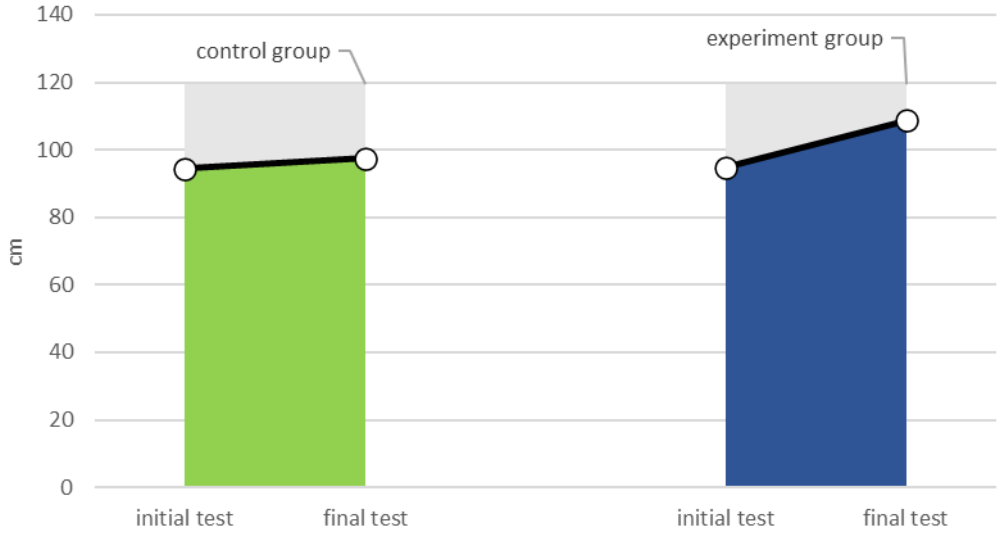

Fig. 2. *Graphical representation of the average values for the two groups in the two tests*

Figure 2 shows that for both the experiment group and the control group the mean values for the initial test are relatively similar. At the end of the preparation period, which corresponds to the final testing, for the experimental group there was a statistically significant increase of 14.77%, while for the control group there was an increase of only 3.56%.

4. Conclusions

The present study explored the hypothesis that *Ashihara* Karate practitioners who participate in a training program containing plyometric exercises can achieve significant changes in balance capacity. Dynamic balance is decisive in contact sports involving different movements, dodges, partakes or direct contact with the opponent. Both in initiation, for learning Technical actions, as well as in performance preparation, the capacity for dynamic equilibrium is decisive. Thus, comparing the descriptive statistics of the initial and final test results, obtained with the help of the Y-Balance platform, there is a significant average difference of about 11 cm in favor of the practitioners in the experimental group compared to those in the control group.

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