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Karate Efficiency and the Development of Some Anthropological Features among 7th and 8th Grade Pupils in Elementary School

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Abstract

The aim of this research is to identify significant anthropological factors important for success in a karate fight by which we may obtain some information on the complexity of karate in the latent structure significant in the application of karate as a sport in education, and as part of curricular and extracurricular activities. For this purpose, we applied a set of 18 anthropometrical measures, a set of 10 basic motor tests, a set of 5 situation-related motor karate tests, a set of 8 performance marks in 6 basic karate techniques and 2 karate kata on the sample of 105 pupils aged 13-15 who, in addition to their physical education classes, have been engaged in karate training for at least 4 years. By factor analyses in the morphological domain, we isolated the ecto-mesomorphy factor and endomorphy factor; in the basic motor domain we isolated the factor of general motor efficiency; in the situation-related motor domain we isolated the factor of specific speed and the factor of specific agility and in the domain of karate techniques performance marks, we isolated the factor of technical efficiency. Further on, by applying canonical discriminant analyses we established differences between quality and less quality pupils - all active karate athletes in the complete domain of isolated factors. The discriminant function showed that karate athletes of higher quality, compared to those of lower quality, mostly differ in greater technical efficiency, followed by greater basic and specific motor efficiency, in addition to having some less adipose tissue.

Key words: *biomotor status; differences; factors; karate; physical education.*

Introduction

In order to carry out the educational process, lessons and the process of physical exercise in a planned, rational and safe way, programming is necessary (Findak, 2003). This is the reason why pupils should be tested at the beginning of every school year regarding their initial condition since it presents a significant set of information which helps create a more global, operational and applicable syllabus and curriculum for physical education lessons for the current school year. General objectives of physical education are also permanently oriented towards the effective use of free time and involving students into sport clubs and developing an interest for personal improvement in different sports activities. Extracurricular activities that are acceptable and available to each student maintain optimum development of all dimensions of kinanthropological characteristics. Quantitative definition of motor abilities and achievements of each student provides a sufficient set of information to be used by a kinesiologist to properly guide students in choosing extracurricular activities which will eventually guide students with outstanding results towards a certain sports activity in school or out-of-school clubs (Katić, Jukić, & Milić, 2012).

Studying anthropomorphic characteristics in karate athletes may create a specific framework of morphological and functional features of a biotype best satisfying the specific demands of this kind of martial art (Chaabène, Hachana, Franchini, Mkaouer, & Chamari, 2012). It is desirable for karate athletes to have a small percentage of body fat (Immamura, Yoshimura, Uchida, Nishimura, & Nakazawa, 1998; Giampierto, Pujia, & Bertini, 2003).

Katić, Blažević, Krstulović and Mulić (2005) reported longitudinal skeletal development to be one of the predictors of karate performance. Moreover, elite karateka athletes have greater developed vertical physical build, highlighted by an average somatotype - mesomorphic-ectomorphic (Giampierto et al., 2003). In this context, in the sport where the body has to be propelled through space as fast as possible, being more endomorphic is suggested to be detrimental to performance (Giampierto et al., 2003; Katić et al., 2005; Sinning, 1985). In general, top-level male karate athletes have high ratings of both mesomorphic-ectormorphic characteristics and low endomorphic characteristics. Concerning female karate athletes, the endomorphic component is very close to the mesomorphic one (Fritzschel & Raschka, 2007; Amusa & Onyewadume, 2001; Pieter & Bercades, 2009).

Furthermore, it has been found that people who practice karate have a greater bone mineral density than people of the same age who were not involved in training (Andreoli, Monteleone, & Van Loan, 2000). Drozdzowska, Munzer, Adamczyk and Pluskiewicz (2011) suggested that karate is a sport with a positive influence on the skeletal status, with the most significant benefits occurring in adults.

Explosive muscle power plays a major role in achieving top results in karate (Blažević, Katić, & Popović, 2006; Katić, Blažević, & Zagorac, 2010; Ravier, Grappe, & Rouillon, 2003). According to the World Karate Federation (WKF, 2012) kumite

performance depends on the speed and the power of karateka actions. The decisive actions during kumite (leg and hand kick) mainly depend on the explosive muscle power, meaning that the karate match performance was exclusively influenced by the higher level of power/speed generation of upper and lower extremities.

Generally, there is not a single characteristic of performance that dominates a fighting sport (Beekley, Abe, & Kondo, 2006). Karate athletes must perform several high intensity actions during a match. A top-level karateka has a high level of body fitness, and, according to Becker and Bell (1990), fight in karate is considered a high intensity competition. Also, karate success depends more on the speed of contractions than on muscle power/strength (Ravier, Grappe, & Rouillon, 2004).

Acquisition of karate techniques is a time-consuming process which depends both on basic motor abilities and specific motor abilities alike. Motor knowledge in karate, as well as general and specific motor abilities, is integrated into a morphological system in time (Mori, Ohtani, & Imanaka, 2002), by optimizing sizes and relations of somatotype components of karateka.

On the sample of 200 pupils in 3rd and 4th grades of secondary school who were subjected to a one-semester karate programme treatment, Babin (1986) analyzed the impact of some motor abilities (6 latent dimensions obtained through factor analyses of 23 composite motor tests) and the efficiency in performing kata (evaluated by six competent experts). The results of the regression analyses showed a strong connection between applied latent motor dimensions and the kata performance marks. The highest connection coefficients were obtained in abilities which are manifested as regulated explosive power and movement frequency, thus these dimensions probably present a motor basis for efficient kata performance.

The research (Katić et al., 2012), established differences in the biomotor status between young male and female karate athletes aged 13-15 years, in relation to those who do not practice karate. The results showed that in female karate athletes success was determined dominantly by integration of power, coordination, muscle tone and speed regulation. Female karate athletes in their motor function use fine muscle tone regulation more often than male karate athletes, who mostly use basic strength.

Jukić, Katić and Blažević (2012) performed the identification of the morphological and motor structures that determine the achievement of elite karate results for the young cadet age. Two motor factors had a significant influence on the determination of the young female kareteka fighting efficiency: the first one integrates speed, power and agility/coordination regulators, followed by muscle tone and synergy regulation regulator, and the second factor was of basic trunk strength, securing the initial energy component in the technique realization, particularly kicks. Of the morphological factors, the transversal dimensionality of the skeleton, particularly fist, significantly determined the fight efficiency of young female karateka.

The following research (Katić, Jukić, Čavala, Vučić, & Blažević, 2013) ascertained the tie-connection of basic and specific motor abilities in determining fighting efficiency

of elite karate athletes of the cadet age. In male athletes, this tie was achieved by the mechanism that was at the same time responsible for the specific speed of kick realization and regulation of basic strength-power, that is, an energetic regulation of movement dominates (Strength regulator). In female karate athletes the tie of basic and specific motor abilities was achieved by the mechanism that is at the same time responsible for speed, power, agility and flexibility regulation, as basic motor abilities, and the specific agility and speed of technique realization, that is, an information movement regulation dominates (Speed regulator).

The research mentioned determined the influence of the morphological characteristics, basic and specific motor abilities on the fighting efficiency of Croatian cadet age karate fighters of both genders, whereas the aim of this research was to establish the complexity of anthropological factors significant for achieving success in karate in the latent structure. Thus, in education, both in curricular and extracurricular activities, we might be able to assess the contents which, through transformation, could be used to influence precisely those abilities and characteristics important for the psychophysical development of 7th and 8th grade pupils in the elementary school. In concordance with that, the factor structure of the applied variables of the morphological, basic-motor and specific motor area will be established, and of specific motor knowledge of students who chose karate as an extracurricular activity (evaluation of basic karate techniques performance), followed by the application of the canonical discriminant analysis that would determine the differences between higher and lower quality male student karate athletes in the overall area of the isolated factors.

Materials and Methods

Study Subjects

The sample of examinees in this research consisted of 105 male pupils in the Republic of Croatia who have systematically been engaged in karate for at least 4 years, competing in fights (kumite), aged 13-15 years, making 80% of the highest quality registered kumite male cadet contestants in the Republic of Croatia. The testing was done in January 2014.

In addition to the competition quality and age, a precondition for the tests was clinical health of all the contestants, no expressed aberrations, and free will to participate in the tests.

Instruments

Predictor Group of Variables

Measures of anthropometric characteristics were represented by 18 variables, these being: Body height (cm), Arm length (cm), Leg length (cm), Hand length (cm), Knee diameter (cm), Elbow diameter (cm), Wrist diameter (cm), Hand diameter (cm), Body mass (kg), Upper arm circumference flexed (cm), Upper arm circumference relaxed (cm), Forearm circumference (cm), Thorax circumference (cm), Calf circumference

(cm), Triceps skinfold (mm), Back skinfold (mm), Abdominal skinfold (mm), and Calf skinfold (mm).

The space of basic motor abilities was defined by a set of 10 variables: Side steps (s), Obstacle course backwards (s), Seated straddle stretch (cm), Arm plate tapping (freq), Foot tapping (freq), Standing long jump (cm), Throwing a 2kg medicine ball (m), 20 meter dash from a standing start (s), 60 seconds sit-ups (freq), and Bent arm hang (s).

The first five variables assess the general factor of movement regulation, and the other five variables assess the general factor of energy regulation. In this way the motor status is defined by two components: information (coordination, speed and flexibility) and the energy component (action strength factors: repetitive, explosive and static).

While selecting the tests for assessing situational motor abilities, it was taken into consideration that the tests selected were the best for assessing the most important factors for being successful in a fight, which are specific agility-mobility and specific speed, i.e., speed of technique performance (Katić et al., 2012):

1. Sidesteps on taking guard with arms up (Sidesteps on taking guard). The test was intended to assess specific speed of movement, and the subjects' task was to cross a four meter path as quickly as possible by sidesteps in both directions six times. The test was repeated three times with an adequate recovery break, and the result was measured in tenths of seconds;
2. Speed of movement in a triangle (Movement in a triangle). The test was intended to assess specific speed of movement, and the subjects' task was to move as quickly as possible in a fighting guard position along a marked triangle on the ground. The dimensions of the equilateral triangle were three meters. A subject moved quickly from one point of the triangle to the second point, around a medicine ball, positioned there, and returned sideways to the third point, where he/she also went around a medicine ball, returning sideways to the starting point. He/she returned sideways, sideways forward and sideways back to the starting position. Speed of movement in a triangle was measured in tenths of seconds, and the task was repeated three times;
3. Speed of gedan barai block technique performance (Gedan barai block). The subjects' task was to perform as many blocks as they can in 30 seconds from an initial fighting position. The task was repeated three times, and the result was recorded as a total number of correctly performed blocks;
4. Speed of mawashi geri leg kick technique performance (Mawashi geri). The subjects' task was to perform as many mawashi geri kicks on the bag in 30 seconds from an initial fighting position. The reach of the kick was determined in relation to the subject's height, and every subject was supposed to reach at least the height of his/her neck. The height a subject was supposed to reach on the bag was, for better control, marked by a belt above which the kick was supposed to be performed. The task was repeated three times and the result was recorded as the total number of correctly performed mawashi geri kicks; and

5. Speed of performing blocks and arm kicks as a combined technique (Block-blow). The subject's task was to perform a combination of gedan barai - gyaku tsuki with maximum speed five times in a row. In order to ensure fair conditions for both tall and short subjects, the distance from the target, which was to be hit by a gyaku tsuki kick, was measured by the distance from the subject to the target. The distance from the target was defined by the length of an arm performing the gyaku tsuki. On the measurer's mark, the subject started performing the combination of gedan barai-gyaku tsuki as quickly as possible from a fighting position. The combination was performed five times, and the final gyaku tsuki kick to the wall makiwara or a vertical mat marked the end of the task. The task was repeated three times, and the result was measured in tenths of seconds.

The jury of three independent experts for the karate sport has been used for the evaluation of technical efficiency, that is, technique quality evaluation, using the evaluation of 6 basic karate techniques and two karate kata. The following techniques were evaluated individually: Gyaku tsuki, *Kizami tsuki* and *Mawashi geri*, and in combinations *Gyaku tsuki – Mawashi geri, Gyaku tsuki – Uraken* and *Kizami tsuki – Gyaku tsuki.* Technical efficiency was determined based on the subjective evaluations of three reviewers as well, for the performance of two karate kata: KATA 1 and KATA 2.

Criterion Variable

Fighting efficiency was determined based on the competition results achieved at cadet regional competitions and state championship. Based on the results achieved the reviewers classified the karate athletes in two categories: high quality and lower quality. The high quality group consisted of the examinees who won 1st place at the regional championship and/or one of the first three places at the state championship. To avoid the classification error, the category of high quality karate athletes, besides the listed rankings at the two competitions, should satisfy the minimum criterion of two wins per individual competition.

Data Analysis

Data analysis methods involved calculating descriptive statistical parameters: arithmetic mean (M), standard deviation (SD). Factor analysis was applied to analyze the structures of: morphological characteristics, basic motor abilities, specific motor abilities and technical efficiency. All factor analyses were performed by factoring correlation matrices of variables. Hotelling's method of principal components and Guttman-Kaiser's criterion were used for determining the number of significant principal components, i.e., factors. The initial solution was transformed into oblique solution, which allows inter-correlations between the factors, using a promax solution.

The canonical discriminant analysis was applied in determining differences between high and lower quality karate athletes in the isolated factors of the morphological area, area of basic and specific motor abilities and area of specific knowledge – technical efficiency.

Results and Discussion

Factor analyses in the morphological domain isolated two factors which explain for the 80% of the total respondents' variability (Table 1).

The first promax factor has been defined equally by high projections of variables for assessing the longitudinal skeleton dimensionality, the transversal skeleton dimensionality as well as variables for assessing body mass and volume. The structure of this factor describes the ecto-mesomorph somatotype and is the main characteristic of younger cadet karate athletes for it explains for 60% of their total variability.

The second promax factor has dominantly been defined by the projections of variables for assessing sub-skin adipose tissue. The structure of this factor describes endomorph somatotype, and explains for 20% of their total variability.

Table 1

Descriptive statistics of variables- anthropometric characteristics (M, SD), principal components (H) and pattern matrices of morphological area (A)

Variable	M	SD	H1	H2	A1	A2
Body height (cm)	166.29	11.37	**0.83**	-0.43	**1.00**	-0.27
Arm length (cm)	72.04	6.42	**0.76**	-0.32	**0.87**	-0.17
Leg length (cm)	98.23	7.21	**0.72**	-0.49	**0.95**	-0.35
Hand length (cm)	17.92	1.97	**0.72**	-0.32	**0.84**	-0.18
Knee diameter (cm)	9.65	0.62	**0.83**	-0.10	**0.80**	0.09
Elbow diameter (cm)	6.55	0.54	**0.87**	-0.21	**0.90**	-0.02
Wrist diameter (cm)	5.41	0.46	**0.76**	-0.30	**0.87**	-0.14
Hand diameter (cm)	7.74	0.71	**0.76**	-0.33	**0.89**	-0.18
Body mass (kg)	55.23	13.48	**0.97**	0.04	**0.83**	0.27
Upper arm circumference flexed (cm)	25.81	3.55	**0.90**	0.16	**0.69**	0.38
Upper arm circumference relaxed (cm)	23.84	3.05	**0.93**	0.20	**0.70**	0.43
Thorax circumference (cm)	80.21	8.34	**0.92**	0.08	**0.77**	0.30
Calf circumference (cm)	33.51	3.53	**0.87**	0.21	**0.64**	0.42
Forearm circumference (cm)	23.32	2.28	**0.95**	-0.05	**0.87**	0.17
Triceps skinfold (mm)	10.23	4.30	0.27	**0.88**	-0.32	**1.00**
Back skinfold (mm)	7.89	2.55	0.56	**0.73**	0.04	**0.90**
Abdominal skinfold (mm)	10.08	4.84	0.48	**0.80**	-0.09	**0.96**
Calf skinfold (mm)	10.25	3.68	0.40	**0.80**	-0.15	**0.95**
Lambda			10.80	3.60		
% variance			60.01	20.01		
Cumulative % variance			60.01	80.02		

Evidently, in young karate athletes, the development processes lead to the integration of longitudinal and transversal skeleton measures as well as muscle tissue into an integral morphological structure which, at the same time, reveals a positive side of the overall development of the organism, while the adipose tissue defined by another isolated factor presents a negative side of the development. Compared to the female

cadet karate athletes (Jukić, Katić, & Bala, 2013), the processes of morphological characteristics integration occurred at an earlier stage and in cadets, the processes of differentiation resulted in forming four morphological dimension-structures. Thus, in addition to the first morphological dimensions responsible for the development of muscle tissue and other responsible for the quantity of adipose tissue, we identified two skeleton factors: the first one being responsible for skeleton growth in length and the second one responsible for skeleton growth in diameter. At the same time, the transversal dimensionality of the arms skeleton enables a greater power manifestation and at the same time, a more efficient realization of blocks and punches.

Table 2 presents factors of the motor domain among karate athlete pupils, the competitors in the Republic of Croatia among the young cadets category. One significant factor has been obtained explaining for the 44% of the total respondents' variability in the motor set of variables.

Table 2

Descriptive statistics of variables- motor abilities (M, SD) and principal component (H)

Variable	M	SD	H1
Standing long jump (cm)	190.69	27.14	0.84
Arm plate tapping (freq.)	35.85	4.40	0.68
20 m sprint (s)#	3.63	.29	-0.73
Side steps (s)#	9.11	.92	-0.77
Bent arm hang (s)	35.37	19.09	0.55
60 seconds sit-ups (freq.)	48.31	9.66	0.52
Obstacle course backwards (s)#	11.70	2.26	-0.57
Seated straddle stretch (cm)	69.56	13.38	0.59
Foot tapping (freq.)	21.04	1.90	0.63
Throwing a 2kg medicine ball (m)	6.58	1.64	0.71
Lambda			4.46
% variance			44.60

#variable with opposite metric orientation

The isolated factor defines general motor efficiency in young quality karate athletes and integrates basic motor abilities: explosive power, agility/coordination, movement frequency speed and flexibility into an integral system (structure). The mentioned motor system is the combination of several regulators, primarily the impetus regulator, movement structures regulators, speed regulator and the muscle tone regulator. The integration of the mentioned motor abilities, i.e. the forming of the mentioned motor system is performed with the involvement of the cognitive information processing (Katić & Bala, 2012; Katić, Bala, & Barović, 2012).

In Table 3, through factor space analyses of variables for assessing specific motor abilities, we isolated two significant factors explaining for the 63% of the total respondents' variability, 40% out of the total variability is explained by the first factor, responsible for the realization speed of the specific karate technique, while the basis

of the second isolated factor is the ability of the specific agility-movability of young karate athletes.

Table 3

Descriptive statistics of variables- specific motor abilities (M, SD), principal component (H) and pattern matrices (A)

VARIABLE	M	SD	H1	H2	A1	A2
Gedan barai	31.80	4.43	**-0.68**	-0.01	**0.51**	-0.33
Block-blow#	3.94	0.64	**0.71**	-0.47	**-0.87**	-0.08
Mawashi geri	33.08	5.81	**-0.70**	0.44	**0.84**	0.06
Side steps on taking guard#	9.34	0.91	0.46	**0.62**	0.09	**0.79**
Movement in a triangle#	9.05	0.84	0.59	**0.58**	-0.03	**0.82**
Lambda			2.01	1.14		
% variance			40.27	22.77		

#variable with opposite metric orientation

In Table 4, through factor space analyses of variables for assessing specific knowledge, we isolated one significant factor explaining for over 88% of the total respondents' variability. All kata techniques and performances have high projections on the isolated factor (from 0.91 to 0.96) and they define the factor of general technical efficiency among younger karate athlete pupils.

Table 4

Descriptive statistics of variables- technical efficiency (M, SD) and principal components (H)

Variable	M	SD	H1
Gyaku ttsuki	3.20	0.67	0.95
Kizami tsuki	2.97	0.75	0.95
Mawashi geri	3.02	0.76	0.91
Gyaku tsuki – Mawashi geri	2.90	0.76	0.94
Gyaku tsuki – Uraken	2.73	0.79	0.94
Kizami tsuki – Gyaku tsuki	3.14	0.74	0.94
Kata 1	3.16	0.70	0.96
Kata 2	2.94	0.77	0.96
Lambda			7.09
% variance			88.64

As can be seen in Table 5, through factor analyses in the total of 6 isolated factors, i.e. primary factors, the morphological, motor and specific motor domain, we obtained 3 secondary factors, i.e. second-rate factors.

The first secondary factor is defined in the motor domain with high projections of the two primary factors: the motor factor responsible for basic motor efficiency (0.91) and the specific factor responsible for specific motor efficiency in the aspect of specific agility-movability. The first secondary factor integrates basic motor abilities and specific agility into an integral motor structure on which the motor functioning of karate athletes is dominantly based.

Table 5

Principal components (H) and pattern matrices (A) in the factor area of morphological, basic and specific motor abilities, and technical efficiency

Factor	H1	H2	H3	A1	A2	A3
Morphological factor 1	0.57	0.56	-0.53	0.59	0.67	-0.23
Morphological factor 2	0.03	0.93	0.14	-0.27	0.93	0.27
General motor factor	0.89	-0.13	-0.22	0.91	-0.01	0.07
Specific factor 1	0.43	0.27	0.72	0.01	0.28	0.86
Specific factor 2#	-0.83	0.26	0.12	-0.85	0.15	-0.13
Motor knowledge	0.65	-0.20	0.45	0.44	-0.15	0.61
Lambda	2.43	1.39	1.08			
% variance	40.42	23.09	17.95			
Cumulative %	40.42	63.504	81.457			

#variable with opposite metric orientation

The second secondary factor is morphological and dominantly defined with primary factors: Morphological factor 2 (sub-skin adipose tissue) and Morphological factor 1 (longitudinal and transversal skeleton dimensionality and body mass and volume). The second secondary factor defines morphological structure dominated by the endomorphy component and, to a smaller degree, ecto-morph component. The third secondary factor is defined by Specific factor 1 and Motor knowledge. Therefore, there is a connection between specific ability in technique realization speed and technical efficiency, i.e. the knowledge of basic elements of the karate technique.

After having defined factors of the morphological, basic and specific motor domain and the techniques performance, we applied canonical discriminant analyses between karate athlete pupils and less quality karate athletes in the domain of these isolated factors (Table 6).

Table 6

Results of canonical discriminant analysis in the factor area of morphology, basic and specific motor abilities, and technical efficiency

Factor	DF
Motor knowledge	0.837
General motor factor	0.561
Specific factor 2#	-0.351
Specific factor 1	0.326
Morphological factor 2	-0.191
Morphological factor 1	-0.041
CanR	0.654*
CENTROID 1	-0.672
CENTROID 2	1.092

#variable with opposite metric orientation, *p<0.001
DF – discriminant function, CanR – coefficient of canonical discrimination

Canonical discriminant coefficient of 0.65 is significant at the $p<0.001$ level meaning that pupils, karate athletes, when compared in quality very much differ in the isolated factors domain. The centroids clearly determine the position of the respondents' groups on the discriminant function: Centroid 1 on the negative pole presents less quality karate athletes and Centroid 2 on the positive pole presents karate athletes of higher quality.

On the discriminant function (DF) all primary factors of the motor ability differentiate karate athlete pupils of higher quality from the karate athletes of lower quality dominantly in Technical efficiency (Technical knowledge) and Motor efficiency (Motor factor), and less in the Specific efficiency factors (Specific factor 2 and Specific factor 1). Discriminant function reveals that karate athletes of higher quality have little less adipose tissue.

The success in a karate fight, i.e. fighting efficiency, is mostly and dominantly influenced by knowledge and/or technique adoption (technical efficiency) which is significantly saturated with basic and specific motor abilities. Therefore, the optimal correlation of karate technique performance quality and the level of basic and specific motor abilities mostly determines fighting efficiency of young pupils karate athletes.

Conclusion

As a result of this research, we were able to establish the factor structure of applied variables in the morphological, basic-motor and specific-motor domains and specific motor knowledge of pupils systematically engaged in karate in sport clubs (the marks of the basic karate techniques performances). Further on, by applying canonical discriminant analyses, we established the difference between quality and less quality karate athlete pupils in the total domain of isolated factors, by which we identified the complexity of the anthropological factors in the latent structure which are significant for success in karate. Pupils actively engaged in karate are more successful if they have a more developed level of adoption of technique elements. However, it is particularly interesting that technical efficiency is significantly saturated with basic and specific motor abilities, primarily defined by explosive power, agility, specific agility, movement frequency speed and reaction speed in performing technical elements and flexibility. We may assume that by introducing karate contents in education, through physical education classes and extracurricular and out-of-school activities, and through transformation, we may significantly influence the previously mentioned abilities and characteristics important for the psychophysical development of pupils in 7th and 8th grade in the elementary school.

General tasks of physical education classes are also permanently directed towards the efficient spending of spare time and on engaging pupils in sport clubs as well as developing an interest for personal progress in different sport activities. Due to its contribution to psychophysical development of children and teenagers, karate should be much more present in lessons and in this way, contribute to a healthier

development. Karate contents offer a possibility to carry out lessons regardless of the material and technical conditions and are easy to perform and adopt. Karate is prevailed by various elements (involving arms and legs) and can be brought closer to children in an interesting way, which maximizes effects and influences on the development of the whole anthropological status and in this way attracts physical exercise with all its positive sides. These are the reasons why karate should be involved in the physical education curriculum, particularly as an optional sport in elementary schools.

This paper is an example of how to direct, select and accustom pupils to karate using the educational process in physical education.

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Efikasnost karatea u funkciji razvoja nekih antropoloških obilježja učenika 7. i 8. razreda osnovne škole

Sažetak

Cilj istraživanja je identificirati značajne antropološke faktore važne za uspjeh u karate borbi, čime se mogu dobiti informacije o kompleksnosti karatea u latentnoj strukturi važnoj za primjenu karate sporta u edukaciji, putem izvanškolskih i školskih aktivnosti. Zato je na uzorku od 105 učenika RH koji se uz nastavu TZK najmanje 4 godine bave karateom, uzrasne dobi od 13 do 15 godina, primijenjen skup od 18 antropometrijskih mjera, skup od 10 temeljnih motoričkih testova, skup od 5 situacijskih motoričkih testova iz karatea, skup od 8 ocjena izvedbe 6 osnovnih karate tehnika i 2 karate kate. Faktorska analiza je izolirala u morfološkom prostoru: faktor ekto-mezomorfije i faktor endomorfije; u temeljnom motoričkom prostoru: faktor generalne motoričke efikasnosti; u situacijskom motoričkom prostoru: faktor specifične brzine i faktor specifične agilnosti; i u prostoru ocjena izvedbe karate tehnika: faktor tehničke efikasnosti. Zatim su primjenom kanoničke diskriminativne analize utvrđene razlike između kvalitetnih i manje kvalitetnih učenika – aktivnih karatista u ukupnom prostoru izoliranih faktora. Diskriminativna je funkcija pokazala kako se karatisti veće kvalitete u odnosu na karatiste manje kvalitetne najviše razlikuju u većoj tehničkoj efikasnosti, zatim u većoj temeljnoj i specifičnoj motoričkoj efikasnosti i koji imaju nešto manje masnog tkiva.

Key words: *biomotorički status; karate; faktori; razlike; tjelesna i zdravstvena kultura.*

Uvod

Da bi se odgojno-obrazovni proces, nastavni proces, proces tjelesnog vježbanja, provodio planski, racionalno, organizirano i sigurno, treba ga programirati (Findak, 2003). To je razlog da se na početku svake školske godine pristupa provjeravanju inicijalnog stanja učenika koje predstavlja značajan skup informacija za što kvalitetniju izradu globalnog, operativnog i izvedbenog plana i programa tjelesne i zdravstvene kulture za tekuću školsku godinu. Opće zadaće tjelesne i zdravstvene kulture ujedno su

trajno usmjerene i na djelotvorno korištenje slobodnog vremena kao i na uključivanje učenika u sportske klubove i razvijanje interesa za osobni napredak u različitim sportskim aktivnostima. Izvannastavne aktivnosti koje su prihvatljive i dostupne svakom učeniku podržavaju optimalni razvoj svih dimenzija antropološkog statusa. Kvantitativno definiranje morfoloških obilježja i motoričkih sposobnosti svakog učenika, predstavlja dovoljan skup informacija koje kineziolog može koristiti za pravilno usmjeravanje pri izboru izvannastavnih sadržaja koje će u konačnici učenike i učenice s iznadprosječnim vrijednostima selektirati i orijentirati prema određenoj sportskoj aktivnosti u okviru školskih i izvanškolskih klubova (Katić, Jukić i Milić, 2012).

Proučavanje antropomorfnih karakteristika sportaša karatista može pružiti specifičan okvir morfoloških i funkcionalnih osobitosti biotipa koji najbolje odgovaraju specifičnim zahtjevima ove vrste borilačkog sporta (Chaabène, Hachana, Franchini, Mkaouer i Chamari, 2012). Za karatiste je poželjno da imaju malen postotak tjelesne masti (Immamura, Yoshimura, Uchida, Nishimura i Nakazawa, 1998; Giampierto, Pujia i Bertini, 2003).

Katić, Blažević, Krstulović i Mulić (2005) navode da je longitudinalni razvoj skeleta jedan od prediktora izvedbe u karateu. Štoviše, vrhunski karatisti imaju bolje razvijenu vertikalnu tjelesnu građu, naglašenu prosječnim mezomorfno-ektomorfnim somatotipom (Giampierto i sur., 2003). U tom kontekstu, u sportu u kojem se tijelo mora kretati što je moguće brže, za pretpostaviti je da je navedena građa tijela odlučujuća za tu izvedbu (Giampierto i sur., 2003; Katić i sur., 2005; Sinning, 1985). Općenito, vrhunski muški karatisti imaju visok stupanj i mezomorfno-ektomorfnih karakteristika i niskih endomorfnih karakteristika. Što se tiče karatistica, endomorfna komponenta ima vrijednosti vrlo bliske mezomorfnoj komponenti (Fritzschel i Raschka, 2007; Amusa i Onyewadume, 2001; Pieter i Bercades, 2009).

Nadalje, otkriveno je da osobe koje se bave karateom imaju veću mineralnu gustoću kostiju nego osobe iste dobi koje ne treniraju karate (Andreoli, Monteleone i Van Loan, 2000). Drozdzowska, Munzer, Adamczyk i Pluskiewicz (2011) tvrde da je karate sport koji ima pozitivan utjecaj na status koštanog sustava s jako značajnim prednostima koje se javljaju kod odraslih.

Eksplozivna snaga mišića igra glavnu ulogu u postizanju vrhunskih rezultata u karateu (Blažević, Katić i Popović, 2006; Katić, Blažević i Zagorac, 2010; Ravier, Grappe i Rouillon, 2003). Prema Svjetskom karate savezu (WKF, 2012) kumite izvedba ovisi o brzini i snazi akcija karatista. Odlučujuće akcije tijekom kumita (udarac nogom ili rukom) ovise uglavnom o eksplozivnoj snazi mišića, što znači da je izvedba karate meča isključivo pod utjecajem više razine proizvodnje snage/brzine gornjih i donjih ekstremiteta.

Općenito, ne postoji ni jedna tehnička izvedba za koju se može reći da dominira borilačkim sportom (Beekley, Abe i Kondo, 2006). Karate sportaši moraju izvesti uzastopce nekoliko elemenata visokog intenziteta aktivnosti tijekom borbe. Vrhunski

karataši imaju visoku razinu tjelesne kondicije, te prema Beckeru i Bellu (1990), borba u karateu smatra se natjecanjem visokog intenziteta. Također, karate uspjeh više ovisi o brzini kontrakcije nego o mišićnoj snazi /jakosti (Ravier, Grappe i Rouillon, 2004).

Stjecanje karate tehnika je dugotrajan proces o kojem ovisi i nivo razvijenosti osnovnih motoričkih i specifičnih motoričkih sposobnosti. Motorička znanja u karateu, kao i temeljne i specifične motoričke sposobnosti, integrirane su u morfološkom sustavu (Mori, Ohtani i Imanaka, 2002), optimizacijom veličine i odnosa konstitucijskih komponenti karataša.

Babin (1986) je na uzorku od 200 učenika 3. i 4. razreda srednje škole, koji su bili podvrgnuti tretmanu polugodišnjeg programa karatea, analizirao utjecaj nekih motoričkih sposobnosti (6 latentnih dimenzija dobivenih faktorskom analizom 23 kompozitna motorička testa) i uspješnosti u izvođenju kate (ocjena šestorice kompetentnih stručnjaka). Rezultati regresijske analize su pokazali da postoji visoka povezanost između primijenjenih latentnih motoričkih dimenzija i ocjene izvođenja kate. Najveće koeficijente povezanosti pokazale su sposobnosti koje se manifestiraju kao regulirana eksplozivna snaga i frekvencija pokreta, tako da te dimenzije vjerojatno predstavljaju motoričku osnovu za uspješno izvođenje kate.

U istraživanju Katića i sur. (2012) utvrđene su razlike u biomotoričkom statusu između mladih karataša i karatašica starosne dobi od 13 do 15 godina u odnosu na one koji se ne bave karateom. Pokazano je kako se kod karataša generalna motorička efikasnost u karateu temelji na eksplozivnoj snazi tipa skoka, repetitivnoj snazi trupa i koordinaciji, što prati fleksibilnost, statička snaga ruku i ramenog pojasa te brzina frekvencije pokreta, a kod karatašica za postizanje uspjeha u karateu dominantna je integracija sile, koordinacije, regulacije mišićnog tonusa i brzine. Karatašice u motoričkom funkcioniranju više se koriste brzinom i finom regulacijom mišićnog tonusa u odnosu na karataše koji se više koriste temeljnom snagom.

Jukić, Katić i Blažević (2012) su izvršili identifikaciju morfoloških i motoričkih struktura koje determiniraju postizanje vrhunskih rezultata u karateu kod mlađeg kadetskog uzrasta. U determinaciji borbene efikasnosti mladih karatašica značajan doprinos imala su dva motorička faktora i to: prvi faktor koji integrira regulatore brzine, sile i agilnosti/koordinacije, što prati regulator mišićnog tonusa i sinergijske regulacije, a drugi je faktor temeljne snage trupa koji osigurava početnu energetsku komponentu u realizaciji tehnika, a posebno udaraca. Od morfoloških faktora transverzalna dimenzionalnost skeleta, posebno šake, značajno je determinirala borbenu efikasnost kod mladih karatašica.

U narednom istraživanju Katić, Jukić, Čavala, Vučić i Blažević (2013) su utvrdili spregu-spoj temeljnih i specifičnih motoričkih sposobnosti u determinaciji borbene efikasnosti vrhunskih karatista kadetskog uzrasta. Kod muških karatista ta sprega ostvaruje se mehanizmom koji je istodobno odgovoran za specifičnu brzinu realizacije udaraca i regulaciju temeljne snage-sile, dakle dominira energetska regulacija gibanja (regulator snage). Kod ženskih karatista sprega temeljnih i specifičnih motoričkih

sposobnosti se ostvaruje mehanizmom koji je istodobno odgovoran kako za regulaciju brzine, sile, agilnosti i fleksibilnosti tako i za temeljne motoričke sposobnosti, specifičnu agilnost i brzinu realizacije tehnika. Dakle, dominira informacijska regulacija gibanja (regulator brzine).

Nakon što je u navedenim istraživanjima utvrđen utjecaj morfoloških karakteristika i temeljnih i specifičnih motoričkih sposobnosti na borbenu efikasnost hrvatskih karatista kadetskog uzrasta oba spola, cilj je istraživanja bio ustanoviti kompleksitet antropoloških faktora važnih za uspjeh u karateu u latentnoj strukturi. Time bi se u edukaciji, putem izvanškolskih i školskih aktivnosti, mogli procijeniti oni sadržaji kojima bi se transformacijskim procesom utjecalo na upravo one sposobnosti i karakteristike bitne za psihofizički razvoj učenika 7. i 8. razreda osnovne škole. U skladu s tim utvrdit će se faktorska struktura primijenjenih varijabli morfološkog, temeljno-motoričkog i specifično-motoričkog prostora, zatim specifičnih motoričkih znanja učenika koji se sustavno u sportskim klubovima bave karateom (ocjene izvedbe temeljnih karate tehnika), a zatim će se primjenom kanoničke diskriminativne analize utvrditi razlike između kvalitetnih i manje kvalitetnih učenika-karatista u ukupnom prostoru izoliranih faktora.

Materijal i metode

Uzorak ispitanika

Uzorak ispitanika za ovo istraživanje predstavljalo je 105 učenika muškog spola starosne dobi 13-15 godina, državljana Republike Hrvatske koji se sustavno najmanje 4 godine bave karateom, natječući se u borbama (kumite), a što čini oko 80% najkvalitetnijih registriranih natjecatelja kadetskog uzrasta. Testiranje je obavljeno u siječnju 2014. godine.

Osim natjecateljske kvalitete i uzrasta, uvjet za testiranje bio je da su svi ispitanici klinički zdravi i bez izraženih aberacija, i da dragovoljno pristupaju testiranju.

Uzorak varijabli

Prediktorski skup varijabli

Mjere antropometrijskih karakteristika predstavljalo je 18 varijabli i to: tjelesna visina (cm), dužina ruke (cm), dužina noge (cm), dužina šake (cm), dijametar koljena (cm), dijametar lakta (cm), dijametar ručnog zgloba (cm), dijametar šake (cm), tjelesna masa (kg), opseg nadlaktice u fleksiji (cm), opseg nadlaktice u relaksaciji (cm), opseg podlaktice (cm), opseg grudnog koša (cm), opseg potkoljenice (cm), kožni nabor nadlaktice (mm), kožni nabor leđa (mm), kožni nabor trbuha (mm) i kožni nabor potkoljenice (mm).

Prostor osnovnih motoričkih sposobnosti definiran je skupom od 10 temeljnih testova motoričkih sposobnosti koji sačinjavaju varijable: koraci u stranu (s), poligon natraške (s), pretklon u sjedu raznožno (cm), taping rukom (frek), taping nogom (frek), skok u dalj iz mjesta (cm), bacanje medicinke od 2 kg (m), ubrzanje sprint na

20 m iz visokog starta (s), podizanje trupa iz ležanja u 60 sek (frek), izdržaj u visu zgibom (s).

Prvih pet testova procjenjuje generalni faktor regulacije kretanja, a drugih pet testova generalni faktor energetske regulacije. Na ovaj način motorički status se definira dvjema komponentama i to: informacijskom (koordinacija, brzina i fleksibilnost) i energetskom (akcioni faktori snage: repetitivna, eksplozivna i statička).

Kod odabira testova za procjenu situacijsko motoričkih sposobnosti vodilo se računa o topme da se uzmu oni koji najbolje procjenjuju najvažnije faktore za postizanje uspjeha u borbi, a to su specifična agilnost-pokretljivost i specifična brzina, tj. brzina izvođenja tehnika (Katić i sur., 2012):

Koraci u stranu u gardu s podignutim rukama. Test je namijenjen procjeni specifične brzine kretanja, a zadatak je ispitanika u ovom testu bio da što brže prijeđe stazu od četiri metra bočnim koracima u oba smjera šest puta. Test se ponavljao tri puta s dovoljnom pauzom za oporavak, a rezultat se mjerio u desetinkama sekunde;

Brzina kretanja u trokutu. Test je namijenjen procjeni specifične brzine kretanja, a zadatak ispitanika bio je da se što brže kreće u borbenom gardu po stranicama trokuta obilježenog na tlu. Dimenzije istostraničnog trokuta iznosile su tri metra. Od jednog vrha trokuta ispitanik je brzim kretanjem išao po stranici do vrha trokuta, zaobišao medicinku koja je tamo stajala i vraćao se bočno natrag prema trećem vrhu trokuta, gdje također zaobilazi medicinku i dolazi bočnim kretanjem na mjesto s kojeg je započeo test. Istim putem vraća se bočno, bočno naprijed i bočno natrag do startne pozicije. Brzina kretanja po stranicama trokuta mjerila se u desetinkama sekunde, a zadatak se ponavljao tri puta;

Brzina izvođenja tehnike blokade gedan barai. Zadatak ispitanika u ovom testu bio je da iz početnog borbenog stava u vremenu od 30 sekundi izvede što više blokada. Zadatak se ponavljao tri puta, a rezultat u testu je bio evidentiran kao broj ukupno ispravno izvedenih blokada;

Brzina izvođenja tehnike udarca nogom mawashi geri. Zadatak ispitanika u ovom testu bio je da iz početnog borbenog stava u vremenu od 30 sekundi izvede što više udaraca mawashi geri na vreći. Visina udarca je bila određena prema visini ispitanika, a svaki je ispitanik trebao doseći barem visinu svoga vrata. Visina koju je ispitanik trebao doseći na vreći radi bolje kontrole bila je obilježena pojasom iznad kojeg je morao biti izveden udarac. Zadatak se ponavljao tri puta, a rezultat u testu je bio evidentiran kao broj ukupno ispravno izvedenih udaraca mawashi geri u vreću i

Brzina izvođenja blokade i udarca rukom i to kao kombinirane tehnike. Zadatak ispitanika u ovome testu bio je da pet puta zaredom izvede maksimalnom brzinom kombinaciju gedan barai - gyaku tsuki. Da bi svi ispitanici i visoki i niski bili u jednakim uvjetima kod izvođenja ovog testa, udaljenost od cilja u koji je trebalo udariti udarcem gyaku tsuki mjerena je udaljenošću ispitanika od cilja. Udaljenost od cilja definirana je pruženom rukom koja je izvodila gyaku tsuki. Na znak mjerioca vremena ispitanik je iz borbenog stava započeo izvoditi kombinaciju gedan barai -

gyaku tsuki što je brže mogao. Kombinaciju je trebalo izvesti pet puta, a kao kraj zadatka računao se posljednji udarac gyaku tsuki u zidnu makiwaru ili okomito postavljenu gimnastičku strunjaču. Zadatak se ponavljao tri puta, a rezultat u testu se mjerio desetinkama sekunde.

Za procjenu tehničke efikasnosti, to jest procjenu kvalitete tehnike, uzet je sud 3 neovisna eksperta za karate sport kroz ocjene izvedbe 6 osnovnih karate tehnika i 2 karate kate. Navedene tehnike su ocijenjene pojedinačno: gyaku tsuki, kizami tsuki i mawashi geri, te u kombinacijama gyaku tsuki-mawashi geri, gyaku tsuki-uraken i kizami tsuki-gyaku tsuki. Tehnička učinkovitost odredila se i na osnovu subjektivnih procjena tri ocjenjivača za izvedbu dviju karate kata: KATA 1 i KATA 2.

Kriterijska varijabla

Borbena efikasnost, odredila se na temelju natjecateljskih rezultata postignutih na kadetskim regionalnim natjecanjima i Državnom natjecanju. Na temelju postignutih rezultata ocjenjivači su karatiste svrstali u dvije kategorije i to na: kvalitetne i manje kvalitetne. U kvalitetniju skupinu svrstani su oni ispitanici koji su osvojili 1. mjesto na regionalnom natjecanju i/ili jedno od prva tri mjesta na Državnom prvenstvu. Da bi se izbjegla greška klasifikacije kategorija kvalitetnih karatista, osim navedenih plasmana na dvama natjecanjima, trebali su zadovoljiti i minimalni kriterij od dvije pobjede po pojedinom natjecanju.

Metode obrade podataka

Metode obrade podataka uključile su izračunavanje deskriptivnih statističkih parametara: aritmetičke sredine (M) i standardne devijacije (SD). Za analizu strukture morfoloških karakteristika, temeljnih motoričkih sposobnosti, specifičnih motoričkih sposobnosti i tehničke efikasnosti primijenjena je faktorska analiza, a upotrijebljena je Hotelling metoda glavnih komponenata i Guttman-Kaiser kriterij za određivanje broja značajnih glavnih komponenata, odnosno faktora. Početna solucija transformirana je u kosu-oblique projekciju, što omogućuje inter-korelacije između faktora, koristeći promax rješenje.

Kanonička diskriminativna analiza je primijenjena za utvrđivanje razlika između kvalitetnih i manje kvalitetnih učenika koji se bave karateom u izoliranim dimenzijama morfološkog prostora, prostora temeljnih i specifičnih motoričkih sposobnosti i prostora specifičnih znanja – tehničke efikasnosti.

Rezultati i rasprava

Faktorska analiza u morfološkom prostoru izolirala je dva faktora koja objašnjavaju 80% ukupnog varijabiliteta ispitanika (Tablica 1).

Prvi promaks faktor definiraju podjednako visoke projekcije varijabli za procjenu longitudinalne dimenzionalnosti skeleta, transverzalne dimenzionalnosti skeleta, kao i varijable za procjenu volumena i mase tijela. Struktura ovog faktora opisuje ekto-mezomorfni somatotip te je glavno obilježje karatista mlađe kadetskog uzrasta budući da objašnjava čak 60% njihova ukupnog varijabiliteta.

Drugi promaks faktor dominantno definiraju projekcije varijabli za procjenu potkožnog masnog tkiva. Struktura tog faktora opisuje endomorfni somatotip, a objašnjava 20% njihova ukupnog varijabiliteta.

Tablica 1.

Očigledno kod mladih karatista razvojni procesi dovode do integracije longitudinalnih i transverzalnih mjera skeleta kao i mišićnog tkiva u jedinstvenu morfološku strukturu, što ujedno predstavlja pozitivnu stranu razvoja organizma kao cjeline, dok masno tkivo kojeg definira drugi izolirani faktor predstavlja negativnu stranu tog razvoja. U odnosu na karatiste kadetskog uzrasta kod karatistica (Jukić, Katić i Bala, 2013) procesi integracije morfoloških obilježja su se odvijali u ranijoj fazi da bi u kadetskom uzrastu procesi diferencijacije doveli do formiranja četiri morfološke dimenzije-strukture. Tako su uz prvu morfološku dimenziju za razvoj mišićnog tkiva i druge dimenzije odgovorne za količinu masnog tkiva identificirana dva faktora skeleta i to: jedan odgovoran za rast skeleta u dužinu i drugi odgovoran za razvoj skeleta u širinu. Pritom transverzalna dimenzionalnost skeleta ruku osigurava veću manifestaciju snage i time efikasniju realizaciju blokada i udaraca.

U Tablici 2 prezentirani su faktori motoričkog prostora kod učenika karatista natjecatelja Republike Hrvatske mlađeg kadetskog uzrasta. Dobiven je jedan značajni faktor koji objašnjava 44% ukupnog varijabiliteta ispitanika u motoričkom skupu varijabli.

Tablica 2.

Izolirani faktor definira generalnu motoričku efikasnost mladih kvalitetnih karatista i integrira temeljne motoričke sposobnosti: eksplozivnu snagu, agilnost/koordinacija, brzinu frekvencije pokreta i fleksibilnost u jedinstveni sklop (strukturu). Navedeni motorički sklop sprega je više regulatora i to posebno regulatora sile, regulatora kretnih struktura, regulatora brzine i regulatora mišićnog tonusa. Integracija navedenih motoričkih sposobnosti, to jest formiranje navedenog motoričkog sklopa, odvija se uz sudjelovanje kognitivnog procesuiranja informacija (Katić i Bala, 2012; Katić, Bala i Barović, 2012).

U Tablici 3 faktorskom analizom prostora varijabli za procjenu specifičnih motoričkih sposobnosti izolirana su dva značajna faktora koji su objasnili 63% ukupnog varijabiliteta ispitanika. Od toga prvi faktor objašnjava 40% ukupnog varijabiliteta i odgovoran je za brzinu realizacije specifične karate tehnike, a u osnovi drugog izoliranog faktora jest sposobnost specifične agilnosti-pokretljivosti mladih karatista.

Tablica 3.

U Tablici 4 faktorskom analizom prostora varijabli za procjenu specifičnih znanja izoliran je jedan značajni faktor koji je objasnio preko 88% ukupnog varijabiliteta ispitanika. Sve tehnike kao i izvedbe kata imaju visoke projekcije na izolirani faktor (od 0.91 do 0.96) pa definiraju faktor generalne tehničke efikasnosti mladih učenika karatista.

Tablica 4.

U Tablici 5 faktorskom analizom nad 6 ukupno izoliranih faktora dakle primarnih faktora morfološkog, motoričkog i specifično-motoričkog prostora dobivena su 3 sekundarna faktora, dakle faktora drugog reda.

Tablica 5.

Prvi sekundarni faktor je motorički definiran sa visokim projekcijama dva primarna faktora i to: motoričkim faktorom odgovornim za temeljnu motoričku efikasnost (0.91) i specifičnim faktorom odgovornim za specifičnu motoričku efikasnost u vidu specifične agilnosti-pokretljivosti. Prvi sekundarni faktor integrira temeljne motoričke sposobnosti i specifičnu agilnost u jedinstvenu motoričku strukturu na kojoj se dominantno temelji motoričko funkcioniranje karatista.

Drugi sekundarni faktor je morfološki i definiran dominantno s primarnim faktorima: Morfološki faktor 2 (potkožno masno tkivo) i Morfološki faktor 1 (longitudinalna i transverzalna dimenzionalnost skeleta te volumen i masa tijela). Drugi sekundarni faktor opisuje morfološku strukturu u kojoj dominira komponenta endomorfije i manje komponenta ekto-mezomorfije.

Treći sekundarni faktor definira Specifični faktor 1 i Motoričko znanje. Dakle dolazi do sprege specifične sposobnosti u brzini realizacije tehnike i tehničke efikasnosti, to jest znanja temeljnih elemenata karate tehnike.

Nakon što su definirani faktori morfološkog, temeljnog i specifičnog motoričkog prostora, kao i izvedbe tehnika, primijenjena je kanonička diskriminativna analiza između učenika karatista više i karatista manje kvalitete u prostoru tih izoliranih faktora (Tablica 6).

Koeficijent kanoničke diskriminacije od 0.65 je značajan na nivou $p<0.001$, što znači da se učenici karatisti u odnosu na kvalitetu znatno razlikuju u prostoru izoliranih faktora. Centroidi jasno određuju poziciju skupina ispitanika na diskriminativnoj funkciji: Centroid 1 na negativnom polu predstavlja karatiste manje kvalitete i Centroid 2 na pozitivnom polu predstavlja karatiste veće kvalitete.

Na diskriminativnoj funkciji (DF) svi primarni faktori motorike diferenciraju učenike karatiste veće kvalitete od karatista manje kvalitete i to dominantno Tehnička efikasnost (Tehničko znanje) i Motorička efikasnost (Motorički faktor), a manje faktori Specifične efikasnosti (Specifični faktor 2 i Specifični faktor 1). Diskriminativna funkcija pokazuje kako su karatisti veće kvalitete s nešto manje masnog tkiva.

Tablica 6.

Na uspjeh u borbi karatista, to jest na njihovu borbenu efikasnost, najviše i dominantno utječe znanje i/ili usvojenost tehnike (tehnička efikasnost), koje je znatno saturirano s temeljnim i specifičnim motoričkim sposobnostima. Dakle, optimalni suodnos kvalitete izvedbe karate tehnika, te razine temeljnih i specifičnih motoričkih sposobnosti u najvećoj mjeri determinira borbenu efikasnost mladih učenika karatista.

Zaključak

Ovim istraživanjem utvrđena je faktorska struktura primijenjenih varijabli morfološkog, temeljno-motoričkog i specifično-motoričkog prostora i specifičnih motoričkih znanja učenika koji se sustavno u sportskim klubovima bave karateom (ocjene izvedbe temeljnih karate tehnika). Potom se primjenom kanoničke diskriminativne analize utvrdila razlika između kvalitetnih i manje kvalitetnih učenika-karatista u ukupnom prostoru izoliranih faktora, čime se identificirao kompleksitet antropoloških faktora u latentnoj strukturi važnih za uspjeh u karateu. Učenici koji se aktivno bave karateom uspješniji su ako imaju više razvijen nivo usvojenosti tehničkih elemenata. Međutim, posebno je zanimljivo što je tehnička efikasnost znatno saturirana s temeljnim i specifičnim motoričkim sposobnostima, a koju u prvom redu definiraju eksplozivna snaga, agilnost, specifična agilnost, brzina frekvencije pokreta i brzina reakcije kod izvedbe tehničkih elemenata te fleksibilnost. Pretpostavka je da bi se uvođenjem sadržaja karatea u edukaciju, putem nastave tjelesne i zdravstvene kulture i izvannastavnih i izvanškolskih aktivnosti, moglo znatno utjecati transformacijskim procesom na prethodno navedene sposobnosti i karakteristike, a koje su bitne za psihofizički razvoj učenika 7. i 8. razreda osnovne škole.

Opće zadaće tjelesne i zdravstvene kulture ujedno su trajno usmjerene i na djelotvorno korištenje slobodnog vremena te na uključivanje učenika u sportske klubove i razvijanje interesa za osobni napredak u različitim sportskim aktivnostima. Karate sport zbog svoga doprinosa u psihofizičkom razvoju djece i mladih trebao bi u većoj mjeri biti zastupljen u nastavi te na taj način pridonijeti zdravijem razvoju. Sadržaji karatea pružaju mogućnost realizacije nastave neovisno o materijalnim i tehničkim uvjetima te se lagano provode i usvajaju. Karate je prepun raznih elemenata (ručnih i nožnih) te se mogu približiti djeci na zanimljiv način, a time se postižu i veći efekti i učinci na razvoj cjelokupnog antropološkog statusa pa im se na taj način približava tjelesno vježbanje i sve ono pozitivno što nosi sa sobom. Iz tih razloga karate bi trebao biti zastupljen u kurikulumu tjelesne i zdravstvene kulture, a posebno kao fakultativni sport u osnovnim školama.

Ovaj rad primjer je usmjeravanja, selekcije i orijentacije učenika prema karateu u odgojno obrazovnom raduu tjelesnom i zdravstvenom području.

Napomena

Istraživanje je provedeno u sklopu znanstvenih projekata "Kineziološka edukacija u predškolskom odgoju i primarnom obrazovanju" (šifra projekta: 227-2271694-1696) i "Antropološka istraživanja biomotoričkog razvoja i kineziološkim aktivnosti" (šifra projekta: 177-0000000-3410) odobrenih od Ministarstva znanosti, obrazovanja i sporta Republike Hrvatske.