MORPHOLOGICAL AND MOTOR CHARACTERISTICS OF YOUNG JUDOKAS

Abstract
The goal of this research was to determine influence of systematical judo practice on morphological and motor characteristics of young students. The sample of this ex-post-factor research included 25 judokas of approximate age of 8.52 years and 32 non-athletes with approximate age of 8.59 years. Morphological and motor characteristic of the students exposed to certain influence of practicing judo were compared to morphological and motor characteristic of those young students who are not exposed to any kind of practicing influence and are marked as non-athletes. For evaluation three variables were observed morphological characteristic and five for motor characteristics. Two-way T-test for small independent groups was used for testing arithmetic mean differences between groups in the individual variables. The results of the analysis indicated that, as for morphological characteristics, there is a significant difference between judokas group and non-athletes group in height. As for motor characteristics there is a significant difference between these two groups in the following variables: velocity strength, repetitive strength and agility, while there were no statistically significant differences for strong stamina and flexibility. The acquired results can be explained by genetic condition of the observed variables at young school ages, as well as with the fact that some of the school children from the judokas group were relatively shortly exposed to the training influence. Besides, some of the school children from the non-athletes group practice some other sport but during the test they were not members of any sport team or sport club.

Key words:

INTRODUCTION

One of the models used in describing a human, or an athlete, is the psychosomatic status, or in wider terms – anthropological status. The model of an anthropological status of an athlete includes a series of factors whose variability is such that differences among humans (athletes) can be established and appropriate status of each individual can be defined. The factors of an anthropological status are the following (Hošek, 2004): morphological characteristics, functional capability, motor capability, cognitive (intellectual) capability, conative characteristics (personality features), values and attitudes, micro-social status, social status and health status. It is well known that each training activity influences more or less the adaptive changes of the body, in different sports different methods and means are used in...
the training procedure in order to increase the level of physical capability, and all of this is accompanied with the change in morphological status of an athlete. It is necessary to stipulate that these changes in the morphological characteristics and motor capabilities of an athlete caused by training process, in addition to specifications of sports branch and selection of adequate methods and means, depend to a great extent on the so called athlete’s innate potentials. In various competitive sports at the age of 9 to 13 years there are significant differences in anthropometric and body composition in boys and girls (Damsgaard, Bencke, Matthiesen, Petersen, & Müller, 2001). One of the examples are female gymnasts, who at the age of 8-14 years, on average, are lower and slimmer than their counterparts in swimming and those who do not do sports (Peltenburg, Erich, Bemink, Zonderland, & Huisveld, 1984). Research in martial arts, especially in judo, is rare, compared to other sports, and the lack is visible in research of younger categories. Popović (1980) researched the influence of systematic and planned training in judo to a transformation of reviewed anthropometric and bio motoric dimensions with school youth of pre-puberty and puberty age. The experiment was executed with the purpose to determine the body status of students and their bio motoric capabilities at the beginning and the end of experimental treatment. Based on measures of the initial and final status, regarding the treatment, an attempt was made to determine whether planned and systematic judo practice significantly influences the changed of examined anthropometric dimensions, as well as changes of isometric, repetitive ballistic repetitive muscle potential with current muscle groups. Bratić (1993) reviewed the relation between basic motoric capabilities and complex motoric tasks – judo techniques on a sample of 234 subjects, aged between 18 and 25. For the evaluation of basic motoric capabilities 14 basic motoric tests were used. The tests were defined as to measure the following motoric capabilities: strength, speed, coordination, balance and pliability. For the evaluation of complex motor tasks (judo techniques) eight variables were applied of larger judo technique groups. Based on the calculated correlation coefficient in space of basic motor variables, the following motoric capabilities (dimensions) were defined: explosive power, coordination and balance. In the area of variables for the evaluation of motor tasks, the factor of general success of judo technique learning was adopted. By researching the sample of 45 subjects, all students of the FFK, the influence of 18 morphological, 12 motor and 9 criteria variables on the success of learning the program of wrestling lectures (Kasum, 2001) was monitored.

Research of Bala and Drid (2010) showed that young judokas (aged 11-16 years.) are better in repetitive exercises and static strength, running speed, coordination of the entire body than their peers who do not do sports. Skinfold values were also lower in judokas. Popović (2010) on a sample of students of Faculty of Sport and Physical Education of the University in Belgrade, spotted the significant connection of dynamics of learning the judo program and repetitive power of arm biceps and triceps, and suggested that tests “number of chin-ups in 10 seconds” and “number of push-ups in 10 seconds” be included in a battery of tests used in judo. The sample of 537 students from second to fifth grade of elementary school on the territory of Vojvodina was examined as for the differences of morphological characteristics and motor capabilities among students that were systematically practicing judo and those who merely attended the regular physical education classes. The system of 16 variables, 8 of which were morphological characteristics and 8 motor capabilities, significant differences were determined among the students in the area of motor abilities (Kopas, Obadov, & Drid, 2008). The trend of development of motor abilities and morphological characteristics of young judokas was monitored on a sample of 257 boys and 169 girls, practicing judo over one year, with a minimum of twice a week per 60 minutes (Drid, Kopas, & Obadov, 2008). 8 variables from motor area and 8 variables from anthropometric area were monitored. The research showed that it is not necessary to define groups per six months and that the division of young judokas to age categories of beginners, young pioneers and senior pioneers is justifiable regarding the motor abilities and morphological characteristics.

In accordance with recent research, domestic and foreign (Jovanović, 2000) three basic factors were identified determining the level of morphological development of a man. These are: factor of lon-
tice to morphological characteristics and motor abilities of students of younger school age, or, to compare the morphological characteristics and motor capabilities of students training judo to morphological characteristics and motor abilities of students of younger school age that are not under the training process (non-athletes).

THE METHOD

Sample of subjects

The sample in this ex-post-facto research included the total of 57 students from first to fourth grade of elementary school, of which 25 were judoka of average age of 8.52 ± 1.13 years.

Variable sample and measurement procedure

In this research three variables were analyzed for the evaluation of morphological characteristics and five variables for the evaluation of motor abilities. Anthropometric measurements were conducted in accordance with existing standards (Lohman, Roche, & Martorell, 1988). Measuring the height of the body anthropometry according to Martin with an accuracy of 0.1 cm. The respondent was in a standard standing position on a firm, horizontal surface. Feet are to be drawn, and fifth, seating region and upper back touching the anthropometer. The head was in the position of the Frankfurt plane and did not touch the scale anthropometry (Norton, Marfell-Jones et al. 2000). Body weight (BW) was measured using a portable instrument that allows measurement accuracy of 0.5 kg. The following variables were analyzed regarding the morphological characteristics: body height (BH), measured with height measure with the accuracy of 0.1 cm and body mass (BM), measured with portable scale enabling the measuring precision of 0.5 kg. These two variables produced the variable “body mass index” – BMI (body mass/body height$^2$ in kg/m$^2$). In determining the variables for the evaluation of motor abilities the age of subjects was considered, and the test were executed per standard
manuals. During testing two measurements were performed, where the analysis was performed for a better result. The following variables were evaluated: for the evaluation of speed power of legs, long jump test was performed (LONG), for the evaluation of repetitive power of body flexor muscle lay-sit test was performed in 20 seconds (LS20), for the evaluation of power stamina of arms and shoulders chin-up endurance test was used (CHINUP), for the evaluation of back thigh flexibility deep sitting forward bend test was used (SFB) and for the evaluation of agility cone running test was used 10 x 5 m (10 x 5 m). Long jump from spot test (LONG) was performed on a flat surface with marked jumping ground where the leap location is on the same level as landing location, and the jump is double leg. The landing is also double leg. Two jumps were performed, and the better result was marked. The results were in centimeters. The lay-sit test in 20 seconds (LS20) was performed by the examinee laying on its back, with knees bent at 90 degrees, and the feet separated in hip width, arms bend as well with fingers intertwined behind the head. The feet are fixed. On the mark “go” the examinee was asked to move from the laying position to sitting position as fast as possible and to touch thighs with elbows, and the return to the initial position. The test was performed in the duration of 20 seconds. The results were marked by the number of correct repetitions. The chin-up endurance test (CHIN-UP) was performed on a shaft. The examinee was asked to hang from the shaft in the chin-up position as long as possible with his chin in the level of the shaft. The stop watch with the 0.1 second precision took time in which the examinee held the described position. The stop watch was stopped when the chin went under the lower level of the shaft. The examinee reached the initial position with the aid of experiment executor. The measurement taker stood on the chair so that its face was in the level of the shaft. If the examinee remained in the position over 120 seconds, the measure taker stopped the stop watch and terminated any further execution. The results were measured as double digit number (seconds, tenth of seconds). The test deep sitting forward bend (SFB) was executed with the examinee in sitting position, with legs forward, feet on a gymnastics bench, slowly rises into a bend as deep as possible. The result in centimeters was determined based on the deepest reach of hand fingers. The examinee reaching feet level receives 0. The examinee with reach under the feet level achieved the result with negative mark, and under the feet level the plus result. The test was performed twice, and the better result was used. Cone running test (10x5m) was performed by markers being set at 5 m distance. The examinee was asked to run from one marker to another 10 times, with the fastest possible result and direction change. The examinee had to pass the marked space with both legs. The results were in seconds. The test was performed twice, and the better result was recorded.

The tests were executed during the regular physical education classes in the “Isidora Sekulić” elementary school and in the “Dinamo” judo club premises. At the beginning of class and practice the students received basic instructions regarding the research and were familiarized with the test performance procedure. The measurement and testing of morphological characteristics and motor capabilities of students was performed in the presence of physical education professor of tested students, the coach and the paper author.

Data Analysis

The processing of data of the research included the usage of statistical program (EXCEL, West Virginia, 2007) for the calculation of the following central and dispersed parameters: arithmetic mean (AM), standard deviation (SD), minimum result (MIN), maximum result (MAX) and variation coefficient (cV%). For testing differences of arithmetic means between the groups in singular variables a two way T-test was used with small independent samples.
RESULTS AND DISCUSSION

In the analysis of influence of training activity to morphological characteristics and motor abilities of judokas and non-athletes, the central and dispersion parameters were initially determined: arithmetical mean, standard deviation, minimum and maximum result and well as variation coefficient for age, body height, body mass and values such as BMI (body mass index), and then the p-value was calculated for the same variables of judokas and non-athletes (nonath.) and the results were received presented in (Table 1).

Table 1. Descriptive parameters – arithmetic mean (AM), standard deviation (SD), variation coefficient (CV%), minimum (MIN) and maximum (MAX) value and T-test result (p-value) for age, body height, body mass and BMI (body mass index)

<table>
<thead>
<tr>
<th></th>
<th>AM</th>
<th>SD</th>
<th>CV%</th>
<th>MIN</th>
<th>MAX</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>8.5</td>
<td>8.6</td>
<td>1.1</td>
<td>1.1</td>
<td>13.2</td>
<td>13.2</td>
</tr>
<tr>
<td>Height (m.)</td>
<td>1.39</td>
<td>1.35</td>
<td>0.07</td>
<td>0.08</td>
<td>5.2</td>
<td>5.84</td>
</tr>
<tr>
<td>Weight (kg.)</td>
<td>35</td>
<td>32.5</td>
<td>6.8</td>
<td>6.8</td>
<td>19.5</td>
<td>21.1</td>
</tr>
<tr>
<td>BMI</td>
<td>18</td>
<td>17.7</td>
<td>2.5</td>
<td>2.6</td>
<td>14.1</td>
<td>14.8</td>
</tr>
</tbody>
</table>

By observing the presented results referring to the age of examinees (Table 1) it was determined that they are pretty equal, and the other values: standard deviation 1.1, variation coefficient 13.2 as well as minimum 7 and maximum 10 result are absolutely equal in both examined groups. The results imply the equality of sub-samples and we can say that this is a very homogenous cluster.

The judokas are 4 cm higher than non-athletes, since the arithmetic mean for judokas is 1.39 cm and for non-athletes 1.35. Standard deviation for this variable with judokas is 0.07 and with non-athletes 0.08, variation coefficient with judokas is 5.2 and with non-athletes 5.84. The shortest non-athlete is 10 cm shorter than the shortest judoka, non-athlete 1.16 cm and judoka 1.26 cm, where with the tallest representatives of these two groups such large difference is not present and is 3 cm, the tallest judoka is 1.52 cm and non-athlete 1.49 cm. T-test produced p-value (p<0.005) .048 which implies to an existence of statistically significant differences in height between the judokas and non-athletes (Table 1).

The next reviewed variable (Table 1) shows that judokas are heavier than non-athletes by 2.5 kg, arithmetical mean of judoka is 35 kg and for non-athletes 32.5 kg. The standard deviation is equal amounting to 6.8 while the variation coefficient is 19.5 with judokas and 21.1 with non-athletes. The lightest judoka is 1.5 heavier that the lightest non-athlete, judoka 21.5 kg and the non-athlete 20 kg. The heaviest judoka is 3.5 kg heavier that the heaviest non-athlete, judoka 53.5 kg and non-athlete 50 kg. But, for this variable it was determined by the T-test and calculated p-value (.170) that there are no statistically significant differences in body weights between the judokas and non-athletes of younger school age.

The obtained BMI (body mass index) results imply the similarity of arithmetical means, which is 18 for judokas, and 17.7 for non-athletes, as well as values of standard deviations, which is 2.5 with judokas and 2.6 with non-athletes (Table 1). Variation coefficient with judokas in observed variable is 14.1 and 14.8 with non-athletes. There is a certain difference with minimum BMI values, which is 11.8 for ju-
dokas and 14 for non-athletes. For maximum values this difference is almost negligible and is 24.8 for judokas and 24 for non-athletes. As well as in the case of weight of examinees p-value was received (.657) in the T-test, and it implies that in this observed variable there is no statistically significant difference between the judoka and non-athlete of younger school age.

**Table 2.** Descriptive parameters – arithmetic mean (AM), standard deviation (SD), variation coefficient (cV%), minimum (MIN) and maximum (MAX) value and T-test results (p-values) for motor test long jump from point (LJP), motor test body lifting (BOLIFT20), motor test chin-up endurance (CHIN-UP), motor test deep sitting forward bend (DFB) and motor test cone running (10x5m).

<table>
<thead>
<tr>
<th></th>
<th>LONG</th>
<th>BOLIFT 20</th>
<th>CHIN-UP</th>
<th>DFB</th>
<th>10x5m</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM</td>
<td>157.2</td>
<td>130.8</td>
<td>17.5</td>
<td>15.3</td>
<td>21.4</td>
</tr>
<tr>
<td>SD</td>
<td>15.6</td>
<td>18.8</td>
<td>2.5</td>
<td>2.6</td>
<td>16.9</td>
</tr>
<tr>
<td>cV%</td>
<td>9.9</td>
<td>14.4</td>
<td>14.1</td>
<td>17.3</td>
<td>78.9</td>
</tr>
<tr>
<td>MIN</td>
<td>125</td>
<td>91</td>
<td>12</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>MAX</td>
<td>182</td>
<td>164</td>
<td>21</td>
<td>20</td>
<td>63.3</td>
</tr>
<tr>
<td>p-value</td>
<td>.000*</td>
<td>.002*</td>
<td>.063</td>
<td>.950</td>
<td>.000*</td>
</tr>
</tbody>
</table>

On a motor test long jump the judokas achieved the average result of 157.2 cm and non-athletes 130.8 cm, which is 27.4 cm shorter (Table 2). The fact that the speed power is more developed with judokas is confirmed by a smaller standard deviation, judokas 15.6 and non-athletes 18.8 as well as lower variation coefficient, with judokas 9.9 and with non-athletes 14.4. Also, with the minimum and maximum result a difference is present in favor of judokas, the shortest jump of judokas is 125 cm and non-athletes 91 cm, and the longest jump of judokas is 18 cm longer than the longest jump of non-athletes. Results of T-test where the p-value (0.000) confirms the existence of statistically significant value in achieved results in long jump from spot test between the judokas and non-athletes with younger school children. The achieved results of the test show the positive influence of judo practice to a development of speed power.

From Table 2 it can be seen that the judokas have achieved better results in motor test (LS20) from the non-athletes of younger school age, judokas (AM 17.5, SD 2.5, cV% 14.1) and non-athletes (AM 15.3, SD 2.6, cV% 17.3). T-test determined that there is a statistically significant difference in the result achieved by judokas and non-athletes (p<0.002). Both minimum and maximum results are larger with judokas compared to non-athletes, judokas 12 and 21 repetitions and non-athletes 10 and 20 repetitions.

Based on these results we can see a better development of repetitive power of body flexor muscles of judokas compared to non-athletes of the same age. Specification of technique execution of throwing and a large number of throwing repetitions in the training process in judo requires the engagement of stomach musculature which positively influences the development of repetitive power of this muscle group.

For the endurance evaluation of arms and shoulders chip-up endurance test was used. In Table 2 we can see that judokas have achieved better results in this test (21.4±16.9; cV%=78.9) compared to non-athletes (14.1±9.6; cV%=68.2). Minimum result of 1 second was achieved by both groups of examinees while the maximum result of this test was achieved by judoka achieving 21.1 seconds more (judoka 63.3 and non-athlete 42 seconds).

With the application of T-test, in addition to difference in average result of 7.3 seconds in favor of judokas a statistically significant difference was not confirmed in the achieved results between the examinee groups (p<0.063). This result can be explained by the lack of exercises for power development and arms and shoulders in these conditions in this age.
Namely, exercises for the development of stamina in power and strength are applied in working with older judokas.

In the motor test deep bend over while sitting the examinees achieved similar average result (Table 2). Judokas achieved the result of 3.9 cm while the non-athletes achieved 4 cm. After the usage of T-test and resulting p-value of ≤0.950 this difference of 1 mm in average result did not present a statistically significant difference between the two groups. This similar result can be explained in sufficient of inadequate work in flexibility development in judoka practice in this club or, on the other hand, in a weaker muscle tone of non-athletes, considering the fact that they have achieved lower results in power tests. It is considered that power and strength are opposite to flexibility since power drills can diminish flexibility.

In the motor test cone running the judokas achieved a better result on average compared to non-athletes for 2.7 seconds (Table 2). Standard deviation for the judoka result was 1.2 with variation coefficient of 5.8, while the standard deviation of non-athlete results was 2.2 with the variation coefficient of 9.2. The best time on this test was achieved by the examinee from the judoka group of 19.1 seconds and the fastest non-athlete ran for 20 seconds. The slowest non-athlete ran this test for 4.4 slower, and it took him 28 seconds, compared to the slowest judoka that ran the distance in 23.6 seconds. The achieved value p≤0.000 after the application of T-test shows statistically significant difference in achieved results of judokas and non-athletes of younger school age. Since agility was estimated with this test, based on the achieved results of the two examined groups we can conclude better agility with the judoka group compared to non-athletes.

The research results show that there is a statistically significant difference in achieved results of judokas and non-athletes in the following variables observed: speed power, repetitive power and agility, while with power endurance and flexibility no differences were spotted.

**CONCLUSION**

Training in judo with children of younger school age is different, in applied methods and means from the training with older categories (junior and senior). At this age more attention is given to technical preparation, that is, the work is directed through different methodical actions towards the adoption of basic judo technique. For the judo technique to be correctly and efficiently executed a certain level of motor abilities is required. The development of motor abilities and technical preparation or mutually connected and dependent, which means that the work on the development of judo technique influences the development of motor abilities, and vice versa, working on the development of motor abilities influences more efficient application of judo technique. Research results confirmed that statistically significant differences exist in body height in favor of judokas, while the statistically significant differences were not present in body mass and BMI of judokas and non-athletes. In two out of five tested motor variables statistically significant difference was not identified. In the following three variables significant difference in favor of judokas was determined: speed power, repetitive power and agility, while statistically significant difference was not present in flexibility and power endurance. The non-existence of statistically significant differences in these variables can be explained by the genetic determination of reviewed variables in younger school age, as well as the fact that certain students from judoka group started practicing only recently and were under the influence of training process for a short time. On the other hand, certain students from non-athlete group, who are currently not in a sports club or section, practiced sports until recently, so some of them were under the training process in the past.

These results fully comply with the results of similar research in other sports. For example, children of the same age that are in the football school show statistically significant improvement in agility and speed parameters (Janković, Jelušić, & Leontijević, 2010), so it can be concluded that children that practice judo or some other sport at younger school age will have great benefit from it even if they choose another sport later on. The best examples were foot-
ball player Michele Platini and Zinedine Zidane, who trained judo as kids, and our national team member Nenad Jestrović that practiced wrestling before football. Our national basketball team member and European champion Veselin Petrović was a pioneer champion of Yugoslavia in wrestling, and legendary basketball player Deron Williams was a pioneer USA champion in wrestling. Famous handball player Nevenka Damjanac who was a very talented judoka took upon handball and made a national team career, while the legendary handball national team member Mirsada Ganići was also a national team member in judo and senior champion of Yugoslavia. Famous handball national team member Predrag Perunić was a senior karate champion of Yugoslavia, while the Olympic, World and European champion in judo, Belgian Ingrid Bergmans achieved a significant career in handball as well. These are some of the many examples that illustrate the level and significance of motor abilities development by practicing different martial arts. Having in mind that a large number of physical education teachers pay attention to the monitoring of motor abilities development with students (Milanović, Radisavljević, & Pašić, 2010), the results of this research can be used as a model for the improvement of physical education classes in schools. The idea of enrichment of the physical education classes by judo and other martial arts elements is not new (Kasum & Ćirković, 2009) and the results of this research only support this idea. In this sense, they present additional argumentation for the implementation of this content in the physical education syllabus.

REFERENCES


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