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Gender Differentiations of Some Anthropological Characteristics of Karate Players – Cadets

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ABSTRACT

The research was conducted with the aim of determining gender differentiations of some anthropological characteristics of male and female cadet karate players. To achieve this aim, a group of 10 morphological variables, ten motor tests, five situation motor test and six technical performance evaluation tests was applied. Two hundred and six competing players were measured, of which 105 male and 101 female. The examinees were divided according to weight categories (lower and higher weight categories). Based on the variance analysis and canon discrimination analysis a conclusion can be made: gender differentiations are most strongly expressed in morphological and basic motor area, and significantly less in the area of specific motor abilities and motor knowledge (technical efficiency).

Key words: *kinesiology, anthropology, karate*

Introduction

From the viewpoint of sport branches classification according to structural complexity (movement structure and situation structure complexity), karate is a poly-structural sport activity dominated by complex movement structures of acyclic character in which the defeat of the opponent by striking or opposition to the opponent`s action occurs.

The opponents try to strike one another with precise and timely strikes, using arms and legs – fist, elbow, foot and knee – aiming at the certain body regions, at the same time blocking or avoiding the opponent´s attacks. According to this, the karate fight can be interpreted as a process of dynamic interaction between two opponents.

There are different methods of interfering with the opponent`s balance, with the intention of performing a strike at an unprotected vital point at the appropriate moment. The specific stances, special movement patterns and precise timing contribute to the efficiency of attack and defense.

The techniques, besides the falls, can rarely be performed in fight as individual techniques. Because of this, there is a series of technique combinations: movement, strike, block; movement, block, strike; movement, block, throw, strike; movement, throw, strike etc. The mentioned movement structures are specified in concordance with the level of anthropological characteristics, motor knowledge and skills development.

Fight dynamics and movement frequency are especially emphasized, demanding a high level of players` motor-functional abilities, especially speed and strength[1], as well as coordination[2].

Specific agility, that is, the mobility of player in relation to the opponent in all eight directions, is especially important for success in competition. The dynamic mobility enables the efficient avoidance of the opponent`s attack, as well as striking an optimum stance for the efficient realization of one`s own techniques[3,4].

The application of adequate measuring procedures can indicate what the characteristics of elite players of different age groups are. Further on, the model of elite player is characterized by the level of development of his abilities, characteristics, motor knowledge and skills.

Certainly for achieving top quality in the performance of karate techniques, reaction speed and the skill of anticipating the opponents next move is critical to achieving success in karate[5].

Girls who mature faster have better results in motor performance than those who enter the maturation phase later (11–13 years), and the differences between the individuals in the population, when it comes to motor performance, depend on growth and development, especially in boys[6].

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Since puberty individually significantly varies in its beginning and duration[7], sometimes there are bigger differences between the girls, than in gender separation of anthropometric characteristics, functional-motor abilities, as well as psychological and social view.

Aim of the research was to determine gender differentiations of some anthropological characteristics in young female and male players (cadets).

Methods

Sample of entities

Sample of entities in this research was defined as a group of best female cadet karate players in the Republic of Croatia, aged 14–16 years. The research was conducted in the year 2013 with the sample of 206 players, competing in fights (kumite), comprising about 90% of the highest quality registered competitors in kumite of cadet age in Croatia. The sample was divided in two subsamples of 105 male and 101 female players. Each subsample was divided into higher and lower weight categories.

The first subsample of examinees consisted of two groups:

1. Male players – cadets of lower weight classes (N=57) and
2. Male players – cadets of higher weight classes (N=48).

The second subsample of examinees consisted of two groups:

1. Female players – cadets of lower weight classes (N=55) and
2. Female players – cadets of higher weight classes (N=46).

Sample of variables

Morphological group of variables

Ten morphological measures necessary for the calculation of the constitution types according to Heath and Carter method[8] (1967) were used, and the measuring was conducted according to the procedures suggested by Mišigoj – Duraković, 1995[9].

The necessary morphological variables for calculation of constitution types according to abovementioned authors are: body height, body weight, upper arm skin fold, back skin fold, abdominal skin fold, lower leg skin fold, upper arm flexion circumference, lower leg circumference, elbow diameter and knee diameter.

Although the International biological program (IBP) considers that the measuring on the symmetric body parts should be conducted on the left side of the body[9], since this is a selected sample of examinees, the measuring was conducted on the »dominant« side.

Motor group of variables

Variable for the evaluation of basic motor abilities of examinees

Ten motor tests with the best karate success evaluation rate[10–13] were chosen for this research. It was taken into account that the chosen variables should cover the area of information (coordination, speed and flexibility) and energetic (action factors of strength and endurance) speed regulation component[14]. Also, at least one variable should have described the area of explosive power, such as jump, throw and sprint, agility coordination, movement frequency speed, repetitive and static strength and flexibility.

The standing long jump, standing start 20 m sprint and throwing 20 kg medicine ball from lying position tests were chosen in evaluation of explosive strength. The side steps and backwards obstacle tests were chosen for evaluation of coordination. The speed of movement frequency was evaluated by the hand tapping and foot tapping variable. The v-sit reach test was used for flexibility evaluation. The repetitive strength was evaluated by the trunk lift test. The pull up test was used in evaluation of static strength. The specific motor abilities that are developed primarily by the special bodily preparation and situational, that is, competitive conditions, during the training process, are considered to be dominant in achieving high sport results.

Although the level of these abilities` development largely depends on the level of basic motor abilities, they should be observed separately because of the specificity of the informational, energetic, motivational and other processes that occur during the performance of specific karate movements.

Due to the same physiological basis of the specific and basic motor abilities a high correlation of the variables that connect these two areas is expected.

In choosing the specific motor abilities evaluation tests it was important to choose those which are most successful in evaluating the most important dimensions of achieving fight success, such as hand movement speed, hand and leg techniques performance speed and specific movements speed.

Area of specific motor abilities was defined by a group of five tests

Gedan barai performance frequency – GEBAPF

Speed of gedan barai block performance (low block with the lower part of forearm) was evaluated by the diagonal hand abduction. The task of the examinee in this test was to perform as many blocks (gedan barai) from the preparation stance (heiko dachi) in the time period of 30 seconds, in the way that the upper arm starts the movement behind the ear (no leaning) with the fist turned upwards, then the fist is moved downwards with a slow rotation, while the other hand is on the hip. The task was

repeated three times and the test result was recorded as a number of correct gedan barai blocks.

Gedan barai – gyako zuki performance speed – SBLOCST

The test is aimed at the evaluation of block technique and hand strike speed performance, as a combined technique. The combination of gedan barai block technique and gyaku zuki hand strike technique is considered to be elementary in karate and is performed often. The task of the examinee in this test was to start from the heiko dachi stance and perform the gedan barai-gyaku zuki combination in maximum speed, five times in the row (alternately). In order to secure the equal conditions for performing this test (regarding the examinees` body height), the distance from the aim towards which the examinee should strike with the gyaku zuki strike was measured by the distance of the examinee from the aim. The distance from the aim was defined by stretching the arm that performed gyaku zuki. At the sign from the measurer the examinee, starting from the heiko dachi stance, began performing the gedan barai-gyaku zuki combination as fast as possible. The examinees performed the combination five times, and the last gyaku zuki strike against the wall makiwara or perpendicularly set gymnastic mat was marked as the end of the task. The task was repeated three times, and the test result was measured in tenths of a second.

Mawashi geri perfromance speed – FMG

The test was intended for the evaluation of mawashi geri leg strike (circular leg strike) technique performance speed. This karate technique is most often used in fight and is the most efficient leg technique. The task of the examinee was to start from the front stance (fudo dachi) and perform as many front mawashi geri strikes on the bag in the time period of 30 seconds. The height of the strike was determined according to the body height of the examinee, and each examinee was supposed to reach at least his neck level. The height that the examinee was supposed to reach was marked by the zone above which the strike should have been aimed. The task was repeated three times and the result was noted as a number of correct mawashi geri strikes onto the bag.

Specific side steps – SSST

The test is very similar to the »side steps« test, with the difference that the side movement is performed in guard with lifted arms (kiba dachi). The test is aimed at the evaluation of specific movement speed, and since the movement direction has to be quickly altered a few times, it is obvious that this test evaluates specific coordination – agility. The task of the examinee in this test was to start from the parallel feet stance (kiba dachi) and cross the marked area of four meters length as fast as possible, with side steps in both directions six times. The test was repeated three times with an adequate recovery pause, and the task was measured in tenths of a second.

Triangle movement – STRIANG

The test is aimed at the evaluation of specific movement speed, but the movement is not only sideways, but also in other directions – those which are often used in fight by competitors (front movement at 45 degrees and backwards under the same degree). The direction alterations in this test are more common and versatile, and it is assumed that this test also measures the agility of the player. The task of the examinee was to start from the fudo dachi stance and move in an offensive way as fast as possible straight forward with a step technique, and then back and sideways on the sides of the triangle marked on the floor. The dimension of the equilateral triangle sides was 3 meters. Starting from the one point of the triangle the examinee moved in an attack mode straight forward with the step technique all the way to the top of the triangle, moved around the skittle and went back moving in an attack mode with the step technique towards the third point of the triangle, where he moved around the skittle again and came moving sideways to the point where he started from. The examinee moved sideways, straight forward and back to the starting position. The speed of movement was measured in the tenths of a second, and the task was performed three times (Figure 7).

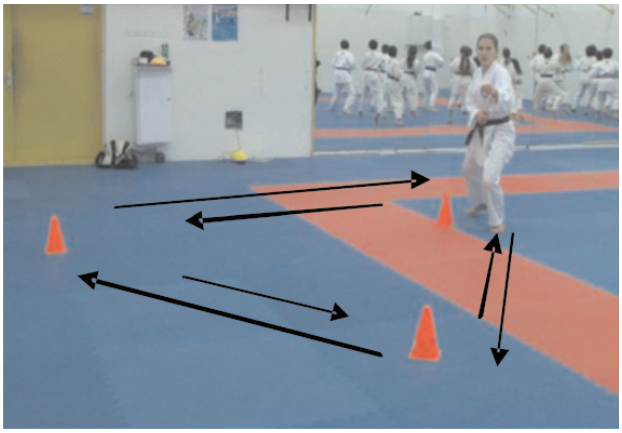

Fig 1. Triangle movement – STRIANG

The procedures of karate technique performance quality evaluation

The quality of individual and combined karate techniques was evaluated, consisting of demonstration of techniques that are used most often in fight and which are representatives of a certain technique group.

In total, the players were evaluated in 3 individual and 3 combined techniques.

The following techniques were evaluated individually:

– gyaku zuki,
– kizame zuki
– mawashi geri,

And combination techniques:

– gyaku zuki – mawashi geri,
– gyaku zuki – uraken,
– kizame zuki – gyaku zuki;

The evaluation of performance quality of individual and combined karate techniques without the presence of the opponent was conducted after three consecutive repeats filmed with a high quality cameras (over 50 f/s). The first camera was set frontally, while the other one was set on the side and was filming the same technique performance.

The technique performance was determined based on the subjective evaluation of five reviewers from six karate techniques, by the subjective grades on the 0–5 scale.

Result processing methods

Common descriptive procedures were used to determine the characteristics of the used variables.

The multivariate (MANOVA) and univariate (ANOVA) variance analysis, as well as discriminative analysis, were used for determining the differences of anthropological characteristics and specific motor abilities and knowledge (techniques), regarding the gender.

All the analyses in this research were processed using the Statistica software package (version 7.1).

Results and Discussion

Gender differentiations of morphological characteristics in total sample and according to weight categories

Quantitative gender differences of morphological measures in total sample of examinees are shown in Table 1. The multivariate variance analysis showed that the players significantly differed, regarding the gender, in the variables of morphological area. The univariate analysis of variance showed that the male players had significantly larger transversal skeleton dimensionality than the female players, especially in knee and elbow diameter, higher body height and significantly less body fat, especially at the upper arm area.

The high canon discrimination coefficient of 0.80 was significant on the $p<0.001$, meaning that the players significantly differed in the area of morphological measures, regarding the gender. The centroids clearly determined the position of groups of examinees on the discriminative function: female gender centroid on the negative pole and male gender centroid on the positive pole.

Regarding the discriminative function (DF) on the positive pole, male players had more expressed ectomorphy, especially in the sense of transversal bone dimensionality, while female players were on the negative pole, and were significantly more endomorph.

TABLE 1
MULTIVARIATE AND UNIVARIATE ANALYSIS OF VARIANCE (MANOVA/ANOVA) AND CANON DISCRIMINATIVE ANALYSIS (DF) OF MORPHOLOGICAL VARIABLES IN TOTAL PLAYERS SAMPLE IN RELATION TO GENDER (N=206)

Wilk's λ	df1	df2	F	p
0.37	10	195	33.91	0.000

Variables	Female (N=101) $\overline{X}$±SD	Male (N=105) $\overline{X}$±SD	F	p	DF
Body height (cm)	162.43±6.89	166.43±11.19	9.46	0.002	0.16
Knee diameter (cm)	8.91±0.37	9.65±0.62	108.10	0.000	0.55
Elbow diameter (cm)	6.00±0.34	6.55±0.54	76.87	0.000	0.47
Body mass (kg)	52.54±8.28	55.27±13.04	3.18	0.076	0.09
Upper arm flex. circumference (cm)	24.92±2.37	25.81±3.55	4.44	0.036	0.11
Lower leg circumference (cm)	32.89±2.64	33.51±3.53	2.02	0.156	0.08
Upper arm skin fold (mm)	13.19±3.06	9.24±2.35	108.34	0.000	–0.55
Back skin fold (mm)	9.78±2.96	7.70±2.16	33.24	0.000	–0.31
Abdominal skin fold (mm)	13.20±4.27	9.16±3.22	59.11	0.000	–0.41
Lower leg skin fold (mm)	12.37±3.38	9.86±2.90	32.92	0.000	–0.30
CanR					0.80
C				Female	–1.34
				Male	1.29

Wilk's λ – value of Wilk's Lambda, df1 and df2 – degrees of liberty, F – F-test value, p – level of significance coefficient, $\overline{X}$ – arithmetic mean, SD – standard deviation, DF – discriminative function variables correlation, CanR – canon discrimination coefficient, C – centroids of female and male group of examinees

The quantitative gender differences of morphologic measures in the sample of lower weight categories are shown in Table 2, and those in the sample of higher weight categories, in Table 3. The discriminative analysis determined that the differences in the sample of higher weight categories were more pronounced in all the morphological measures, especially in elbow and knee diameter and body height, with higher results of male players, while female players had higher results in skin fold, especially on the upper arm. The highly expressed components of ectomorphy and mesomorphy contribute to the greater manifestation of strength, especially explosive in players of higher weight categories.

The differential gender differences in the structure of mesomorph parameters surely exist, and a different time, that is, periodic, involvement of the development phases, is in their base. In that sense[15] using the general and unselected population of children, determined that at the age of 14 boys had more expressed differences of the longitudinal skeleton measures, especially the extremities, the transversal skeleton measures, especially knee diameter, and the measures of the body mass and volume, especially forearm circumference, while the girls had more fat tissue, especially at the abdominal area. The discriminative function structure difference was primarily influenced by the different structures of the transversal dimensions, through the superiority of boys in knee diameter and the girls in the bi-cristal diameter. It is also evident that the sample of girls showed tendency towards adiposity significantly more than boys, while the absolute values of subcutaneous fat tissue measures were more strongly expressed in girls. It is indicative that the secondary characteristics of differentiation of children according to group were subcutaneous fat depots, in the sense that girls displayed this characteristic significantly more often.

In previous research[13] factor analysis isolated different morphological structures regarding the gender. In male players aged 11–15 years an accelerated development of skeleton occurs as a consequence of puberty – body height and muscle tissue – muscle mass, and two morphological factors are formed: ecto-mesomorphy and fat tissue. Development differentiation occurs in female players, and three morphological structures are formed, described by: endo-mesomorph somatotype, ecto-mesomorph somatotype and transversal skeleton dimensionality, especially fist and hand joint, or even four morphologic factors defined as body volume and mass, fat tissue, longitudinal skeleton dimensionality and transversal skeleton dimensionality.

Gender differentiations of basic motor abilities in total sample and according to weight categories

Quantitative gender differences of basic motor area variables in total sample of examinees are shown in Table 4. The multivariate variance analysis showed that the players significantly differed in the variables of motor area, regarding the gender. The univariate analysis of

TABLE 2
MULTIVARIATE AND UNIVARIATE ANALYSIS OF VARIANCE (MANOVA/ANOVA) AND CANON DISCRIMINATIVE ANALYSIS (DF) OF MORPHOLOGICAL VARIABLES IN LOWER WEIGHT GROUPS IN RELATION TO GENDER (N=112)

Wilk's λ	df1	df2	F	p
0.40	10	101	15.20	0.000

Variables	Female (N=55)	Male (N=57)	F	p	DF
	$\overline{X}$±SD	$\overline{X}$±SD			
Body height (cm)	159.10±6.13	159.84±7.87	0.31	0.580	0.04
Knee diameter (cm)	8.80±0.32	9.30±0.49	41.20	0.000	0.50
Elbow diameter (cm)	5.91±0.32	6.22±0.47	17.05	0.000	0.32
Body mass (kg)	46.52±4.76	45.62±6.75	0.66	0.418	–0.06
Upper arm flex.circumference (cm)	23.57±1.53	23.61±2.23	0.01	0.910	0.01
Lower leg circumference (cm)	31.40±2.10	31.17±2.34	0.31	0.580	–0.04
Upper arm skin fold (mm)	12.06±2.97	8.91±2.22	40.71	0.000	–0.50
Back skin fold (mm)	8.83±2.85	6.89±1.98	17.63	0.000	–0.33
Abdominal skin fold (mm)	11.56±4.02	8.08±3.10	26.50	0.000	–0.40
Lower leg skin fold (mm)	11.12±3.36	9.09±2.77	12.17	0.001	–0.27
CanR					0.78
C				Female	–1.24
				Male	1.19

Wilk's λ – value of Wilk's Lambda, df1 and df2 – degrees of liberty, F – F-test value, p – level of significance coefficient, $\overline{X}$ – arithmetic mean, SD – standard deviation, DF – discriminative function variables correlation, CanR – canon discrimination coefficient, C – centroids of female and male group of examinees

TABLE 3
MULTIVARIATE AND UNIVARIATE ANALYSIS OF VARIANCE (MANOVA/ANOVA) AND CANON DISCRIMINATIVE ANALYSIS (DF) OF MORPHOLOGICAL VARIABLES IN HIGHER WEIGHT GROUPS IN RELATION TO GENDER (N=94)

Wilk's λ	df1	df2	F	p
0.22	10	83	30.03	0.000

Variables	Female (N=46)	Male (N=48)	F	p	DF
	$\overline{X}$±SD	$\overline{X}$±SD			
Body height (cm)	166.40±5.54	174.24±9.40	24.04	0.000	0.27
Knee diameter (cm)	9.04±0.39	10.07±0.49	126.62	0.000	0.62
Elbow diameter (cm)	6.10±0.34	6.94±0.31	154.99	0.000	0.68
Body mass (kg)	59.75±5.27	66.72±8.65	22.07	0.000	0.26
Upper arm flex. circumference (cm)	26.54±2.12	28.43±3.02	11.96	0.001	0.19
Lower leg circumference (cm)	34.67±2.06	36.29±2.53	11.50	0.001	0.19
Upper arm skin fold (mm)	14.55 ±2.61	9.65±2.46	88.00	0.000	–0.51
Back skin fold (mm)	10.91±2.71	8.67±1.97	21.22	0.000	–0.25
Abdominal skin fold (mm)	15.17±3.73	10.45±2.90	47.18	0.000	–0.38
Lower leg skin fold (mm)	13.86±2.27	10.77±2.80	29.13	0.000	–0.30
CanR					0.89
C				Female	–1.92
				Male	1.84

Wilk's λ – value of Wilk's Lambda, df1 and df2 – degrees of liberty, F – F-test value, p – level of significance coefficient, $\overline{X}$ – arithmetic mean, SD – standard deviation, DF – discriminative function variables correlation, CanR – canon discrimination coefficient, C – centroids of female and male group of examinees

TABLE 4
MULTIVARIATE AND UNIVARIATE ANALYSIS OF VARIANCE (MANOVA/ANOVA) AND CANON DISCRIMINATIVE ANALYSIS (DF) OF BASIC MORPHOLOGICAL VARIABLES IN TOTAL SAMPLE OF PLAYER REGARDING THE GENDER (N=206)

Wilk's λ	df1	df2	F	p
0.48	10	195	20.78	0.000

Variables	Female (N=101)	Male (N=105)	F	p	DF
	$\overline{X}$±SD	$\overline{X}$±SD			
Long jump (cm)	176.58±18.49	192.09±24.20	26.55	0.000	0.35
Hand tapping (freq)	37.62±4.52	36.09±3.81	7.01	0.009	–0.18
Sprint 20 m (s)#	3.85±0.28	3.63±0.28	30.60	0.000	–0.38
Side steps (s)#	9.66±0.85	9.10±0.91	20.47	0.000	–0.31
Pull up (s)	32.32±16.92	35.19±17.05	1.47	0.227	0.08
Trunk lift (freq)	46.85±8.70	48.96±8.41	3.13	0.078	0.12
Backwards obstacle course (s)#	12.41±2.11	11.51±1.91	10.34	0.002	–0.22
V- sit reach (cm)	79.66±14.20	69.72±13.04	27.39	0.000	–0.36
Leg tapping (freq)	21.06±2.10	21.07±1.87	0.00	0.979	0.00
2 kg medicine ball throwing (m)	5.26±0.72	6.58±1.64	55.15	0.000	0.50
CanR					0.72
C				Female	–1.05
				Male	1.01

Wilk's λ – value of Wilk's Lambda, df1 and df2 – degrees of liberty, F – F-test value, p – level of significance coefficient, $\overline{X}$ – arithmetic mean, SD – standard deviation, DF – discriminative function variables correlation, CanR – canon discrimination coefficient, C – centroids of female and male group of examinees

variance showed that the male players had significantly higher level of explosive power, especially of the throwing type, and coordination, especially agility, while female karatekas were better in flexibility evaluation and hand movement speed test.

High coefficient of canon discrimination of 0.72 was significant on the $p<0.001$ level, meaning that the players, regarding the gender, significantly differed in the area of motor abilities. The centroids clearly defined the position of groups of examinees on the discriminative function: female gender centroid on the negative pole and male gender centroid on the positive pole.

Discriminative function (DF) clearly differentiated male players on the positive pole with more expressed explosive power and agility abilities, in relation to female gender on the negative pole, who were more superior in the area of flexibility and hand movement frequency. Based on these differences, it was expected that male players would use power more often, while female players would use speed and flexibility.

Comparison of canon discrimination and discrimination functions coefficients in the sample of lower weight and higher weight categories (Tables 5 and 6) show that the gender differentiations were more pronounced in higher weight categories, in relation to the lower ones, in all the tests applied, especially of throwing type. Therefore, higher body mass is reflected on the manifestation of greater explosive strength in striking karate techniques.

The obtained results are in concordance with the research[12], which showed a statistically significant difference between boys and girls in performance of applied motor tests in young age group (10–12 years) and older age group (13–14 years). The younger age group showed significant difference only in flexibility, with girls in advantage, while the boys had significantly better basic trunk strength, explosive power of jump and sprint type, as well as coordination. In older age group (13 and 14 years) the flexibility differences were even more pronounced, enabling girls perform movements of larger amplitudes. However, the difference in explosive power grew as well: boys showed even better results, especially of the throwing type, with better agility, balance and greater static strength of arm and shoulder area. Obviously, a greater development of muscle mass occurred in male gender, in relation to female gender.

Gender differentiations are significantly more pronounced in puberty that in pre puberty age, meaning that certain motor abilities development trend is different regarding the gender, with the exception of psychomotor speed development.

Also, the factor analysis isolated possible and different motor structures regarding the gender. In male players: the first factor was responsible for cortical movement regulation; the second one was responsible for strength-power regulation and the third one for precision. In female players: the first one integrated speed, power, movement

TABLE 5

MULTIVARIATE AND UNIVARIATE ANALYSIS OF VARIANCE (MANOVA/ANOVA) AND CANON DISCRIMINATIVE ANALYSIS (DF) OF BASIC MORPHOLOGICAL VARIABLES IN LOWER WEIGHT GROUPS IN RELATION TO GENDER (N=112)

Wilk's λ	df1	df2	F	p
0.51	10	101	9.56	0.000

Variables	Female (N=55)	Male (N=57)	F	p	DF
	$\overline{X}$±SD	$\overline{X}$±SD			
Long jump (cm)	174.85±19.46	184.96±17.82	8.23	0.005	0.28
Hand tapping (freq)	36.84±4.47	35.54±3.42	2.97	0.088	–0.17
Sprint 20 m (s)#	3.84±0.29	3.67±0.25	12.16	0.001	–0.34
Side steps (s)#	9.75±0.91	9.29±0.85	7.67	0.007	–0.27
Pull up (s)	33.53±18.37	36.07±16.93	0.58	0.448	0.07
Trunk lift (freq)	46.47±7.53	47.79±7.71	0.83	0.363	0.09
Backwards obstacle course (s)#	12.16±2.18	11.56±1.68	2.71	0.102	–0.16
V- sit reach (cm)	76.04±12.96	65.95±10.53	20.51	0.000	–0.44
Foot tapping (freq)	20.91±1.98	20.93±1.78	0.00	0.954	0.01
2 kg medicine ball throwing (m)	5.00±0.65	5.56±1.06	11.21	0.001	0.33
CanR					0.70
C				Female	–0.98
				Male	0.95

Wilk's λ – value of Wilk's Lambda, df1 and df2 – degrees of liberty, F – F-test value, p – level of significance coefficient, $\overline{X}$ – arithmetic mean, SD – standard deviation, DF – discriminative function variables correlation, CanR – canon discrimination coefficient, C – centroids of female and male group of examinees

structures and muscle regulators, as well as synergy regulation, the second one was responsible for energy regulation, integration of trunk power and sprint, while the third one integrated precision.

Gender differentiations of situation-motor abilities in total sample and according to weight categories

The quantitative gender differences of specific motor area variables in total sample of examinees are shown in

TABLE 6
MULTIVARIATE AND UNIVARIATE ANALYSIS OF VARIANCE (MANOVA/ANOVA) AND CANON DISCRIMINATIVE ANALYSIS (DF) OF BASIC MORPHOLOGICAL VARIABLES IN HIGHER WEIGHT GROUPS IN RELATION TO GENDER (N=94)

Wilk's λ	df1	df2	F	p
0.33	10	83	17.08	0.000

Variables	Female (N=46) $\overline{X}$±SD	Male (N=48) $\overline{X}$±SD	F	p	DF
Long jump (cm)	178.65±17.24	200.55±27.98	20.65	0.000	–0.33
Hand tapping (freq)	38.57±4.44	36.73±4.17	4.28	0.041	0.15
Sprint 20 m (s)#	3.85±0.27	3.59±0.32	18.77	0.000	0.31
Side steps (s)#	9.55±0.77	8.88±0.94	14.18	0.000	0.27
Pull up (s)	30.88±15.09	34.15±17.32	0.95	0.333	–0.07
Trunk lift (freq)	47.30±9.98	50.35±9.05	2.41	0.124	–0.11
Backwards obstacle course (s)#	12.71±2.01	11.45±2.17	8.46	0.005	0.21
V- sit reach (cm)	83.99±14.54	74.21±14.35	10.77	0.001	0.24
Foot tapping (freq)	21.24±2.23	21.23±1.97	0.00	0.982	0.00
2 kg medicine ball throwing (m)	5.57±0.68	7.79±1.35	99.51	0.000	–0.72
CanR					0.82
C				Female	1.45
				Male	–1.39

Wilk's λ – value of Wilk's Lambda, df1 and df2 – degrees of liberty, F – F-test value, p – level of significance coefficient, $\overline{X}$ – arithmetic mean, SD – standard deviation, DF – discriminative function variables correlation, CanR – canon discrimination coefficient, C – centroids of female and male group of examinees

TABLE 7
MULTIVARIATE AND UNIVARIATE ANALYSIS OF VARIANCE (MANOVA/ANOVA) AND CANON DISCRIMINATIVE ANALYSIS (DF) OF SITUATION – MOTOR VARIABLES IN THE TOTAL SAMPLE OF PLAYERS IN RELATION TO GENDER

Wilk's λ	df1	df2	F	p
0.91	5	200	4.16	0.001

Variables	Female (N=101) $\overline{X}$±SD	Male (N=105) $\overline{X}$±SD	F	p	DF
Gedan barai (freq)	31.89±5.36	31.80±4.43	0.02	0.894	0.03
Gedan barai-gyako zuki (s) #	3.93±0.64	3.94±0.64	0.02	0.875	–0.03
Mawashi geri (freq)	32.05±6.00	33.08±5.81	1.56	0.214	–0.27
Specific side steps (s) #	9.66±0.84	9.34±0.91	7.23	0.008	0.58
Moving in triangle (s) #	9.50±0.97	9.05±0.84	13.03	0.000	0.78
CanR					0.31
C				Female	0.33
				Male	–0.31

Wilk's λ – value of Wilk's Lambda, df1 and df2 – degrees of liberty, F – F-test value, p – level of significance coefficient, $\overline{X}$ – arithmetic mean, SD – standard deviation, DF – discriminative function variables correlation, CanR – canon discrimination coefficient, C – centroids of female and male group of examinees

Table 7. The multivariate variance analysis showed that the players significantly differed in the variables of specific motor area regarding the gender. The univariate analysis of variance showed that the male players were significantly better in the specific agility-mobility tests than female players.

Discriminative function (DF) clearly differentiated male players on the positive pole, superior in specific agility and saturated by basic coordination, explosive power and speed abilities. Again, these differences were somewhat greater in higher weight categories (Table 8 and 9).

Gender differentiation in karate techniques in total sample and weight categories

The quantitative gender differences of specific motor knowledge variables for the total sample of examinees are shown in Table 10. The multivariate variance analysis

TABLE 8
MULTIVARIATE AND UNIVARIATE ANALYSIS OF VARIANCE (MANOVA/ANOVA) AND CANON DISCRIMINATIVE ANALYSIS (DF) OF SITUATION – MOTOR VARIABLES IN LOWER WEIGHT GROUPS IN RELATION TO GENDER (N=112)

Wilk's λ	df1	df2	F	p
0.91	5	106	2.20	0.060

Variables	Female (N=55) $\overline{X}$±SD	Male (N=57) $\overline{X}$±SD	F	p	DF
Gedan barai (freq)	31.15±4.98	30.91±4.47	0.07	0.794	0.08
Gedan barai-gyako zuki (s) #	3.97±0.66	4.02±0.68	0.22	0.643	–0.14
Mawashi geri (freq)	31.40±6.03	32.30±5.78	0.65	0.423	–0.24
Specific side steps (s) #	9.73±0.93	9.54±0.82	1.28	0.260	0.34
Moving in triangle (s) #	9.59±0.97	9.16±0.82	6.58	0.012	0.76
CanR					0.31
C				Female	0.32
				Male	–0.31

Wilk's λ – value of Wilk's Lambda, df1 and df2 – degrees of liberty, F – F-test value, p – level of significance coefficient, $\overline{X}$ – arithmetic mean, SD – standard deviation, DF – discriminative function variables correlation, CanR – canon discrimination coefficient, C – centroids of female and male group of examinees

TABLE 9
MULTIVARIATE AND UNIVARIATE ANALYSIS OF VARIANCE (MANOVA/ANOVA) AND CANON DISCRIMINATIVE ANALYSIS (DF) OF SITUATION – MOTOR VARIABLES IN HIGHER WEIGHT GROUPS IN RELATION TO GENDER (N=94)

Wilk's λ	df1	df2	F	p
0.88	5	88	2.33	0.049

Variables	Female (N=46) $\overline{X}$±SD	Male (N=48) $\overline{X}$±SD	F	p	DF
Gedan barai (freq)	32.78±5.71	32.85±4.19	0.00	0.945	–0.02
Gedan barai-gyako zuki (s) #	3.89±0.62	3.85±0.58	0.10	0.757	0.09
Mawashi geri (freq)	32.83±5.95	34.00±5.76	0.94	0.334	–0.28
Specific side steps (s) #	9.58±0.71	9.09±0.95	8.07	0.006	0.81
Moving in triangle (s) #	9.39±0.97	8.91±0.85	6.51	0.012	0.73
CanR					0.34
C				Female	0.37
				Male	–0.35

Wilk's λ – value of Wilk's Lambda, df1 and df2 – degrees of liberty, F – F-test value, p – level of significance coefficient, $\overline{X}$ – arithmetic mean, SD – standard deviation, DF – discriminative function variables correlation, CanR – canon discrimination coefficient, C – centroids of female and male group of examinees

showed that in the variables of specific knowledge and/or basic technique acquisition, players significantly differed regarding the gender.

The univariate analysis of variance showed that female players were significantly better in technique realization, especially in Mawashi geri and Gyako zuki – Mawashi geri, than male players. These differences were somewhat more expressed in higher weight categories (Tables 11 and 12).

The discriminative function (DF) clearly differentiates female players on the positive pole, more superior in technique performance, than male players on the negative

TABLE 10
MULTIVARIATE AND UNIVARIATE ANALYSIS OF VARIANCE (MANOVA/ANOVA) AND CANON DISCRIMINATIVE ANALYSIS (DF) FOR EVALUATION OF TECHNIQUE VARIABLES (TECHNICAL EFFICIENCY) IN TOTAL SAMPLE OF PLAYERS IN RELATION TO GENDER
(N=206)

Wilk's λ	df1	df2	F	p
0.92	6	199	2.89	0.010

Variables	Female (N=101)	Male (N=105)	F	p	DF
	$\overline{X}$±SD	$\overline{X}$±SD			
Gyako zuki	3.36±0.72	3.20±0.67	2.67	0.104	0.39
Kizame zuki	2.98±0.70	2.97±0.75	0.01	0.930	0.02
Mawashi geri	3.25±0.82	3.02±0.76	4.33	0.039	0.49
Gyako zuki – Mawashi geri	3.11±0.72	2.90±0.76	4.50	0.035	0.50
Gyako zuki – Uraken	2.82±0.66	2.73±0.79	0.82	0.365	0.22
Kizame zuki – Gyako zuki	3.32±0.71	3.14±0.74	3.36	0.068	0.43
CanR					0.28
C				Female	0.30
				Male	–0.29

Wilk's λ – value of Wilk's Lambda, df1 and df2 – degrees of liberty, F – F-test value, p – level of significance coefficient, $\overline{X}$ – arithmetic mean, SD – standard deviation, DF – discriminative function variables correlation, CanR – canon discrimination coefficient, C – centroids of female and male group of examinees

TABLE 11
MULTIVARIATE AND UNIVARIATE ANALYSIS OF VARIANCE (MANOVA/ANOVA) AND CANON DISCRIMINATIVE ANALYSIS (DF) FOR EVALUATION OF TECHNIQUE VARIABLES (TECHNICAL EFFICIENCY) IN LOWER WEIGHT GROUPS IN RELATION TO GENDER
(N=112)

Wilk's λ	df1	df2	F	p
0.93	6	105	1.30	0.265

Variables	Female (N=55)	Male (N=57)	F	p	DF
	$\overline{X}$±SD	$\overline{X}$±SD			
Gyako zuki	3.21±0.69	3.14±0.65	0.31	0.578	–0.20
Kizame zuki	2.85±0.62	2.90±0.66	0.18	0.675	0.15
Mawashi geri	3.12±0.75	2.96±0.74	1.26	0.263	–0.39
Gyako zuki – Mawashi geri	2.99±0.66	2.82±0.70	1.68	0.197	–0.45
Gyako zuki – Uraken	2.69±0.63	2.64±0.73	0.12	0.727	–0.12
Kizame zuki – Gyako zuki	3.21±0.68	3.09±0.71	0.88	0.351	–0.33
CanR					0.26
C				Female	–0.27
				Male	0.27

Wilk's λ – value of Wilk's Lambda, df1 and df2 – degrees of liberty, F – F-test value, p – level of significance coefficient, $\overline{X}$ – arithmetic mean, SD – standard deviation, DF – discriminative function variables correlation, CanR – canon discrimination coefficient, C – centroids of female and male group of examinees

TABLE 12
MULTIVARIATE AND UNIVARIATE ANALYSIS OF VARIANCE (MANOVA/ANOVA) AND CANON DISCRIMINATIVE ANALYSIS (DF) FOR EVALUATION OF TECHNIQUE VARIABLES (TECHNICAL EFFICIENCY) IN HIGHER WEIGHT GROUPS IN RELATION TO GENDER
(N=94)

Wilk's λ	df1	df2	F	p
0.88	6	87	1.98	0.078

Variables	Female (N=46)	Male (N=48)	F	p	DF
	$\overline{X}$±SD	$\overline{X}$±SD			
Gyako zuki	3.53±0.72	3.26±0.70	3.23	0.076	0.51
Kizame zuki	3.14±0.76	3.06±0.83	0.24	0.623	0.14
Mawashi geri	3.40±0.87	3.08±0.79	3.34	0.071	0.52
Gyako zuki – Mawashi geri	3.27±0.76	2.99±0.82	2.96	0.089	0.49
Gyako zuki – Uraken	2.97±0.67	2.83±0.85	0.89	0.348	0.27
Kizame zuki – Gyako zuki	3.46±0.72	3.20±0.79	2.78	0.099	0.47
CanR					0.35
C				Female	0.37
				Male	–0.36

Wilk's λ – value of Wilk's Lambda, df1 and df2 – degrees of liberty, F – F-test value, p – level of significance coefficient, $\overline{X}$ – arithmetic mean, SD – standard deviation, DF – discriminative function variables correlation, CanR – canon discrimination coefficient, C – centroids of female and male group of examinees

pole. Probably better muscle tone regulation (flexibility) influenced better performance quality in those karate techniques dominated by larger movement amplitudes.

Conclusion

Gender differentiations were mainly expressed in the morphological and basic motor area, and significantly less in the area of specific motor abilities and motor knowledge (technical efficiency).

The quantitative gender differentiations of the morphological characteristics were most obvious, showed in the somatotype as well, in the way that the ectomorph component was significantly more pronounced in male players and the endomorph in female players. Larger transversal skeleton dimensionality in male players enabled greater development of body mass, reflected through the manifestation of all strength factors, especially explosive strength. On the other side, the increased values of fat tissue with less pronounced muscle tissue reduced the motor efficiency of female players even more, in relation to male players.

The quantitative gender differentiations of basic motor abilities were also strongly expressed, differentiating male players with expressed abilities, especially explosive power and agility, from female players, who were superior in flexibility and hand movement frequency. Regarding the motor efficiency, strength dominated in male players, while speed and fine muscle tone regulation dominated in female players.

The quantitative gender differentiations in specific motor abilities were less expressed than in the area of morphological characteristics and basic motor abilities. Namely, the biomotor status dictated the manifestation of specific abilities in a way that female players, in realising them, would dominantly use speed and flexibility and male players would use strength, that is, the feature they expressed in relatively greater amount.

The quantitative gender differentiations in specific motor knowledge were equally expressed as the specific motor abilities, showing that female players were superior in technique performance in relation to male players, especially in Mawashi geri and Gyako zuki – Mawashi geri performance quality. Obviously better flexibility enables them an easier performance of techniques with greater amplitude.

The discriminative functions of areas showed phases of quality formation for male and female karate sport, that is, the development of sub-segments of anthropological type used in prediction of fight efficiency in cadet players; therefore, the interaction and/or two-way influences of biomotor factors development on the development of specific abilities and knowledge.

Based on the obtained information the experts – trainers should develop the models of training procedures and processes directed towards formation of high quality players.

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SPOLNE DIFERENCIJACIJE NEKIH ANTROPOLOŠKIH KARAKTERISTIKA KARATISTA – KADETA

SAŽETAK

Istraživanje je provedeno s ciljem određivanja spolnih diferencijacija nekih antropoloških karakteristika muških i ženskih karatista kadeta. Kako bi se ostvario taj cilj, određena je skupina od deset morfoloških varijabli, deset motoričkih testova, pet situacijskih motoričkih testova i šest testova tehničke izvedbe. Izmjereno je dvije stotine i šest natjecatelj, od kojih 105 muških i 101 ženski. Ispitanici su podijeljeni prema kategorijama težine (niže i više kategorije težine). Na temelju analize varijance i kanonske diskriminacijske analize, može se zaključiti: spolne diferencijacije su najizraženije u morfološkom i osnovnom motoričkom području, a značajno su manje u području specifičnih motoričkih sposobnosti i motoričkoga znanja (tehničke efikasnosti).