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MARTIAL ART COURSE LEARNING OUTCOMES AND STUDENT LEARNING IN SPORT MANAGEMENT DEGREE PROGRAMS: A REVIEW OF HOW TO DEVELOP, ALIGN, AND ASSESS COURSE LEARNING OUTCOMES IN MARTIAL ART COURSES

Abstract
Content specific and appropriately developed martial art course learning outcomes are the foundation of robust and relevant sport management courses in higher education. Course learning outcome development in sport management is a structured and specific process that will enhance student learning. The suggested development of course learning outcomes in sport management courses is rooted in, 1) identifying the specific sport management skills and competencies, 2) course content to support the skills and competencies, 3) assign level of difficulty to sport management course content based on Bloom’s taxonomy and action verbs, and 4) academic collaboration to ensure the relevance, accuracy, and measurability of the outcomes.

Key words: sport management, martial art course learning outcomes, course development, student learning, sport management courses

INTRODUCTION
Student learning is an increasingly debated topic across varying academic disciplines, Universities, and educational agencies. The increased focus on student learning will put the demand on faculty and educational administrators to develop, implement, and offer academically robust degree programs that emphasize specific student learning in preparation for the workforce. It is obvious that student learning is relevant in all academic disciplines; however, the sport management academic community has an opportunity to become a front-runner in emphasizing the development of vigorous sport management courses based on specific and measurable course learning outcomes.

RESEARCH METHODS
The intent of this work is to outline the importance, relevance and development of martial art course learning outcomes in sport management courses. In addition, within the scope of this discussion, a review of the effective alignment between student preparation, course content and course learning outcomes will be addressed.
STUDENT LEARNING AND MARTIAL ART COURSE LEARNING OUTCOMES IN HIGHER EDUCATION

According to Peterson, Wittstrom, and Smith (2011) course specific learning objectives and a course effectiveness assessment are essential components in improving student learning. Student learning is based on factors such as identifiable skills, competencies, learning outcomes, and course content. Moreover, these factors are interdependent and must align to enhance student learning on the subject matter in the course (Peterson, Wittstrom, & Smith, 2011). Hammer (2007) includes similar findings and proposes that there is a strong correlation between course outcomes, measuring student competencies, and student learning. Whetten (2007) describes the importance of student learning through the use of specific learning outcomes that identify the elements, concepts, practices, and subject matter to be learned in the course (Whetten, 2007). This is not a random process, but rather a detailed and purposeful attempt to narrow and define precise learning outcomes. Fajardo (2011) includes, “Desired learning outcomes are expressed in terms of competencies and skills that can be applied and evaluated” (p. 18). McNaught, Lam, and Cheng (2012) concur and propose that student learning in higher education should include a focus on outcomes based learning, which includes definite knowledge and abilities. Furthermore, Galbraith, Merrill, and Kline (2011) argue that Universities should take a greater interest in the quality of learning, learning outcomes, and the appropriate assessment of learning outcomes.

Student learning and martial art course learning outcomes in sport management

Even though the literature on martial art course learning outcomes in sport management is lacking, a few scholarly works were identified. Mondello, Andrew, Todd, and Mahony (2008) suggest that sport management courses and curricula must prepare students for the varying occupations in the field. According to Fletcher, Dunn and Prince (2009) the identified skills and competencies for a specific occupation or field in event management should be the foundation for developing post-secondary curriculums. Pierce, Petersen, and Meadows (2011) concur and propose that the post-secondary faculty and institutions offering sport management education are responsible for preparing learners with required occupational competencies based on relevant martial art curriculum development and assessment. Cheng, Fang, Liao and Lin (2013) emphasize the importance of student learning, curriculum content and relevant competencies in the field of sport management. Cheng et al. (2013) includes, From this study, we found that educators should adjust the arrangement of literature and the ways of enhancing students’ fundamental knowledge and skills. In order to make the students in Sports and Leisure related fields competitive, educators should have more discussions and interactions with industry (Cheng et al., 2013, p. 70).

Barcelona and Ross (2004) analyze the importance of course content, curriculum and student preparation for the occupations in sport management. It is argued that there must be a correlation between course development, course delivery, curriculum, student learning, and the career required competencies (Barcelona & Ross, 2004).

Development of martial art course learning outcomes in sport management

The development of course learning outcomes includes several elements. To set the basic direction and purpose of the course specific martial art course learning outcomes the faculty
must ask specific questions. These may include, 1) How many course learning outcomes should be included for a course? 2) How will the course learning outcomes be measured? 3) What type of assessment will be utilized to assess student learning? 4) How will the content in the course learning outcomes represent what the student needs to learn? 5) How will the course learning outcomes be aligned with methods of instruction, instructional practices, and the resources to instruct the course? The answers to these questions vary significantly depending on each institution.

Martial art course learning outcomes define the curriculum structure and content. Furthermore, the curriculum supports the demands of the specific occupational skills and requirements in the field of sport management. To address the questions of student learning, course learning outcomes, and preparing students for a career in the field, the following section will address a suggested process of developing appropriate course learning outcomes in a sport management course. Driscoll and Wood (2007) suggest that the course learning outcomes are the foundation of developing and writing a course. One of the fundamental elements of developing course learning outcomes include the question, What do the students need to learn and know to be prepared for the occupation on the specific topic? This is not a random process, but rather a specific attempt to identify the knowledge, competencies, and abilities related to an occupation (Driscoll & Wood, 2007). These elements can be identified through reviewing sport management job descriptions, professional/accreditation associations’ suggested requirements, and previously published scholarly research.

**Sport management and degree program subject matter**

When analyzing martial art course learning objectives and student learning in sport management it is helpful to review Universities’ sport management degree program offerings and subject matter content. The following review of the University degree programs in sport management is not exhaustive, but general in nature to gain an understanding of the major subject matter areas of study. In Sweden, the sport management degree program offered by the Swedish School of Sport and Health Sciences include subject matter such as leadership, financial management, legal aspects, media, ethics, event management, and social responsibility (GIH Swedish School of Sport and Health Sciences, 2014). In the United States, the University of Michigan sport management program emphasizes financial management, marketing, facility management, legal aspects, research methods, ethics, and organizational strategy and behavior (University of Michigan, 2014). In the United Kingdom, the Coventry University sport management degree includes financial management, leadership in sports organizations, marketing and sponsorships, facilities and event management, legal aspects of sports and media (Coventry University, 2014).

The European University in Geneva, Switzerland, offers an MBA with emphasis in sport management that includes traditional business courses, but also, sport related courses, such as sport marketing, event management, financial management, sponsorships, and management issues in sports (European University, 2014).

Deakin University in Australia provides a degree in business-sport management and include subjects, such as financial management, event management, legal aspects of sports, leadership, marketing, social aspects of sport, and sport performance (Deakin University, 2014). The sport management degree offered by Hanyang University in Korea is inclusive and includes a large number of courses; however, the general direction of the content emphasizes financial and economic elements, sport and culture, leadership in sports, facilities and event management, sociology of sports, sport and consumer behavior, sport business, and marketing (Hanyang University, 2014). The general trends of subject matter included in the various Universities’
degree programs outline content such as financial management and economic elements of sports, leadership and management in sports, legal and ethical aspects of sports, facilities and event management, marketing and sponsorships, social/societal elements of sport. The subject matter and course offerings provide an insight to the content and course requirements when considering course learning objectives in sport management.

**Course learning outcome development: a sample**

Financial management in Sports (the title of the course may vary) is a course offered across the University programs outlined in the previous section. In addition, Mondello, Andrew, Todd, and Mahony (2008) propose that financial management in sports is an important component of sport management curricula. However, it is also suggested that there are varying perceptions and thoughts in the academic community on the content and content delivery in the financial management in sport courses (Mondello et al., 2008). In a later section of this work a sample of course learning outcomes for a financial management in sports course will be described. The reader should be aware that the sample course learning outcomes for the course included in this work are; 1) based on Blooms Taxonomy of Learning, 2) for an undergraduate, graduate level, and PhD course, 3) based on content and subject matter as outlined in Fried, Shapiro, and DeSchriver (2008). This content includes the basics of financial management in sports, such as principles of financial analysis, capital structuring, financial management, profits, and financial troubleshooting (Fried, Shapiro, & DeSchriver, 2008).

It is recognized that the content obtained from Fried, Shapiro, and DeSchriver (2008) may not concur with everyone’s perception or experience of what should be included in a financial management in sport course; the content is simply a guide for potential content. In addition, some institutions do not recognize that a course text or publications function as the basis for the content in the development of course learning outcomes; however, for simplicity purposes of this exercise, it is. It has been proposed that Bloom’s taxonomy of learning is an effective means of developing and supporting student learning and course learning outcomes (Bloom, 1956; Driscoll & Wood, 2007; Hammer, 2007; Morgan et al., 2002; Whetten, 2007). The Bloom’s categories are; knowledge, comprehension, application, analysis, synthesis, and evaluation represent cognitive skills (Driscoll & Wood, 2007). In addition, the Bloom’s taxonomy action verbs, which support the categories of learning, will allow specific application of the cognitive skills (Driscoll & Wood, 2007).

![Figure 1](image_url)

See Figure 1 for Bloom’s taxonomy actions verbs. Thus, the action verbs, when included in the course learning outcomes, represent sets of cognitive skills that support Bloom’s categories of learning. The categories, verbs, and course learning outcomes promote student learning that focus on level of difficulty of course work (Hammer, 2007; Morgan et al., 2002). In essence, the students are required to utilize different types of cognitive skills to the course learning outcomes and course requirements. Hammer (2007, p. 52) includes, “taxonomies allow the classification of cognitive (and other) learning objectives, which in this case are cumulative, with lower order cognitive skills such as the recall of facts being subsumed by comprehension, extrapolation, application, and so on.”
When developing martial art course learning outcomes one can apply the action verbs that one considers relevant to the level of difficulty sought on the specific course content and topic (Driscoll & Wood, 2007; Morgan et al., 2002). The application of the action verbs and level of difficulty assigned may differ between institutions; however, for the purpose of this work, 1) knowledge, comprehension and application relate to undergraduate degree level of difficulty, 2) analysis and synthesis involve graduate level of difficulty, and 3) synthesis and evaluation include PhD level of difficulty. Listed below are sample course learning outcomes with the application of the action verbs for an undergraduate, graduate and PhD level financial management in sport course.

**Undergraduate level course**

The action verbs applied to the course learning outcomes for this undergraduate level course are based on knowledge, comprehension and application levels of difficulty.

Sample Course Learning Outcomes

1. Analyze the financial structures, practices and processes in varying forms of sports organizations.
2. Examine the financial concepts, systems, and statements as related to sport organizations.
3. Compare the concepts and practices of budgeting, financial management, inventory, and production management in relation to managerial roles in sport organizations.
4. Analyze the taxation, legal, and ethical issues involved in the financial management of sport organizations.
Phd level course

The action verbs applied to the course learning outcomes for this PhD level course are based on synthesis and evaluation level of difficulty.

Sample Course Learning Outcomes

1. Design the financial structures, practices and processes in varying forms of sports organizations.

2. Develop the financial concepts, systems, and statements as related to sport organizations.

3. Assess the concepts and practices of budgeting, financial management, inventory, and production management in relation to managerial roles in sport organizations.

4. Evaluate the taxation, legal, and ethical issues involved in the financial management of sport organizations.

5. Compare the current financial trends and issues faced by managers in sports organizations (Fried, Shapiro, & DeSchriver, 2008).

The course learning outcomes for the undergraduate, graduate and PhD level course include the same content; however, the level of difficulty vary based on the application of Bloom’s taxonomy and action verbs. The action verbs and levels of difficulty will require the students to apply different cognitive skills; in addition, there is a progression of applying and utilizing the action verbs. The level of difficulty and expectations of students’ abilities to apply the cognitive skills increase in the varying degree programs (Morgan et al., 2002). It is evident that a few of the action verbs are similar in nature and specific in definition; however, based on the level of each course, each faculty member has expectations related to level of performance, which will influence the actual grading of the student’s work. In other words, faculty discretion will determine the student’s level of performance based on the action verbs.

Challenges to martial art course learning outcome development

Developing and writing outcomes is a specific and purposeful process. It is a structured and proactive endeavor that requires structure and direction in correlation with student learning. There are challenges with developing course learning outcomes. The course outcomes may be too generic in scope, the outcomes may be too narrow in focus on content, there are too many or too few outcomes, faculty bias may influence content, the outcomes may not be measurable, assessments utilized may not align with the intent of the outcomes, the use of the action verbs may be standardized and not related to level of difficulty (DeMeres, 2009; Hammer, 2007). Očigledno je da su neki od aktivnih glagola slični po prirodi i specifični po definiciji; međutim, u odnosu na složenost svakog od stepena, svaki član nastavnog osoblja ima očekivanja koja se odnose na stepen izvođenja, što će utjecati na stvarnu ocjenu rada studenta. Drugim riječima, osoblje po vlastitom nahođenju utvrđuje stepen izvođenja studenta na osnovu aktivnih glagola. Due to the differences between institutional practices and expectations there is not one single answer to address these challenges. Driscoll and Wood (2007) imply that there is not one single answer to identify the correct or right number of outcomes, content or format.

However, Morgan et al., (2002) suggests that the process must be based on sound educational practices. In addition, DeMeres (2009) propose that developing course outcomes is a collaborative effort and requires the insights and critique of several academics to ensure the development of adequate outcomes. Driscoll and Wood (2007) concur and argue that course outcomes is rooted in a collaborative effort and requires a common understanding of the purpose, intent and application of the outcomes.
To address challenges or questions related to the purpose, relevancy, accuracy, and measurability of outcomes, the author of this work suggests a collaborative effort between faculty and administrators. Addressing and answering the following questions as a group of educators will allow for a positive discourse on the development and utilization of course learning outcomes. 1) Is the number of outcomes sufficient or too many? 2) Have we defined how the course learning outcomes will be measured? 3) Is the assessment identified appropriate to assess student learning? 4) Does the content in the course learning outcomes represent what the students need to learn? 5) Do the methods of instruction, instructional practices, and the resources align with and support the intent and purpose of the course learning outcomes?

CONCLUSION

The faculty and educational administrators in sport management are responsible for the development, implementation, and offering of academically robust degree programs that emphasize specific student learning in preparation for the workforce. Included in this process is the development and application of course learning outcomes. The suggested development of martial art course learning outcomes in sport management addressed in this work is rooted in, 1) identifying the specific sport management skills and competencies, 2) course content to support the sport management skills and competencies, 3) assign level of difficulty to sport management course content based on Bloom’s taxonomy and action verbs, and 4) academic collaboration to ensure the relevance, accuracy, and measurability of the outcomes. It is important to recognize that there is not one single method or process to write or develop course learning outcomes. However, the academic community in sport management has an opportunity to take the lead in emphasizing the development of robust sport management courses based on specific and measurable course learning outcomes.

REFERENCES


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DIFFERENCES IN MANIFESTATION OF PEAK TORQUE OF THIGH MUSCULATURE AT DIFFERENT ANGULAR VELOCITIES IN KARATE ATHLETES

Abstract

The main goal of this research was to determine differences in manifestation of peak torque of agonist and antagonist muscles of the thigh, at different angular velocities in karate athletes of different age groups, as well as to determine unilateral (hamstring/quadriceps) and bilateral relationships (left/right leg) based on these values. Potential muscle imbalance around the knee area and between the left and right leg is determined via unilateral and bilateral relationships. Several studies showed that the reduced strength relationship between the hamstring and the quadriceps muscle results in an increased rate and incidence of the lower leg injuries, such as rupture of anterior cruciate ligament (ACL), overuse syndrome, hamstring strains and tears. The testing was performed on an isokinetic dynamometer, which consisted the evaluation of peak torque of the quadriceps and hamstring muscles at velocities of 60°/s and 180°/s, for both concentric and eccentric muscle actions. The sample size consisted of 28 karate athletes, separated into tri age groups: cadet, junior and senior. The results of this research showed that for both concentric and eccentric muscle actions statistically significant differences (p≤0,05) between variables of maximal torque development of knee flexors and knee extensor muscles at different angular velocities within all age groups are present. At the velocity of 180°/s values of peak torque were smaller. As regards to the unilateral relationship, it was determined that statistically significant differences are present at different speeds across all age groups. Greater values were obtained at velocities of 180°/s. No significant differences were noticed between bilateral relationships at different velocities within all age groups. The values of unilateral relationship among this age group ranged from 50% to 80%, which according to the commonly accepted criteria doesn’t sort them in a group of athletes with increased injury risk. On the other hand, the values of bilateral relationship among some age groups surpassed the limit of 10% which was taken as a reference point. Therefore, it was recommended to these athletes to undertake certain precautionary measures in order to correct this difference.

Key words: karate athletes; isokinetic; peak torque; bilateral relationship; unilateral relationship;

INTRODUCTION

Karate or karatedo (jap. Empty hand, or more precisely the way of the empty hand) is a martial art which originated in Japan. In a literal translation „kara“ means empty, „te“ means hand or fist, thus an empty hand, or how to defend, or to fight „without using weapons“ (Chaabene et al., 2012). As a sport discipline karate demands a high level of technical skills and proficiency, precise movement control in both static and dynamic conditions, along with the capability of executing techniques (blocks, hits, strikes, sweeps, undertakes, false actions, tricks etc.) in the shortest amount of time (Wilk et al., 1983; Sorensen et al., 1996; Zehr et al., 1997; Mori et al., 2002). In order to efficiently and successfully participate in this martial art, an athlete must possess highly developed aerobic and anaerobic capacities, as well as a high level of explosive strength, reaction speed and a satisfactory strength level. Nowadays, karate is one of the most massively participated individual sports which consists of two competition disciplines: forms (katas) and sport battle (kumite) (Koropanovski et al., 2011).
Manifestation of peak torque of the upper thigh musculature in karate athletes was measured via the isokinetic dynamometer. Isokinetic represent a method of engaging muscles in an active motion during which constant speed is chosen, while the resistance is automatically adjusted. As opposed to isometric exercises, in which the speed and resistance remain unchanged, and isotonic exercises, in which the velocity varies, and the resistance remains constant, in isokinetic exercises movement is performed under constant velocity (dynamic speed, 1-300°/s) with adjustable resistance. Isokinetic method is used in both diagnostic (evaluation) and rehabilitation purposes. Isokinetic devices provide conditions for athletes to develop maximal force in full range of motion (ROM) whilst at the same time adjusting and accommodating resistance according to pain sensations or fatigue occurrence. Therefore, the occurrence of overloading the muscle or joint structures is avoided (Drid et al., 2009). Isokinetic testing devices are used for evaluating the current conditions of the locomotion system, by quantitatively testing the strength levels of selected muscle groups under different movement velocities. During the testing process of extremities, slower velocities are most commonly used for measuring the maximal strength capabilities, and on the other hand greater velocities are used (with greater number of repetitions) for determining muscle endurance capabilities.

It is possible to obtain the following parameters when using isokinetic testing method: strength capabilities of certain selected muscle groups, strength relationship between agonists and antagonists, bilateral comparison of the same muscle groups, the amount of total work, muscle endurance expressed via the fatigue index, range of motion for the tested joint etc.

Testing on an isokinetic dynamometer included both the flexor and extensor muscles of the knee joint at velocities of 60°/s and 180°/s, in both concentric and eccentric muscle regimes. One of the basic parameters which was used in this research paper was the peak torque. Peak torque (Nm) represents maximal value of rotational force developed during measured movement at certain angular velocity (Jaric, 2002). Based on this parameter differences between karate athletes at different angular velocities were determined, so that potential muscle imbalance around the knee joint could be determined. Muscle imbalance around the knee joint has been previously addresses in several studies which have shown that a reduced strength relationship between knee flexors and extensors results in increased incidence of lower limb injuries, such as ACL ruptures, overuse syndrome, hamstring strains and ruptures, etc. (Knapik et al., 1991; Aagaard et al., 1998). This is determined via the unilateral relationship. Data obtained from the isokinetic dynamometer present a very valuable piece of information for both the coach and the athlete, because it ensures precise planning of the training process, as well as preventing a great number of injuries at the same time.

Unilateral relationship, i.e. relationship between flexor and extensor muscles of the knee joint is considered a relatively good indicator of normal – physiological strength balance of antagonist muscles of the knee joint, but it greatly depends on the velocities at which isokinetic testing is performed. For lower testing velocities (0°/s – 60°/s) it amounts to 50%-60% depending on the participants and the testing device used. Unilateral relationships (agonist/antagonist) of upper thigh musculature are most commonly termed in the literature as “H/Q ratio”. Relationship between agonists and antagonists may point to weakness of certain muscles group. “Conventional” relationship is the most commonly described relationship in the literature and it is calculated by dividing values of peak torque of concentric hamstring contraction by the value of peak torque of the concentric quadriceps contraction (H/Q_{CONV}). However it is believed that the “functional” relationship (H/Q_{FUNC}) is more relevant. In order to calculate the functional relationship, relationship of the values of peak torque of eccentric hamstring contraction need to be divided by concentric quadriceps muscle peak torque. That way the relative capability of the hamstring muscle to function in an eccentric contraction and therefore function as knee stabilizer is estimated, which is a situation that occurs very frequently across a wide spectrum of sport activities (Ayala et al., 2012). Most authors use 50% and 80% as reference values for conventional relationship between knee flexors and extensors (Andrade et al., 2012). According to Ayala et al. functional relationship between hamstring and quadriceps muscles which is less than 0.6, increases the chance of suffering from a hamstring injury seventeen fold. Functional relationship from 0.7 to 1 is accepted as sufficient for maintaining dynamic stability and integrity. 1 to 1 (1:1) relationship has been accepted as a reference value.

As for the bilateral relationship, one of the studies defined musculoskeletal abnormalities as bilateral imbalance of strength of the quadriceps muscle and hamstring muscle that is greater than 10%
On the other hand, Knappik et al. have defined the bilateral relationships between hamstring and quadriceps muscles as all values greater than 15%.

Skaton-Silva et al., (2012) in their research of estimating muscle efficiency of dominant and non-dominant extremities obtained results that the imbalance between agonists and antagonists (for knee and elbow joints) is less than 10%, therefore the group of authors concluded that daily karate practice doesn’t lead to bilateral asymmetry which may result in increased injury incidence of neither the lower limbs nor the upper limbs. Probst et al., (2007) have researched flexibility and strength levels of the lower limbs (muscle balance of agonist and antagonists) and knee stability during the execution of specific leg karate techniques, with assumption that additional overload of the leg musculature will result in negative outcomes during the performance of karate specific techniques, stances, and movements, as well as in an increased risk of knee injury. The authors concluded that karate training process resulted in significant improvements in strength levels of the quadriceps muscle and to in a decreased time to the onset of muscle contraction without concomitant and accompanying risk of knee injury. The authors also found that certain aspects of karate training process, such as the frontal direct kick (jap. Mae-Geri), can be implemented as part of other sports, especially in those sports where a high level of quadriceps strength is required with a concomitant short time until the onset of muscular activity. The results of these research studies benefit the well-known fact that all four extremities are included within karate training process. The results of flexibility tests between the control group and the karate group, which evaluated flexion, extension of the knee joint, hip joint and ankle joint, as well as their rotational capabilities, showed that the flexibility presents a very important component of many sports, and to karate sport as well (due to great amplitudes of Jodan kicks). However, the most surprising fact is that within the same research study, the results obtained for the flexibility levels of the lower limbs, and especially of the hamstring muscles, of the karate group were worse compared to the same results of the control group.

The problem of research presents an analysis of differences in manifestation of peak torque of the upper lower limb musculature at different angular velocities in karate athletes. The object of research was the manifestation of peak torque of the upper thigh musculature in karate athletes. The main goal research was to determine differences in manifestation of peak torque of the agonist and antagonist muscles of the upper thigh musculature, at different angular velocities in karate athletes of different age, and based on these results to calculate unilateral (hamstring/quadriceps) and bilateral relationships (left/right leg). On the foundations of the main goal, partial goals have also been devised:

1. To determine the unilateral relationship differences (hamstring/quadriceps), at different angular velocities in the manifestation of peak torque of the upper thigh musculature in karate athletes of different age.

2. To determine the bilateral relationship differences (left/right leg) at different angular velocities in the manifestation of peak torque of the upper thigh musculature in karate athletes of different age.

METHOD

The sample size consisted of n=28 karate athletes, of cadet, junior and senior age. They were divided into three groups: 9 senior karate athletes (24,1 ± 3,72 years); 9 junior karate athletes (17,6 ± 0,84 years); 10 cadet karate athletes (15,85 ± 0,69 years); All participants were competitive athletes, winners of international and state level championships. All tests were carried out within the ethical rules and guidelines and each participant has been presented with a clear and thorough explanation of the testing procedure, potential dangers and benefits as well as expected outcomes of the testing process.

For testing isokinetic strength levels of the hamstring and quadriceps musculature a HUMAN NORM isokinetic dynamometer was used. The device was recalibrated before each testing procedure. The device recorded the following values: peak torque, peak torque expressed as percentage of the total body mass, maximal work and total work expressed as percentage of total body mass. The same procedure was carried out for both left and right legs (Madsem et al., 1996; Gleeson et al., 1996). The range of motion (ROM) of the tested lower leg limb was 90 degrees. The same person carried out the instruction process before testing and during the testing process.
The following isokinetic parameters have been used in this research study:

- Peak torque of concentric muscular contraction of knee extensors of the right leg (CE-R);
- Peak torque of concentric muscular contraction of knee extensors of the left leg (CE-L);
- Peak torque of concentric muscular contraction of knee flexors of the right leg (CF-R);
- Peak torque of concentric muscular contraction of knee flexors of the left leg (CF-L);
- Peak torque of eccentric muscular contraction of knee flexors of the right leg (EF-R);
- Peak torque of eccentric muscular contraction of knee flexors of the left leg (EF-L);
- Bilateral relationship of extensors left and right legs (CE-L/CE-R);
- Bilateral relationship of flexors left and right legs (CF-L/CF-R);
- Conventional relationship between flexors and extensors of the right leg (H/QCONV-R)
- Conventional relationship between flexors and extensors of the left leg (H/QCONV-L)
- Functional relationship between flexors and extensors of the right leg (H/QFUNC-R)
- Functional relationship between flexors and extensors of the left leg (H/QFUNC-L).

In order to test and measure the strength levels of knee flexors and extensors, after a standardized warm up, the participants sat on an isokinetic dynamometer. In order to get familiarized with the testing protocol each participant performed up to three trials, which should have been 50%, 70% and 90% of their maximal effort. The ROM has been set to 90°. Standardized protocol was used: each leg was tested four times (maximal effort) at angular velocities of 60°/s and 180°/s (extension and flexion) (Drid et al., 2009). In order to eliminate any negative side effects of fatigue the participant were given adequate rest time between sets (>2 min.). The testing device recorded the following variables during the testing procedure: peak torque, peak torque expressed as percentage of body mass, maximal work output and total work expressed as percentage of body mass. The same procedure was carried out for both left and right legs (Madsen et al., 1996; Gleeson et al., 1996).

For data analysis and data processing IBM Statistical package for Social Science (SPSS) [version 20.0] was used. Univariate analysis of variance (ANOVA) was used to determine whether statistically significant differences exist in manifestation of peak torque at different angular velocities in karate athletes of different age. Paired-Samples T test was used to determine differences in manifestation of peak torque in karate athletes performed at different angular velocities. The level of statistical significance has been set at \( p \leq 0.05 \).

RESULTS

Results of peak torque of upper thigh musculature at angular velocity of 60°/s for karate athletes of different age groups are shown in Table 1. Based on the results obtained through the Kolmogorov-Smirnov test it was concluded that there are not statistically significant deviations from a normal distribution, which in further analysis of data allow the use of parametric techniques. Based on the results in Table 1. it can be concluded that within the first six variables of peak torque there is a statistically significant difference between karate athletes of different age groups \( (p \leq 0.05) \). The differences between age groups were calculated via the “LSD Post hoc” method. There is a statistically significant difference within the first six variables among karate senior athletes and karate cadet athletes, in favor for seniors. As far as the relationship between seniors and juniors a statistically significant difference exists in variable of peak torque for concentric muscular contraction of right upper thigh extensor muscles (CE-L) as well as in the variable of peak torque for a concentric contraction of right upper thigh flexor muscles (CF-R). Seniors obtained better average results. In comparison between cadets and juniors a statistically significant difference exists within the first six variables and it goes favor of juniors.

Among the variables that refer to bilateral, unilateral and functional relationship no statistically significant difference has been observed between groups, except for bilateral relationship variable of left leg flexor muscles (CF-L/CF-R) between cadets and juniors. Cadets possess a greater asymmetry level.
Table 1. Univariate analysis of variance between variables among different karate athlete’s age groups, at angular velocity of 60°/s.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cadets</th>
<th>Juniors</th>
<th>Seniors</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS±SD</td>
<td>AS±SD</td>
<td>AS±SD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE-R</td>
<td>147.80±37.16</td>
<td>188.78±30.57</td>
<td>212.78±34.53</td>
<td>8.757</td>
<td>0.001</td>
</tr>
<tr>
<td>CE-L</td>
<td>137.90±34.48</td>
<td>183.00±37.58</td>
<td>215.78±35.59</td>
<td>11.333</td>
<td>0.000</td>
</tr>
<tr>
<td>CE-L/CE-R</td>
<td>7.33±±3.63</td>
<td>7.33±±3.63</td>
<td>7.33±±3.63</td>
<td>6.85±±3.63</td>
<td>0.001</td>
</tr>
<tr>
<td>CF-R</td>
<td>98.60±26.04</td>
<td>126.67±9.34</td>
<td>145.67±22.65</td>
<td>12.258</td>
<td>0.000</td>
</tr>
<tr>
<td>CF-L</td>
<td>137.90±34.48</td>
<td>183.00±37.58</td>
<td>215.78±35.59</td>
<td>11.333</td>
<td>0.000</td>
</tr>
<tr>
<td>CF-L/CF-R</td>
<td>8,757</td>
<td>0,001</td>
<td>8,757</td>
<td>0,001</td>
<td></td>
</tr>
</tbody>
</table>

Legend: *aa – statistically significant difference (p≤0,05) compared to cadets; *bb – statistically significant difference (p≤0,05) compared to juniors; *cc – statistically significant difference (p≤0,05) compared to seniors.

Results of peak torque of upper thigh musculature at angular velocity of 180°/s for karate athletes of different age groups are shown in Table 2. Based on the results obtained through the Kolmogorov-Smirnov test it was concluded that there are no statistically significant deviations from a normal distribution, which in further analysis of data allow the use of parametric techniques. Based on the results in Table 2, it can be seen that out of six variables that refer to manifestation of peak torque, only in variable of peak torque in eccentric contraction of the right upper thigh musculature (EF-R) a statistically significant difference among groups is not present. There is a statistically significant difference within the first six variables among karate senior athletes and karate cadet athletes, in favor for seniors. Between cadets and juniors a statistically significant difference is present in variables of peak torque of extensor muscles in concentric contraction of both legs (CE-R, CE-L), peak torque of flexors in a concentric contraction of both legs (CF-R, CF-R) and in peak torque of flexors muscles in an eccentric contraction of the left leg (EF-L). The difference goes in favor of juniors. There are no statistically significant differences between juniors and cadets in the variable of peak torque of flexors muscles in eccentric contraction of the right leg (EF-R). There are no statistically significant differences between seniors and cadets in the first six variables.

There are no statistically significant differences in variables of bilateral, unilateral and functional relationships across all groups.

Table 2. Univariate analysis of variance between variables among different karate athlete’s age groups, at angular velocity of 180°/s.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cadets</th>
<th>Juniors</th>
<th>Seniors</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS±SD</td>
<td>AS±SD</td>
<td>AS±SD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE-R</td>
<td>119.30±23.77</td>
<td>144.00±22.77</td>
<td>159.22±59.54</td>
<td>7.237</td>
<td>0.003</td>
</tr>
<tr>
<td>CE-L</td>
<td>114.50±31.01</td>
<td>165.11±37.05</td>
<td>176.11±64.28</td>
<td>4.930</td>
<td>0.016</td>
</tr>
<tr>
<td>CE-R/CE-L</td>
<td>7.23±±5.63</td>
<td>7.23±±5.63</td>
<td>7.23±±5.63</td>
<td>7.237</td>
<td>0.003</td>
</tr>
<tr>
<td>CF-R/CF-L</td>
<td>9.94±6.52</td>
<td>4.81±6.10</td>
<td>9.48±7.73</td>
<td>1.599</td>
<td>0.222</td>
</tr>
<tr>
<td>CF-R/CF-L</td>
<td>9.94±6.52</td>
<td>4.81±6.10</td>
<td>9.48±7.73</td>
<td>1.599</td>
<td>0.222</td>
</tr>
</tbody>
</table>

Legend: *aa – statistically significant difference (p≤0,05) compared to cadets; *bb – statistically significant difference (p≤0,05) compared to juniors; *cc – statistically significant difference (p≤0,05) compared to seniors.
Differences between variables at angular velocities of 60°/s and 180°/s among cadets, junior and seniors is depicted separately in Tables (3,4,5). The same trend of statistical significance appears across all three tables and across all the age groups. Based on p values it can be seen that among the first six variables of peak torque manifestation a statistically significant difference is present among the first four variables, during peak torque of flexors and extensors in concentric contraction of both legs (CE-R, CE-L, CF-R, CF-L). Greater differences are obtained at angular velocity of 60°/s. There are no statistically significant differences among variables of peak torque manifestation of flexor muscles in eccentric contraction (EF-R, EF-L).

Table 3. Significance of differences between velocities of 60°/s and 180°/s in cadets

<table>
<thead>
<tr>
<th>Variables</th>
<th>AS₁±SD₁</th>
<th>AS₂±SD₂</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE-R</td>
<td>147.80±37.16</td>
<td>98.30±22.70</td>
<td>9.142</td>
<td>0.000</td>
</tr>
<tr>
<td>CE-L</td>
<td>137.90±34.48</td>
<td>94.10±22.69</td>
<td>9.073</td>
<td>0.000</td>
</tr>
<tr>
<td>CF-R</td>
<td>98.60±26.04</td>
<td>75.60±16.12</td>
<td>4.993</td>
<td>0.001</td>
</tr>
<tr>
<td>CF-L</td>
<td>89.70±25.34</td>
<td>73.20±15.85</td>
<td>4.337</td>
<td>0.002</td>
</tr>
<tr>
<td>EF-R</td>
<td>109.60±25.62</td>
<td>119.30±23.77</td>
<td>-1.851</td>
<td>0.097</td>
</tr>
<tr>
<td>EF-L</td>
<td>103.90±23.48</td>
<td>114.50±31.01</td>
<td>-1.636</td>
<td>0.136</td>
</tr>
<tr>
<td>CE-R/CE-L (%)</td>
<td>10.08±7.92</td>
<td>9.13±5.65</td>
<td>0.346</td>
<td>0.737</td>
</tr>
<tr>
<td>CF-R/CF-L (%)</td>
<td>13.15±9.84</td>
<td>9.94±6.52</td>
<td>0.829</td>
<td>0.429</td>
</tr>
<tr>
<td>H/QCONV-R (%)</td>
<td>66.93±8.31</td>
<td>77.44±6.28</td>
<td>-8.241</td>
<td>0.000</td>
</tr>
<tr>
<td>H/QCONV-L (%)</td>
<td>65.18±8.48</td>
<td>78.91±10.20</td>
<td>-5.697</td>
<td>0.000</td>
</tr>
<tr>
<td>H/QFUNC-R (%)</td>
<td>76.63±17.61</td>
<td>123.83±21.68</td>
<td>-11.472</td>
<td>0.000</td>
</tr>
<tr>
<td>H/QFUNC-L (%)</td>
<td>78.10±17.22</td>
<td>123.72±23.50</td>
<td>-7.616</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Table 4. Significance of differences between velocities of 60°/s and 180°/s in juniors

<table>
<thead>
<tr>
<th>Variables</th>
<th>AS₁±SD₁</th>
<th>AS₂±SD₂</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE-R</td>
<td>188.78±10.57</td>
<td>118.67±21.89</td>
<td>10.479</td>
<td>0.000</td>
</tr>
<tr>
<td>CE-L</td>
<td>183.00±13.58</td>
<td>122.78±16.12</td>
<td>6.104</td>
<td>0.000</td>
</tr>
<tr>
<td>CF-R</td>
<td>126.67±9.34</td>
<td>90.78±10.94</td>
<td>9.694</td>
<td>0.000</td>
</tr>
<tr>
<td>CF-L</td>
<td>125.33±13.96</td>
<td>94.89±11.37</td>
<td>7.934</td>
<td>0.000</td>
</tr>
<tr>
<td>EF-R</td>
<td>150.78±33.38</td>
<td>144.00±32.77</td>
<td>0.547</td>
<td>0.599</td>
</tr>
<tr>
<td>EF-L</td>
<td>156.11±25.56</td>
<td>165.11±37.05</td>
<td>-1.715</td>
<td>0.125</td>
</tr>
<tr>
<td>CE-D/CE-L (%)</td>
<td>10.73±9.25</td>
<td>7.23±5.63</td>
<td>1.214</td>
<td>0.259</td>
</tr>
<tr>
<td>CF-D/CF-L (%)</td>
<td>5.81±5.52</td>
<td>4.81±6.10</td>
<td>0.360</td>
<td>0.728</td>
</tr>
<tr>
<td>H/QCONV-R (%)</td>
<td>68.68±12.68</td>
<td>78.40±15.16</td>
<td>-3.145</td>
<td>0.014</td>
</tr>
<tr>
<td>H/QCONV-L (%)</td>
<td>70.13±10.90</td>
<td>78.30±12.11</td>
<td>-2.750</td>
<td>0.025</td>
</tr>
<tr>
<td>H/QFUNC-R (%)</td>
<td>81.00±18.48</td>
<td>122.95±27.48</td>
<td>-3.802</td>
<td>0.005</td>
</tr>
<tr>
<td>H/QFUNC-L (%)</td>
<td>86.88±13.95</td>
<td>135.27±27.11</td>
<td>-5.876</td>
<td>0.000</td>
</tr>
</tbody>
</table>

As far as percent values are concerned, there are no statistically significant differences in variables of bilateral relationship of flexors and extensors of both legs (CE-L/CE-R, CF-L/CF-R). However a statistically significant difference is present for variables of unilateral (H/QCONV-R, HQCONV-L) and functional relationship of both legs (H/QFUNC-R, H/QFUNC-L). Greater percent values are obtained at angular velocity of 180°/s.
Table 5. Significance of differences between velocities of 60°/s and 180°/s in seniors

<table>
<thead>
<tr>
<th>Variables</th>
<th>$AS_1 \pm SD_1$</th>
<th>$AS_2 \pm SD_2$</th>
<th>$t$</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE-R</td>
<td>212.78±34.53</td>
<td>137.11±20.270</td>
<td>13.079</td>
<td>0.000</td>
</tr>
<tr>
<td>CE-L</td>
<td>215.78±35.59</td>
<td>133.89±23.640</td>
<td>14.417</td>
<td>0.000</td>
</tr>
<tr>
<td>CF-R</td>
<td>145.67±22.65</td>
<td>102.33±16.06</td>
<td>8.955</td>
<td>0.000</td>
</tr>
<tr>
<td>CF-L</td>
<td>143.44±34.27</td>
<td>102.44±23.30</td>
<td>8.398</td>
<td>0.000</td>
</tr>
<tr>
<td>EF-R</td>
<td>165.67±49.23</td>
<td>159.22±59.54</td>
<td>0.479</td>
<td>0.645</td>
</tr>
<tr>
<td>EF-L</td>
<td>175.11±52.82</td>
<td>176.11±64.28</td>
<td>-0.061</td>
<td>0.953</td>
</tr>
<tr>
<td>CE-R/CE-L</td>
<td>7.33±6.63</td>
<td>7.82±5.97</td>
<td>0.191</td>
<td>0.854</td>
</tr>
<tr>
<td>CF-R/CF-L</td>
<td>11.20±6.50</td>
<td>9.48±7.73</td>
<td>0.556</td>
<td>0.593</td>
</tr>
<tr>
<td>H/QCONV-R (%)</td>
<td>68.85±7.00</td>
<td>74.87±8.21</td>
<td>-2.331</td>
<td>0.048</td>
</tr>
<tr>
<td>H/QCONV-L</td>
<td>66.59±12.02</td>
<td>76.64±11.57</td>
<td>-4.662</td>
<td>0.002</td>
</tr>
<tr>
<td>H/QFUNC-R</td>
<td>77.21±17.99</td>
<td>116.16±40.90</td>
<td>-3.339</td>
<td>0.010</td>
</tr>
<tr>
<td>H/QFUNC-L</td>
<td>79.88±16.76</td>
<td>131.02±45.59</td>
<td>-3.610</td>
<td>0.007</td>
</tr>
</tbody>
</table>

DISCUSSION

In the past years testing on an isokinetic dynamometer has become the most prevalent and dominant method of evaluating muscular imbalances between agonists and antagonists as well as between different legs. Data obtained in this manner presents a remarkably relevant and useful information for both athletes and coaches, because it provides precise planning of the training process, and it also contributes to a decreased rate of sport injuries, which present the biggest danger of today’s sport. Isokinetic testing should be carried out multiple times throughout the year in different phases of the training cycle. This way, based on obtained results, training process can be geared towards specifically aimed strength improvements and strengthening of weak areas (better success rate in certain sport).

Based on the results obtained in this study, it can be concluded that statistically significant differences in manifestation of peak torque in karate athletes of different ages at angular velocity of 60°/s and 180°/s are present. The biggest differences are between senior and cadet age groups, which was expected due to the big age difference, and therefore the value of peak torque manifestation in all six variables, at both angular velocities is statistically greater in favor of seniors. A similar situation is present between juniors and cadets where in all six variables at angular velocity of 60°/s the value of peak torque manifestation is statistically greater in juniors, while at angular velocity of 180°/s this is the case in four out of six variables. Reason for such discrepancy may lie in the reason that cadets haven’t reached full maturity and a sensitive period for development of maximal strength is still ahead of them, which according to Guzhalowski occurs between ages 16 and 18. Between seniors and juniors, statistically significant differences are present in smaller number of variables, which tells us that their results are pretty similar.

For all six variables that are connected to peak torque manifestation across all age groups a statistically significant differences is present for both flexors and extensors at different angular velocities. Peak torque values at smaller velocities (60°/s) are greater, while on the other hand at greater velocities (180°/s) values of peak torque are smaller. This rule of thumb is as well-known as the Hill’s curve. This is corroborated with findings from Daneshjoo et al. (2013) and Kofotils et al. (2007).

Bilateral relationship has been defined in one of the studies as imbalance between two legs that is greater than 10 (Rahnama et al., 2005). Of course, same muscle groups are compared (extensors to extensors, flexors with flexors). Estimation of bilateral strength asymmetry in muscles of the lower limb is of great value and importance, due to its adequate use for injury prevention and due to the performance manifested in competitions. In this research paper bilateral asymmetry values obtained at angular velocities of 60°/s usually surpass 10%, which has been taken as a reference value. On the other hand, bilateral asymmetry values at extensor and flexor muscles obtained at angular velocities of 180°/s are usually below 10%. This velocity is closer to velocities experienced in competition, and is therefore more relevant compared to velocity of 60°/s. Of course a precise percent line cannot be drawn, and therefore certain precautions should be undertaken in order to correct this imbalance. For imbalance correction Drid et al., (2009) recommend proprioception training modality.
Unilateral relationship between agonists and antagonists is used for examining functional capabilities of knee stability and muscle balance between hamstrings and quadriceps across different movements (Aagaard et al., 1998). If hamstring muscle is too weak, an increased possibility of injury of the ACL is present, because they have a synergistic function in stabilizing the knee joint and keeping its structural and functional integrity. Two different relationships should be distinguished, and these are conventional and functional relationships.

The most described relationship within the literature is definitely the “conventional” relationship, which is calculated by dividing value of peak concentric hamstring torque with the value of peak concentric quadriceps torque (H/QCONV). For reference values of conventional relationship between hamstring and quadriceps muscles most authors take values of 50% to 80%. (Andrade et al., 2012). In this research, values for conventional relationship at velocities of 60°/s are 67.66%±9.8%, while for velocity of 180°/s they are 7.46%±10.53%. These values are well within normal range, meaning that this groups of karate athletes, according to this parameter doesn’t have an increased likelihood of injury occurrence. These results have also been obtained by Probst et al., (2007).

When conventional relationship is compared between different angular velocities, statistically significant differences are present across all age groups. Values of conventional relationship are greater at velocities of 180°/s than at 60°/s. These results match the results obtained by Hewett et al. (2008). They believe that this occurs because as the velocity of motion increases during seated, open-chain isokinetic activity, the forward momentum of the tibia increases to a point where increased hamstrings recruitment is required to limit both extension rotation and anterior translation of the joint. Therefore, as angular velocity increases men tend to increase peak torque levels of hamstring muscles, in order to stabilize the joint and guard the ACL. The interesting fact is that this doesn’t happen in women and the potential reasons for this, authors believe are differences in stature and development between men and women. Therefore, as speed of movement increases women are to a far greater degree exposed to injuries of this sort.

However, it is believed that “functional” relationship (H/QFUNC) is of much greater importance. In order to calculate functional relationship, the relationship of peak torque values of eccentric muscular contraction of the hamstring muscles is divided by concentric values of peak torque of the quadriceps muscle. This way, relative capability of the hamstring muscle to function in eccentric regime is estimated, and also in this way it stabilizes the knee joint, which is a very frequently occurring situation in many sport related activities. If the reference values of the functional relationship between hamstrings and quadriceps muscle fall below 60%, the risk of an injury occurrence increases seventeen fold. Functional relationship between 70% and 100% has been accepted as adequate for dynamic stability. 1:1 relationship has been accepted as reference value. (Ayala et al., 2012). In this research the functional relationship values at velocity of 60°/s was 9.86%±31.05%, which puts this group of karate athletes in a population with sufficient dynamic stability. At velocities of 180°/s results are far greater, and are as follows: 125.43%±31.05% and clearly show that even at greater velocities karate athletes do not have an increased risk of injury which may occur due muscular imbalances. This type of values are obtained across all age groups.

Certain authors suggest a screening process of both conventional and functional relationships of strength levels during the off-season in healthy athletes in order to identify athletes who are in greater risk of suffering from an injury of the lower limbs during the training process and competition (Croisier, 2004).

CONCLUSION

The first analysis of differences has determined that statistically significant differences are present in the manifestation of maximal torque across all age groups of karate athletes at different angular velocities. Peak torque values are greater at lower angular velocities, while these values are lower at higher angular velocities. This fact is known as the Hills law.

The second analysis of differences has shown a presence of statistically significant differences in unilateral relationship at different angular velocities across all age groups of karate athletes. This was confirmed for both conventional and functional relationships. At both velocities results are within the range of reference values from 50% to 80% for conventional relationship. Results for functional relationship are within reference ranges as well.
Third analyses has determined that there are no statistical differences in bilateral relationship at different angular velocities in any of the examined age groups. As for the results, they surpass the limit of 10% in certain age groups, which we took as a reference value, and therefore we recommend that certain measures should be undertaken in order to correct this.

Finally conclusion of this research is that karate athletes do not have any significant unilateral asymmetries, and therefore do not have an increased risk of suffering from sport injuries such as ACL rupture, hamstring strains and tears, nor from the overuse syndrome. On the other hand, certain values of bilateral relationship which surpass 10% in certain age groups are calling for caution. These differences should be carefully treated, and Drid et al., (2009) recommend proprioceptive training as the best solution.

**REFERENCES**


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DIFFERENCES IN MOTOR ABILITIES OF BASKETBALL AND FOOTBALL CADET SELECTION

Summary

This research was conducted in order to determine the current level of motor skills of basketball players selected in the cadet representation of Bosnia and Herzegovina and the football cadets of the School of Football "Olimp" from Pale who play in the cantonal league of BiH, as well as the differences between the two groups of respondents. The research included basketball players from the best basketball clubs from the Republic of Srpska and the Federation of Bosnia and Herzegovina. The total sample of the respondents is 16 selected basketball players and 12 selected players. After statistical data processing, the results of the study showed that there are statistically significant differences in all motor skills between the two groups of subjects. The results of the cadet basketball team of BiH are compared with the cadet selection of OKK Zvezda and cadets of lower rank of the competition. Comparative inspection of the results of the cadets of BiH with the selection of the combined cadet and junior selection of OKK Zvezda found that the results at a similar level ie, that they do not differ, while the difference between cadets of BiH and cadets of the lower rank of the competition is statistically significant.

Key words: motor skills, basketball players, football players, differences

INTRODUCTION

Cadets are called young men aged 14 to 16, and this is the period of middle age, the period of puberty and adolescence. In this period, growth and development are slower. Growth in height slows down, and growth grows in width, and the body proportions are equalized. Grafting is nearing completion, muscle tone increases, functional muscle properties become similar to the characteristics of an adult person. The heart muscle becomes stronger, decreasing the discrepancy between the mass and the volume of the heart. The balance in the development of individual organs and organic systems is established. In this period, the foreseen model of football and basketball games should be adopted in the most basic elements. In physical preparation, the work is focused on the development of motor and functional abilities, especially those whose sensitive phases are in progress (speed, coordination, balance). Aerobic and anaerobic endurance are developing, and the development of endurance in speed and strength begins.

When it comes to the topic of this paper which analyzes the aptness and speed of young basketball players and footballers and research on this topic, we have consulted some similar works, for example, Jukić et al. (2003) report that one player on average jumps 30 to 65 times
during a single match. Ercul et al. (2004) quotes Gorjan's findings that jumps of both legs are dominant in basketball and are used in 86% of cases. One-off jumps, according to Gorjan's results, are used in 14% of cases. Jump up from the legs of both legs is used mainly after a shot from the opponent or after a free throw from the opponent, in the event of a jump from the spot and attempts to block the shot (Erčulj et al., 2004).

A jump with both legs from a snap to two contacts is a jump performance in a specific way, characteristic of basketball, although a similar jump technique is used in football when switching to a duel game with head-to-head strokes. The basic characteristics of this jump are: one step ahead, mostly in advance; drawing the other leg into the jump position only when the leg with which the spike was made has reached contact with the ground; reflects both legs after attracting the other leg and making contact with the ground with the other leg. The advantage of this jump is good jump control and a bit longer preparation time for the jump that allows the situation to be assessed. The main drawback of this jump is quitting a reactive muscular contraction. This type of jump is used after a shot from the game or after a free throw, in the case of a jump of shot, attempts to block the shot and after the referee's failure (Erčulj et al., 2004). A jump high with both legs from a snap in one contact is another, for a basketball very characteristic jump up. In football it is used in golman techniques as well as in a duel game at break. Its basic properties are: Running with one foot in a shot, mostly in advance; attracting the other leg already during the flight phase to the position of the spin-throw; simultaneously making contact with the ground with both feet just before the jump up; jump up immediately after reaching both legs simultaneously. The advantage of this jump is the use of reflex muscular contraction and, therefore, a somewhat stronger jump up. The disadvantage of this jump is that due to the very short phase of contact with the ground before the jump is high, slightly weaker control of the jump (balance) and lack of time to assess the situation. Practically, the situation must be assessed before starting the preliminary rebound in advance. This type of jump is mainly used in the case of a jump for a ball after a previously failed jump, a jump for a ball after a missed shot under the basket, in case of a jump of jumps and jumps in order to arrive in the possession of the ball after a halting stop (Erčulj et al., 2004). Jump with one foot from running is used in basketball when shooting after a break, or when jumping right after running (Erčulj et al., 2004). In football, this kind of jump technique is used for head-to-head scrambling.

Similar research was conducted by Fratric and Starovlah (2008) in the work of the difference in the functional and motor skills of young footballers, basketball players and volleyball players, Vukotić and Mušović (2011) in the work of the difference in motor and functional abilities for football players and handball players aged 13 to 15 years.

The subject of this paper is the motor skills of the basketball cadet representation of Bosnia and Herzegovina and the selected footballers who perform in the cantonal league of BiH.

The aim of the research was to determine the differences between footballers and cadet cadets.

**METHOD OF WORK**

**Sample respondents**

The sample of the respondents consisted of 16 basketball players from the cadet national team of Bosnia and Herzegovina and 12 cadets playing in the cantonal league of Bosnia and Herzegovina. All respondents are in the training process for at least five years and the tests, which form an integral part of any more serious plan and program of work, have been done voluntarily.

**Sample variables**

The choice of variables was based on the object and purpose of the research. For the assessment of the motor skills of these selected basketball players and cadet footballers in
in this study, five tests of motor skills and three specific test capabilities were used. The following areas were tested:

- Acceleration at 20 m expressed in squares.
- Speed of change of direction and direction of movement expressed in scandals.
- Speed of change of direction and direction of movement with aspects of aerobic endurance expressed in scandals.
- Maximum height when jumping in height expressed in centimeters.
- The maximum height of the ordinary jump upwards after the spike in two contacts expressed in centimeters.
- The maximum height of the ordinary jump upwards after the spike in one contact expressed in centimeters.
- The maximum jumping height is one, with dominant legs up from the run expressed in centimeters.

The test battery is made up of standardized tests that were used in earlier research into the energetic and motor skills of athletes. The applied tests are divided into the group Basic tests and group Specific tests: M 20-running with 20m high start, TT-T test, K-kamikaze, ST-Vertical jump - Sardžent test, MSDM-Jump in long, SK2-Jump up from the nasa in two contacts, SK1-Jump up from the slip in one contact, SZ-Jump up one leg from the run.

Tips and instructions given to respondents

Instructions for carrying out basic tests are common and standard and as for instructions for specific tests, all three tests are explained as an element of basketball game. Considering that the Jump jumps up from one of the two injuries in one or two contacts and jumps up one foot from the run, frequent basketball moves, respondents are told to jump naturally, that is, as during the game itself, while the footballers needed a little more repetition for reasons of less use of this structure of movement and jumping during the football game itself and, consequently, a lesser level of training in this way of preparation for jumping, because the technique in football is not limited and related to the rules of the game, as is the case in basketball. In relation to the test Jump up from the nascent to the two contacts, it is noted that one step is made first with a leg, and then after drawing the other leg, the jump is higher with the use of a swinging arm. It was noted that every respondent himself chooses with his foot to make a step forward, depending on the style, or individual habits. In relation to the test Jump up from the back of one contact, the respondents noted that the test is performed with both legs at the same time, and then the jump is performed higher and lower. In relation to the test Jump up with one leg from the start it was noted that the reflection is performed after a few steps of the run. The run was performed at an angle of about 40° with respect to the frontline of the terrain. Attention has been paid to the possibility of using a swing leg during the reflection.

RESULTS AND DISCUSSION

Basic statistical parameters

Table 1 shows the descriptive statistical parameters of the motor skills of basketball cadet selection in Bosnia and Herzegovina.

Table 1. Descriptive statistical parameters of motor skills of cadet basketball
Table 2 presents the descriptive statistical parameters of the motor skills of the football team cadet selection of the School of Football "Olimp".

By inspecting the above tables 1 and 2, based on the asymmetry value (Skew.) and flattening (Kurt.) distribution curve results, one can conclude that the results of all motor abilities are normally distributed, which is the basic precondition for further statistical analysis for determining the differences in motor skills between the above groups.

Negative values of the scans (measures of the Gaussian curve asymmetry) indicate that the result distribution curve is negatively acceptable asymmetric, i.e. inclined to the side of better results, as in this case, we have two tests in basketball, a jump with one leg out of run (SZ) and T test (MTT), and in three tests with the football player, T test (MTT), kamikaze test (MKAM) and Sardine test (MSAR). Positive values of the scans indicate that the distribution result curve is inclined to the side of the worse results we have in all other variables. The kamikaze test (MKAM) has a value of over ± 1, indicating a significant distribution asymmetry for basketball players. Negative values of kurtosis (Gaussian curve homogeneity measure) we have in the T test, (MTT), a jump higher by one leg from the run (SZ) and long jump (MSDM) in the basketball player, and in most of the variables in the soccer players pointing to the platonic curve, that is, the results in these tests are heterogeneous, i.e. have reduced distribution homogeneity. In other variables, the positive values of kurtosis indicate that this is a significant leptocorticity or homogeneity.
Students t-test

After calculating the arithmetic meanings of all motor and situational motor skills using the Student's T-test for independent samples, the difference of parameters between the cadets that were previously divided into two groups, external and internal players, was calculated.

Table 3. Differences in the motor skills of basketball players and soccer players

<table>
<thead>
<tr>
<th>Varijabla</th>
<th>Mean košarkaši</th>
<th>Mean fudbaleri</th>
<th>t-value</th>
<th>Df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>M20</td>
<td>3,25</td>
<td>3,05</td>
<td>2,85</td>
<td>26</td>
<td>0,00</td>
</tr>
<tr>
<td>MTT</td>
<td>10,20</td>
<td>9,89</td>
<td>2,09</td>
<td>26</td>
<td>0,04</td>
</tr>
<tr>
<td>MKAM</td>
<td>29,77</td>
<td>26,60</td>
<td>4,11</td>
<td>26</td>
<td>0,00</td>
</tr>
<tr>
<td>MSAR</td>
<td>52,62</td>
<td>45,40</td>
<td>2,70</td>
<td>26</td>
<td>0,01</td>
</tr>
<tr>
<td>SZ</td>
<td>71,25</td>
<td>61,20</td>
<td>3,02</td>
<td>26</td>
<td>0,00</td>
</tr>
<tr>
<td>MSDM</td>
<td>237,93</td>
<td>224,00</td>
<td>2,34</td>
<td>26</td>
<td>0,02</td>
</tr>
<tr>
<td>SK1</td>
<td>50,06</td>
<td>45,60</td>
<td>2,17</td>
<td>26</td>
<td>0,04</td>
</tr>
<tr>
<td>SK2</td>
<td>54,00</td>
<td>46,20</td>
<td>4,07</td>
<td>26</td>
<td>0,00</td>
</tr>
</tbody>
</table>

Legend: Mean basketball players - the arithmetic mean of the basketball team; Mean footballers - the arithmetic mean of a group of footballers; t value - the value of the t-test coefficient for testing the significance of the differences; Df - degrees of freedom; p is the coefficient of significance of differences in arithmetic meanings.

Inspection of Table 3. where the results of the Student T-test for the calculation of differences between basketball players and footballers in motor skills are presented, shows that there is a statistically significant difference in all variables. We can conclude that cadet footballers have achieved better results than cadets in cadets in speed, agility and anaerobic endurance tests, while basketball players have achieved better results in all skip tests.

Table 4. Discrimination analysis

<table>
<thead>
<tr>
<th>Eigen-val</th>
<th>Canonical-R</th>
<th>Wilk's-Lambda</th>
<th>Chi-Sqr</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>4,75</td>
<td>0,90</td>
<td>0,17</td>
<td>37,78</td>
<td>8,00</td>
</tr>
</tbody>
</table>

Table 4 shows the results of a discriminatory analysis that determined a statistically significant difference (p=0.00) among the respondents who deal with various sports games, basketball and football.

CONCLUSION

The obtained results of the differences between footballers and basketball players showed statistically significant differences in favor of the basketball players of the cadet team of BiH when it comes to tests that measured hockey and explosiveness, and in favor of the footballers when it comes to the areas of agility, speed and anaerobic endurance. Significant differences have been established between the groups of footballers and basketball players in all three specific pop-up tests (SZ, S2K and S1K). Basketball players achieved better results in all three tests compared to football players. It turned out that, after analyzing the results, using these three specific tests or using one of them, certain differences in the quality of the motor space can be diagnosed, depending on the sport the respondents are dealing with. From this research we can see that footballers had better results in tests for speed and agility tests that could be expected with regard to their constitution and the training process they underwent. By the fact that football is not one of the most important things in football, it gives the players more agility and agility, so the results in these tests are better. In the basketball player we can
see that they showed better results in the tests of explosive power of the lower limbs, which was expected by the fact that in this sport jumps are used as one of the main characteristics for achieving the best result, and they are very important for individual statistics of basketball players. This research can contribute to better monitoring, planning and programming of basketball or football training by serving as a comparison with a similar study in the area of motor skills, and in addition it can be repeated on the same sample of respondents and see if there is progress or stagnation in the space of motor skills. The data obtained by this research can also be useful in terms of individual tracking of footballers and basketball players, determining their current form and predicting results.

LITERATURE
5. Gogić, D. (2017) Differences in the level of development of motor skills of footballers and basketball players aged 16 years, Faculty of Sport and Physical Education in Nikšić

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ANTHROPOLOGICAL DIMENSIONS QUANTITATIVE CHANGES UNDER THE INFLUENCE OF MORPHOLOGICAL ABILITIES IN ATHLETES

Abstract
Morphological anthropometry is important for selection of candidates for a particular sport or discipline, monitoring and evaluation of the training process, objective evaluation of the overall development and control of the nutritional status of children athletes and fitness enthusiasts. The sample of respondents was 54 secondary schools in Banja Luka, aged 15 years covered by the regular physical education and additional trainer work for the development of strength and agility within the Sports Association for the Physical Education School. All subjects involved in the experiment were healthy as determined by a medical examination before and after the experiment. The sample of variables for morphological capability makes the dimensions: circular dimensions of the skeleton and the body mass as follows: average thorax in cm, the thigh stretched legs in cm, the maximum extent of the leg in cm, mass of the object in gr. Subcutaneously adipose tissue and that the thickness of abdominal skin folds in mm, the thickness of thigh skin folds in mm, the thickness of the skin fold of the lower leg in mm. Suggested model sample of the anthropometric measures for the assessment of the morphological characteristics is applied according to the instructions of the International biological program (IBP). Results of canonical discriminative features indicate that in the final compared to the initial measurement with the experimental group there was a statistically significant change ability. Set morphological hypotheses were confirmed.

Key words: Anthropology, athletes, students, morphological skills

INTRODUCTION
It is believed gray latent structure of morphological characteristics consists of four dimensions. (Kurelic.2005). Faktor longitudinal dimension of the skeleton is responsible for the growth of bone in the body length. In during growth and development of certain parts of the body follow different curve, reaches its maximum at the different points. Faktor transversal dimension of skeleton responsible for bone growth in width. Faktor circular dimensions and mass of the body responsible for the overall weight and volume of the body and is defined predominantly weight. Faktor subcutaneous adipose tissue shows the total amount of fat in the body.

It is very important to have information on the structure and development of morphological dimension because of the possibility transformation. Maximum transformation is possible in subcutaneous adipose tissue, followed by a body volume is very low or negligible at the longitudinal and transverse dimensions of the skeleton.

Morphological anthropometry is important for selection of candidates for a particular sport or discipline, monitoring and evaluation of the training process, the lens evaluating the overall development and control of the nutritional status of children athletes and fitness enthusiasts.
METHOD
The sample of respondents was 54 secondary schools in Banja Luka, aged 15 years covered by the regular physical education and additional trainer work for the development of strength and agility within the sports association for physical culture school. All respondents involved in the experiment were healthy as determined by a medical examination before and after the experiment.

The aim of the research was that in addition to the regular physical education classes, and determine the impact of motor power and agility to additional classes to the abilities of morphological changes at subject. Set the following tasks: establish initial state morphological skills-students, to determine the final status of morphological abilities of students and identify differences between initial and final state of the morphologic and functional abilities pupils. Set the following hypotheses: there are no statistically significant change in the results of morphological ability to final measurement in relation to the state of the respondents initial. The sample of variables for morphological capability makes the dimensions: circular dimensions of the skeleton and the body mass as follows: average thorax in cm, the thigh stretched legs in cm, the maximum extent of the leg in the body weight in cm. Subcutaneously adipose tissue and that the thickness of the leather folds of abdomen in mm, the thickness of thigh skin folds in mm, the thickness of the skin fold of the lower leg in mm. The proposed model sample of the anthropometric measures for the assessment of the morphological characteristics is applied according to the instructions of the International biological program (IBP).

RESULTS AND DISCUSSION
Basic statistical parameters of the respondents to assess the morphological characteristics of the initial measurement

Table 1

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Min</th>
<th>Max</th>
<th>SD</th>
<th>Skewn</th>
<th>Kurtos</th>
</tr>
</thead>
<tbody>
<tr>
<td>AOGKŠ</td>
<td>54</td>
<td>82.14</td>
<td>76.00</td>
<td>87.00</td>
<td>1.35</td>
<td>0.588</td>
<td>-1.553</td>
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<tr>
<td>AOBUT</td>
<td>54</td>
<td>54.25</td>
<td>48.00</td>
<td>59.00</td>
<td>4.66</td>
<td>0.352</td>
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</tr>
<tr>
<td>AOPTK</td>
<td>54</td>
<td>34.57</td>
<td>29.00</td>
<td>38.00</td>
<td>3.42</td>
<td>0.389</td>
<td>1.814</td>
</tr>
<tr>
<td>AMAST</td>
<td>54</td>
<td>58.62</td>
<td>50.00</td>
<td>64.64</td>
<td>6.49</td>
<td>0.258</td>
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<td>16.76</td>
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<td>AKNBU</td>
<td>54</td>
<td>13.14</td>
<td>9.00</td>
<td>16.00</td>
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<tr>
<td>AKNPK</td>
<td>54</td>
<td>10.84</td>
<td>7.00</td>
<td>14.00</td>
<td>4.96</td>
<td>0.369</td>
<td>0.648</td>
</tr>
</tbody>
</table>

Legend: AOGKS-average thorax, AOBut-the thigh-stretched leg, AOPTK-maximum volume of the leg, the weight of the body-AMAST, AKNTR-skinfold thickness of the abdomen, thickness ACNB-thigh skin folds, AKNPK-skinfold thickness of the lower leg

Results shown in Table 1 in patients at the initial measure in morphologic characteristics, the initial measurement point that there is no statistical difference between the results of significance subjects than normal distribution. Results tests used to assess the morphological characteristics indicate that the distribution is positive. To is confirmed by the asymmetry of distribution (skunis) which does not exceed 1:00 which means that tests were not heavy (up to +1.00) and no light (up to -1.00), but correspond to subject population and results below are one. The homogeneity (kurtosis) indicates that there is present that is present as good sensitivity were obtained values below 2.75. The results of morphological characteristics do not depart from the results of similar studies of proven by us in this population of subjects, there by enabling the application of the processing method of multivariate results in this research. General results in the population from which the sample is derived of these subjects is the time one surf on.
Table 2. Basic statistical parameters of the respondents to assess the morphological characteristics of the final measurement

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Min</th>
<th>Max</th>
<th>SD</th>
<th>Skewn</th>
<th>Kurtos</th>
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<td>AOGKŠ</td>
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<td>-0.300</td>
</tr>
<tr>
<td>AOBUT</td>
<td>54</td>
<td>57.46</td>
<td>50.00</td>
<td>60.00</td>
<td>1.65</td>
<td>0.162</td>
<td>0.055</td>
</tr>
<tr>
<td>AOPTK</td>
<td>54</td>
<td>38.15</td>
<td>30.00</td>
<td>40.00</td>
<td>6.40</td>
<td>0.263</td>
<td>0.636</td>
</tr>
<tr>
<td>AMAST</td>
<td>54</td>
<td>60.31</td>
<td>52.00</td>
<td>65.00</td>
<td>0.15</td>
<td>0.251</td>
<td>0.903</td>
</tr>
<tr>
<td>AKNTR</td>
<td>54</td>
<td>13.64</td>
<td>9.00</td>
<td>17.00</td>
<td>8.52</td>
<td>0.773</td>
<td>1.802</td>
</tr>
<tr>
<td>AKNBU</td>
<td>54</td>
<td>10.52</td>
<td>8.00</td>
<td>15.00</td>
<td>6.89</td>
<td>0.345</td>
<td>0.544</td>
</tr>
<tr>
<td>AKNPK</td>
<td>54</td>
<td>8.11</td>
<td>6.00</td>
<td>13.00</td>
<td>4.45</td>
<td>0.855</td>
<td>0.148</td>
</tr>
</tbody>
</table>

Legend: AOGKŠ-average thorax, aobut the thigh-stretched leg, AOPTK-maximum volume of the leg, the weight of the body-AMAST, AKNTR-skinfold thickness of the abdomen, thickness ACNB-thigh skin folds, AKNPK-skinfold thickness of the lower leg

The obtained results in the Table 2 in subjects in the morphological characteristics, the final measurements indicate that no statistically significant difference between the results from the normal patients distribution. Results tests which evaluated morphological characteristics of the patients indicate that the distribution positive. To is confirmed by the asymmetry of distribution (skjunis) which do not exceeds 1.00 a this means that tests were not heavy (up to +1.00), no light (up to -1.00), but correspond to the population of research and below are one. The homogeneity result (kurosis) indicates that there is present a good sensitivity (discrimative tests), since the obtained values below 2.75. The results of morphological characteristics do not differ from the results of similar studies verified by us on this population of patients.

Analysis of the difference between the initial and final measurements of subjects examined by t-test

Table 3. Significance mean difference of the initial and final measurements of the morphological characteristics of the respondents

<table>
<thead>
<tr>
<th></th>
<th>Mean(i)</th>
<th>Mean(f)</th>
<th>t-value</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>AOGKŠ</td>
<td>82.14</td>
<td>86.75</td>
<td>2.73</td>
<td>.018</td>
</tr>
<tr>
<td>AOBUT</td>
<td>54.25</td>
<td>57.46</td>
<td>3.09</td>
<td>.008</td>
</tr>
<tr>
<td>AOPTK</td>
<td>34.57</td>
<td>38.15</td>
<td>3.83</td>
<td>.005</td>
</tr>
<tr>
<td>AMAST</td>
<td>58.62</td>
<td>60.31</td>
<td>2.76</td>
<td>.017</td>
</tr>
<tr>
<td>AKNTR</td>
<td>16.76</td>
<td>13.64</td>
<td>2.73</td>
<td>.018</td>
</tr>
<tr>
<td>AKNBU</td>
<td>13.14</td>
<td>10.52</td>
<td>3.48</td>
<td>.001</td>
</tr>
<tr>
<td>AKNPK</td>
<td>10.84</td>
<td>8.11</td>
<td>2.69</td>
<td>.022</td>
</tr>
</tbody>
</table>

Table 3 contains the results of the t-test morphological characteristics between the initial and final measure. After obtained result it is concluded that there is a statistically significant difference between the volume of the thorax (AOGKŠ .018) of the volume of the lower leg(AOPTK .005), the mass of the body (AMAST .017) abdominal skinfold (AKNTR .018), skin folds of the thighs (ACNB .001), and the leg skin weapons (AKNPK .022).

Differences between initial and final state of the morphological characteristics of the respondents abilities.

Table 4. Significance isolated discriminant function of the morphological characteristics of the respondents

<table>
<thead>
<tr>
<th>Disk.Funkc.</th>
<th>Eigenvalue</th>
<th>Cannoniel R</th>
<th>Wilks Lambda</th>
<th>Chi-Sqr.</th>
<th>df</th>
<th>P-Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.922</td>
<td>0.65</td>
<td>0.421</td>
<td>56.89</td>
<td>7</td>
<td>.035</td>
</tr>
</tbody>
</table>
We have obtained one discriminant function medium of high intensity (CR = 65%), which indicates in which the correlated set of data upon which analysis is performed discriminative obtained results. Results discriminant strength anthropological measures of the given test-Wilks Lambda .421, indicating that the difference between the initial and final measurement in space morphological characteristics important because the size Hi square test has a high value.

Table 5. The factor structure isolated discriminant function

<table>
<thead>
<tr>
<th>Antropomere</th>
<th>Root 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>AKNBU</td>
<td>0.525</td>
</tr>
<tr>
<td>AOBUT</td>
<td>0.499</td>
</tr>
<tr>
<td>AOPTK</td>
<td>-0.489</td>
</tr>
<tr>
<td>AMAST</td>
<td>-0.356</td>
</tr>
<tr>
<td>AKTR</td>
<td>0.125</td>
</tr>
<tr>
<td>AOGKŠ</td>
<td>0.100</td>
</tr>
<tr>
<td>AKNPT</td>
<td>0.056</td>
</tr>
</tbody>
</table>

Legend: AOGKŠ-average thorax, aobut the thigh-stretched leg, AOPTK-maximum volume of the leg, the weight of the body-AMAST, Akntr-skinfold thickness of the abdomen, thickness ACNB-thigh skin folds, AKNPK-skinfold thickness of the lower leg

Table 5 presents the structure of the discriminant measure anthropologicical function is participation in the formation of the morphological characteristics of the discriminant functions of significant. Show centroids represent the arithmetic mean of the result of the initial and final measure. In order to verify the significance of differences between the initial and final measurements of subjects, and the efficiency of program contents of regular classes education and experimental model motor power and agility measured seven anthropometric measures that are supposed to be good predictors space. Show study results indicate that the largest contribution to the discriminant function with anthropometric measures, skin fold thighs (AKNB 0.525) and the thigh (aobut 0499).

Table 5. Centroid measurements

<table>
<thead>
<tr>
<th>Measure</th>
<th>Root 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td>1.856</td>
</tr>
<tr>
<td>final</td>
<td>-1.856</td>
</tr>
</tbody>
</table>

Results in Table 5 represent the discriminant function of the centroid of all on the basis of anthropometric dimensions equal to 1.856 and - the measurement of the centroid 1.856. Significance shown which was tested the significance of the discriminant function indicates that their distance (a statistically significant discrimination).

Table 6.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Initial</th>
<th>final</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td>45</td>
<td>9</td>
<td>54</td>
</tr>
<tr>
<td>Final</td>
<td>11</td>
<td>43</td>
<td>54</td>
</tr>
<tr>
<td>Initial</td>
<td>83,33%</td>
<td>16,67%</td>
<td>100%</td>
</tr>
<tr>
<td>final</td>
<td>20,38%</td>
<td>79,62%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Separation of the groups shown in table 6 as percentiles indicates that the separation of committed (discrimination) explains results from 81.48% (mean percent of the groups) of the canonical correlation coefficient which is CR = 65%.

The results of discriminant analysis of morphological characteristics in the final compared to the initial measurement indicates that under the influence of programs of regular physical
education teaching and experimental models of motor strength and agility there was a statistically significant change in morphological space subjects.

CONCLUSION
The sample of respondents was 54 secondary schools in Banja Luka, aged 15 years covered by the regular physical education and additional trainer work for the development of strength and agility within the Sports Association for the Physical Education School. All subjects involved in the experiment were healthy as determined by a medical examination before and after the experiment.

The aim of the research was that in addition to the regular physical education classes, and determine the influence of morphological abilities and strength and agility to additional classes on morphological changes in abilities of respondents.
Set the following tasks: establish initial state morphological skills-students, to determine the final status of morphological abilities of students and to determine the changes between the initial and final state in the space of morphological abilities of students.

Set the following hypothesis: there are significant changes in the results of morphological abilities of the final measurement in relation to initial state subjects.
Were determined following conclusions:
Results of canonical discriminative features indicate that in the final compared to the initial measurement with the experimental group there was a statistically significant change abilities. Set morphological hypotheses were confirmed.
Using T test and canonical discriminant analysis has been shown that the subjects students involved in additional training operation in the sports association for physical culture in the school and regular physical education a statistically significant difference in the morphological abilities of the students included merely PE classes. Past experiences suggest and confirm that school physical education does not reach a level that corresponds to the capabilities, needs and abilities of students and suggests that school physical education insufficiently affect the physical abilities of students, and that the results are not satisfactory. One of the important factors bkoji characterized by modern technology of teaching physical education and training is certainly the fact that the optimal level of morphological abilities of school children covered by a regular physical education can not develop and maintain a proper relative anthropological characteristics.

Results of morphological abilities of respondents have practical value for:
- Quality methodical design training work on the development of morphological abilities
- selection and guidance of gifted children for a particular sport or discipline
- monitoring and evaluation of the training process of morphological abilities of
- planning work program for the development of strength and agility and ability of the individual characteristics of the respondents.

The research results can serve as a basis for future research that would include other anthropological characteristics and therefore it would be received and harder information about the transformation process antrolpoloških morphological characteristics under the influence and abilities of agility in young athletes.
REFERENCES
2. Kurelic et al. (1975). *Structure and development of morphological and motor dimensions younger*. Institut for scientific research. Belgrade: Faculty of Physical Education
6. Przulj, D. (2010). Differences in motor ability of the morphological characteristics between students and athletes and no athletes. *Sport and health, scientific journal in the field of sport and physical education*, Pale: Faculty of Physical Education and Sport

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COMPARATIVE ANALYSIS OF MOTOR SKILLS OF SECONDARY SCHOOL FIRST GRADE PUPILS BY APPLICATION OF EUROFIT BATTERY TESTS

Summary

Seven tests from Eurofit battery were applied on the sample of 30 boys of the first grade of the Banja Luka High School, age 15 years +/- 6 months, and 28 students of the first grade of the Secondary Technical School in Gradiška. The aim of this research is to use Eurofit to determine the differences in the motor skills of first-grade pupils between two secondary schools for the purpose of assessing their current motor status and further programming of work based on the results obtained. The results showed that long-range jumping tests and abs exercises in 30 seconds gave the most discriminating results between two schools. It can also be argued that High School pupils had better results in most tests.

Key words: pupils, motor skills, Eurofit battery tests.

1. INTRODUCTION

The problem of choosing the method, content and organization of training work is a continuing interest in research, and in recent years extensive research at home and abroad have been conducted in order to make organized physical activity contribute to the optimal development of anthropological characteristics of both sexes at all ages, regardless of their abilities and qualities. Human abilities and qualities can be developed most successfully in the so-called "sensitive stages". Most of authors agrees with this (Stojanović 1987; Matvejev 2000; Spame and Caetzee (2002); Višnjić, Jovanović and Miletić, (2004), indicating that these are the periods of ontogenesis when most significant rate of development of certain skills and characteristics of individuals is achieved based on the natural laws, including also increase of adaptive capabilities and creation of especially favorable conditions for the formation of certain motor skills. That is why in recent years there has been increased interest to involve children and adolescents in sports activity because the process of growing up, according to some researchers (Aoron et al. 1995; Drabik 1996; Markus et al. 2000; Malacko 2002; Stewart et al., 2004; cited in Batrićević, 2008) is particularly sensitive to the possibility of expressing negative impact. Up to the eighties different battery tests were used in Europe when testing motor skills of children and young people. One of them, which may have been most systematically developed and used in the study „Leuven Longitudinal Study of Belgian boys“ in Belgium, served as the basis for the creation of EUROFIT battery tests (Malina & Katzmarzyk, 2006, according to the Council of Europe, Committee for the Development of Sport: European Test of Physical Fitness, 1988). In cooperation with several European countries, "The Eurofit Physical Fitness Test Battery" was created as a standardized test battery recommended by the Council of Europe (Council of Europe, Committee for the
Development of Sport: European test of physical fitness) for the evaluation of physical development and motoring ability of children of school age. The idea for this battery originated in 1987, with the desire to create a battery of tests that would be easy to use, economical and applicable in different school settings, and that it contains the tests which are standardized, so that the results can be compared across Europe.

2.RESEARCH METHODOLOGY
The sample consists of 30 first-grade boys from Banja Luka High School, ages 15 years + / _ 6 months, and 28 first-grade pupils from the secondary technical school in Gradiška. Methods used in this paper have a quality and quantitative approach. Namely, quality approach implies description and observation, and quantitative implies measurement and testing. The sample of variables in this paper represents the motor skills to assess speed, agility, explosive strength, repetitive strength, flexibility and muscle endurance. Assessment of motor abilities of pupils included application of EUROFIT battery of tests i.e. a group of motor tasks that are considered to bear the relevant information on motor skills of respondents. The EUROFIT tests battery (Eurofit, 1993), prescribed by the Committee for the Development of Sport of the Council of Europe, is a set of nine simple tests that relate to flexibility, strength, endurance and power. The standardized test battery was proposed by the Council of Europe as an effective tool for monitoring the condition of school children and has been used in many schools around the world since 1988.

The following tests were used:
1. Flamingo test
2. Plate tapping
3. Sit and reach
4. Standing broad jump
5. Handgrip test – dynamometry
6. Sit-ups in 30 seconds (abdominal)
7. Bent arm hang
8. 20 m endurance shuttle-run
9. 10x5 meter shuttle run

3. RESEARCH RESULTS
Table 1. Results of descriptive statistics between the first grade of two secondary schools

<table>
<thead>
<tr>
<th></th>
<th>FLB</th>
<th>BL High School</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>28</td>
<td>30</td>
<td>58</td>
</tr>
<tr>
<td>Mean</td>
<td>19.263</td>
<td>19.401</td>
<td>19.334</td>
</tr>
<tr>
<td>Std.</td>
<td>2.892</td>
<td>2.988</td>
<td>2.901</td>
</tr>
<tr>
<td>Dev</td>
<td>.546</td>
<td>.545</td>
<td>.546</td>
</tr>
<tr>
<td>Std. Er</td>
<td>18.141</td>
<td>18.285</td>
<td>18.17</td>
</tr>
<tr>
<td>Lower</td>
<td>20.385</td>
<td>20.517</td>
<td>20.102</td>
</tr>
<tr>
<td>Upper</td>
<td>15.04</td>
<td>15.25</td>
<td>15.04</td>
</tr>
<tr>
<td>Min</td>
<td>25.00</td>
<td>25.22</td>
<td>25.22</td>
</tr>
<tr>
<td>Max</td>
<td></td>
<td></td>
<td>25.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>PLT</th>
<th>BL High School</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>28</td>
<td>30</td>
<td>58</td>
</tr>
<tr>
<td>Mean</td>
<td>11.867</td>
<td>11.174</td>
<td>11.509</td>
</tr>
<tr>
<td>Std.</td>
<td>1.372</td>
<td>1.442</td>
<td>1.439</td>
</tr>
<tr>
<td>Dev</td>
<td>.259</td>
<td>.263</td>
<td>.189</td>
</tr>
<tr>
<td>Std. Er</td>
<td>11.335</td>
<td>10.636</td>
<td>11.130</td>
</tr>
<tr>
<td>Lower</td>
<td>12.399</td>
<td>11.713</td>
<td>11.887</td>
</tr>
<tr>
<td>Upper</td>
<td>9.52</td>
<td>8.35</td>
<td>8.35</td>
</tr>
<tr>
<td>Min</td>
<td>15.80</td>
<td>16.29</td>
<td>16.29</td>
</tr>
<tr>
<td>Max</td>
<td></td>
<td></td>
<td>16.29</td>
</tr>
</tbody>
</table>
### Table 2. Analysis of the variance between the two groups of a first-grade of secondary schools

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squar</th>
<th>MeanSquar</th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BetweenGroups</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FLB</td>
<td>.275</td>
<td>.275</td>
<td>1</td>
<td>.032</td>
<td>.859</td>
</tr>
<tr>
<td></td>
<td>WithinGroups</td>
<td>484.965</td>
<td>56</td>
<td>8.660</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>485.240</td>
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</tr>
<tr>
<td>PLT</td>
<td>6.952</td>
<td>6.952</td>
<td>1</td>
<td>3.500</td>
<td>.067</td>
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<tr>
<td></td>
<td>WithinGroups</td>
<td>111.219</td>
<td>56</td>
<td>1.986</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>118.171</td>
<td>57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAR</td>
<td>17.906</td>
<td>17.906</td>
<td>1</td>
<td>.667</td>
<td>.418</td>
</tr>
<tr>
<td></td>
<td>WithinGroups</td>
<td>1503.974</td>
<td>56</td>
<td>26.857</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1521.879</td>
<td>57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBJ</td>
<td>.614</td>
<td>.614</td>
<td>1</td>
<td>9.106</td>
<td>.004</td>
</tr>
<tr>
<td></td>
<td>WithinGroups</td>
<td>3.779</td>
<td>56</td>
<td>.067</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>4.393</td>
<td>57</td>
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<tr>
<td>SUP</td>
<td>113.352</td>
<td>113.352</td>
<td>1</td>
<td>12.031</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>WithinGroups</td>
<td>527.631</td>
<td>56</td>
<td>9.422</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>640.983</td>
<td>57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BAH</td>
<td>2.510</td>
<td>2.510</td>
<td>1</td>
<td>.024</td>
<td>.879</td>
</tr>
</tbody>
</table>

### Notes
- **FLB**: Physiological Limitation of Breath
- **PLT**: Physical Limitation of Time
- **SAR**: Sensitivity to Altitude
- **SBJ**: Sensitivity to Barometric Pressure
- **SUP**: Sensitivity to Uniform Pressure
- **BAH**: Sensitivity to Barometric Height
Table 2 shows the results of the one-factor analysis of variances with the first-grade pupils from the High School in Banjaluka and first-grade pupils from the secondary Technical School in Gradiška. Based on the results, it is evident that the statistically significant difference between the two schools has appeared in variables of standing broad jump and sit-ups for 30 seconds, while in other variables the difference is not statistically significant. There is a significant difference in athletic disciplines given that a large number of students from High School go in for athletics.

Table 3. Factor structure of discriminant functions matrix

<table>
<thead>
<tr>
<th>Function</th>
<th>.692</th>
<th>.602</th>
<th>-.373</th>
<th>.163</th>
<th>.036</th>
<th>.031</th>
<th>.014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sit-ups in 30 seconds</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standing broad jump</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plate tapping</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sit and reach</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flamingo test</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bent arm hang</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10x5 meter shuttle run</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3 shows that in terms of discriminatory function the difference in motor abilities is mostly affected by tests of repetitive strength and explosive power. It can also be seen that other tests have less influence on the discriminant function. The intensity of differences between these groups is examined by the canonical correlation value. The closer this value is to zero the closer the group centroids are to each other (less difference between groups) and vice versa.
4. DISCUSSION

Looking at the descriptive parameters /Table 1/, it is noticeable that in the majority of variables, high school pupils from the High School in Banja Luka achieved better results. It can be assumed that such a relationship arose due to the fact that in this class a greater number of pupils had a higher quality selection in terms of motor skills. Also, pupils in Banja Luka have more accessible sports facilities that can influence the manifestation of motor skills. It can be assumed that the morphological characteristics are one of the factors that could affect the results, because this is a puberty period where morphologically dominant children have an advantage in the manifestation of motor abilities, i.e. the maturity biological factor can be crucial. Biological growth and development of children takes place according to certain laws. Secondary school age is the period of intensive growth and development of children of both
sexes. Since the children are in the stage of accelerated development, the influence of the outer environment is increased. Physical education is a basic organizational exogenous factor affecting the children development changes (Gojković, 2010). It is therefore necessary to measure, monitor and correct the anthropometric characteristics during the teaching process. The beginnings of research of anthropometric characteristics, particularly by foreign authors, mostly relate to the factor structure (until later, except for the factor structure, here were studies of relations, differences and development of anthropometric characteristics (Momirović et al, 1969; N. Viskić - Štalec, 1974; and Kurelić et al, 1975; A. Hošek and B. Jeričević, 1982; Radovanović et al., 1998; Ivanović, 2002; T. Krsmanović and Radosav, 2008).

Radulović and Krivokapić (2013) state that morphological indicators of physical development, nutrition status and structure of the body composition of fourteen year old boys and girls in Montenegro have satisfactory values in relation to the standards of growth and development and peers from some European countries. Above the average body height and body weight characterize both sexes, whereby the proportion of fat component is quite low, especially in boys, so that 3-6% of respondents with overweight are registered, while about 1% of respondents are classified as obese. In relation to the criteria and orientational values of motor skills for the given age followed by the eurofit battery tests, and by comparing these values with peers from other countries, boys have achieved average, and girls below average results. An exception is the motor skills that are largely genetically determined (the speed of alternative movements and explosive force) that had above average values with the boys, and generally average values with the girls. Montenegro, Serbia, Belgium, Spain, Slovakia, Lithuania, Estonia, Albania (Radulović and Krivokapić, 2013). Compared to the mentioned countries, the results of this study are somewhat weaker, although this is a small sample compared to research carried out in these countries.

By analyzing the obtained results, it is necessary to analyze the school curriculum and the way teachers conduct it, as this could certainly be a discriminant factor in the achieved results of children in both schools. It is always assumed that children are trained for this kind of testing, their motivation, or exogenous and endogenous factors that can influence the testing. A higher level of motor and functional abilities of athletes compared to non-sportsmen can be attributed to endogenous factors, and predominantly exogenous, i.e. transformational processes in sports clubs and the physical education in relation to non-sportsmen, which were covered only by physical education (Batričević, 2008).

By analysis of the variance it was determined that statistically significant differences occurred between tests of standing board jump and sit-ups in 30 seconds, and as we have stated in favor of the High School in Banja Luka. On the basis of age and tests in which there is a significant difference between schools, it can be assumed that students from the High School are biologically more mature and more involved in sports, which has resulted in significantly better results in tests of explosive strength and muscular endurance, or repetitive force. Branković et al. (2012) found a significant influence of morphological characteristics on the performance of repetitive force. It is obvious that the pupils of the Banja Luka High Schoo, or the tested class, were physically more dominant in relation to their peers from Gradiška, and thus we can conclude that these children had previously entered puberty, where the boy started to have secretion of testosterone and the development of musculature, which certainly has a large impact on the manifestation of motor abilities tested with these two tests. Athletes involved in the training cycle are better able to achieve better results in motor skills tests, and better or worse results can be attributed to this effect. The results showed that athletes statistically significantly differ in their level of motor and functional abilities from non-sportsmen (Kostić, 2008). The higher level of motor and functional abilities of athletes respondents in comparison to non-sportsmen can be attributed to endogenous factors, and
predominantly exogenous, i.e. ransformational processes in sports clubs and physical education in relation to non-sportsmen who were covered only by physical education classes. It is well known that in training with athletes, the gradual increase in load to the upper limit of motor-functional capabilities is characteristic, which enabled supercompensation processes for every athlete (Batričević, 2008). The results showed that athletes statistically significantly differ in their higher levels of motor and functional abilities than non-sportsmen.

As indicated, the impact of the environment in which children live and go to school can influence their development of motor skills and in relation to that Tadić (2013) in his master's thesis found that some motor skills have a significant difference when it comes to children living in urban and rural areas. Previous research in our region conducted by Mitić (1980), Bala and Krmanović (1982, according to Marić, 2010), Sredić (2003, Šegrugur et al 2010), Gačić (2011) indicate that the expected conclusion is that students from urban areas show better results, whereas research carried out by Krmanović et al (2000, according to Marić, 2010), Badrić and Petračić (2007), Petrić and Blažević (2008), Herasina et al (2011) showed the opposite. "Based on the results we can see that the results are most discriminate with the muscular endurance and explosive strength tests. Betričević (2008) came to similar results in his research. When it comes to the results of repetitive strength, we can conclude that there is a great influence of anthropometric measures on the outcome result in tests that test the abilities mentioned. Branković et al., conducted research in 2012 that confirm this statement and point out that the results of morphological dimensions and repetitive strength will contribute to the individualisation of teaching work by making planning, programming, implementing and controlling teaching work appropriate to individual abilities and characteristics of students. "Bajrić et al found in their research that children who have the advantage in morphological characteristics also achieve better results in motor skills. They also found that children who have a high percentage of fat perform poorer tests in speed and explosive strength. Morphological dimensions as an integral part of the motor chain function may be a limiting or mitigating factor in the exercise of motor abilities. There were few such studies on the population of high school students, aged 15, covered only by regular teaching in physical education. "In this regard, it is well known that while in some motor activity one type of bodybuilding directly interferes with the realization of the kinetic program, that same physical body in another shows up (Branković, 2012). Research has shown that there is statistically significant association of morphological characteristics with the results of the motor abilities of secondary school students covered by regular teaching of physical education (Stojanović et al., 1980 Stojiljković, 2005; Višnjić, 2006, Janković, 2009 Projević, 2009). "Milanović (2011) Based on the empirical check of reliability and sensitivity of the most frequently used tests in different models of monitoring the motor skills of children and young in the world, it can be concluded that they have satisfactory reliability and sensitivity for all ages, both sexes from the III to the VIII grade of the primary school. On the basis of the results of the research it can be concluded that the monitoring of physical development and the development of motor skills of students in the course of physical education will basically follow the concept of the so-called "health related physical fitness" model, and the actual application of the battery tests for monitoring physical development and the development of motor skills of students from the 3rd to the 8th grade of elementary school in the conditions of our school system should be performed based on data on physical growth and composition of the body, general endurance, strength, flexibility and agility.

5. INSTEAD OF CONCLUSION
The research of the anthropological characteristics of children and young people is increasingly present in teaching practice, in order to apply the methods and forms of work that most contribute to increasing the efficiency of regular and additional teaching of physical
education (Branković, 2012). Monitoring of the realization of regular physical education programs and assessment of the actual results are important for the improvement of educational practice of teaching physical education and encouraging teachers to be more responsible and creative in their work. This procedure provides reliable data for taking corrective interventions in the practical implementation of the curriculum (Zdanski and Galić, 2002; Višnjić, 2006; Bompa, 2006).

6. REFERENCES


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EFFECTS OF SPRINT PROGRAM ON SOME MOTOR AND FUNCTIONAL ABILITIES IN TEACHING PHYSICAL EDUCATION

Summary

The study was conducted in order to determine the effects of sprint training on the transformation of motor skills and functional capabilities in elementary school pupils. The sample of subjects consisted of 54 elementary school pupils in Kosovska Mitrovica, aged 11 years ± 6 months. The experimental group consisted of 27 subjects selected for the sprint training in physical education classes, three times a week for 45 minutes, for a period of eight weeks. The control group also consisted of 27 subjects who, in the same time interval, had the same number of classes as the experimental group, and attended the classes of regular physical education program (three times a week for 45 minutes, for a period of eight weeks). The main aim of the research was to determine the influence of the sprint program in regular teaching of physical education on the development of motoric and functional capabilities in the experimental group members. Another aim of the research was to determine the influence of the program contents of regular physical education on the development of the same anthropological features in the control group of the subjects. The results showed that the experimental group of subjects achieved better results in the tested areas, and that there were significant effects of sprint training in the final testing.

Key words: physical education, sprint program, motor and functional abilities, elementary school students

1. INTRODUCTION

In essence, the systematic teaching process is the transformation process by which students are transformed from one state to another, in accordance with the previously established goals of physical education teaching. In order to achieve this, it is necessary to apply the principles of transformation processes, so that the teaching process could be efficiently managed. It is also necessary to know the dimensional structure of the anthropological characteristics and their influence on the efficiency of the performance of technical-tactical elements, because the correctness of the orientation process, the selection of pupils, the efficiency of the teaching process and the achievement of the best results depend on it.

Sprint run is a complex cyclical movement that allows maximum speed to be achieved at a given time, through maximum intensity. From the standpoint of sports training, speed as a physical feature implies the ability of a man to make movements in the shortest time and given conditions, assuming that the task conduction does not last long and there is no fatigue (Milanović, 2007; Palović, R. & Radinović, Z., 2010.).

A number of authors (Schneider, V., 1994; Bowerman, W. Freeman, W., & Gambetta, P., 1998; Jonić, Z., 2009; Janković, M., 2012;) points out that sprint speed is expressed through cyclical and acyclical movements during motor running. The speed of development and
transmission of force is a key factor in successful sprinting. Whenever the speed of movement increases, there is an increase in the "action" and "reaction" of the soft tissues. Action can be defined as the rate of applied forces in the body, while the reaction refers to the ability of soft tissues and the body as a whole to absorb and recover from these forces.

The overall improvement of the sprint run maximum can be influenced by the development of speed-strength abilities. In order to optimally develop kinematic and dynamic speed indicators, a variety of training methods should be applied and combined in an appropriate way. The transformation of functional abilities definitely belongs to the sphere of the most frequently applied and most useful transformations of the training process. A high level of aerobic ability is extremely important in all sports of extended duration.

In general, the study of the transformation processes of various anthropological features under the influence of workout process on the human organism is one of the most significant subjects of interest in sports science (Bompa, 2006; Milanović, 2007; Malacko, J. & Pejčić, A., 2009), given that many previous research have unambiguously found that certain training processes significantly influence changes in different human abilities and motor skills.

Analysis of the effects under the influence of a specific programmed learning process is increasingly becoming a subject of scientific research (Schneider, V., 1994; Branković, N., 1998; Branković, N., Milanović, S., & Pavlovic B., 2012), considering the importance of research results as exact indicators for further planning and programming of teaching work, as well as for selecting adequate methodological procedures in accordance with the desired goal.

The main objective of this study is to determine the influence of applied sprinting speed exercises in regular physical education to the motor and the functional capabilities of the experimental group of subjects. An additional goal is to determine the influence of the program contents of regular physical education on motor and functional abilities in the control group subjects.

2. METHODS

The population, from which a sample of 54 subjects was taken, consists of male elementary school pupils in Kosovska Mitrovica, aged 11 years ± 6 months. The sample was divided into experimental and control groups. The experimental group was composed of 27 subjects selected for sprint training at physical education classes, three times a week for 45 minutes, for eight weeks. The control group was also composed of 27 subjects who completed classes of regular physical education, three times a week for 45 minutes, for eight weeks.

Prior to the beginning of the teaching work, and after two months of treatment in both groups, ten tests for assessment of motor abilities were conducted: explosive force, flexibility, coordination, repetitive force and segmental speed test. The tests were selected based on the instructions and recommendations of the Kurelić et. al (1975).

Explosive power was assessed through the standing long jump (MSDM) and standing triple jump (MTRS) tests. Flexibility was assessed through tests of twist with the stick (MISPL) and forward bend on the bench (MDPK). Coordination assessment included acrobatic tests of co-ordination and co-ordination tests with the stick. The assessment of repetitive power included- lifting upper body in 30s test (MD30) and squats (MČUČ), and the assessment of segmental speed was carried out through the hand tapping (MTAR) and foot tapping (MTAN) tests.

Functional capabilities were assessed through three tests: the Margaria test (FMARG) - for determining the anaerobic muscle potential (1); vital capacity of the lungs (FKVPL) (2), and a modified Harvard step test - the pulse frequency after the load (FPPOP) (3). Functional tests in this study were taken from the model of functional tests of Heimar and Medved, 1997.

The program of sprint exercises in the experimental group of subjects realized within regular physical education was conducted with the aim of influencing anaerobic/aerobic
endurance, respiratory and cardiovascular system, strengthening the muscles of the lower extremities and consuming a higher amount of energy, using predominantly interval working methods.

The practical realization of sprint exercises included the following exercises: running in place with pronounced hand movements, quick skipping, jump-rope exercises, quick jumping-jacks, quick heel-striking, short-run sprints, running with a change in step length (same frequency), running with a change in the height of the knees in the step, running under, above and around the ramps to jump up with a runner, running with a progressive speed increase to reach the maximum speed. The maximum acceleration was developed using variables (running with a change in the length of the step (same frequency)), running with a change in the knee height in the step, a sprint run of 4 x 10 meters running, a sprint run of 3 x 20 meters, a sprint run of 2 x 30 meters. Attention was paid that all the subjects participate actively in the organization of the motor content; that individual classes do not last long; that tasks are carried out in groups; that the loads correspond to the individuals’ level of abilities.

Data obtained from initial and final testing were processed using the multivariate and univariate analysis of covariance.

3. RESULTS
Table 1. Multivariate analysis of covariance between experimental and control group in motor abilities at final testing with neutralization of differences in initial testing.

<table>
<thead>
<tr>
<th>Wilks' Lambda</th>
<th>F</th>
<th>df 1</th>
<th>df 2</th>
<th>P-level</th>
</tr>
</thead>
<tbody>
<tr>
<td>.583</td>
<td>7.56</td>
<td>10</td>
<td>54</td>
<td>.000**</td>
</tr>
</tbody>
</table>

Legend: the values of Bertlet's test (Wilks' Lambda), Ra's F-approximation (Rao's R) and level of significance (P-Level)

Table 1. shows the multivariate analysis of covariance which determines the realized effects of experimental treatment on the development of motor skills in the experimental group, compared to the control group in the final test, with the neutralization of the recorded difference in the initial testing. The results show that there is a statistically significant difference at the multivariate level between the experimental and control group subjects at a significance level greater than .01 (P-level = .000), which confirms the Wilks' Lambda test (.583) and F-test (7.56). The current difference occurs under the influence of experimental sprinting exercise, which effectively worked on the development of motor skills in the experimental group.

Table 2. Univariate analysis of the covariance between the experimental and control group in the motor abilities of the final test in the neutralization of the differences in the initial testing.

<table>
<thead>
<tr>
<th>Tests</th>
<th>Adj. Means</th>
<th>Adj. Means</th>
<th>F-ratio</th>
<th>P-level</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSDM</td>
<td>164.83</td>
<td>153.46</td>
<td>7.82</td>
<td>.000</td>
</tr>
<tr>
<td>MTRS</td>
<td>495.60</td>
<td>450.34</td>
<td>6.95</td>
<td>.000</td>
</tr>
<tr>
<td>MDPK</td>
<td>38.54</td>
<td>30.72</td>
<td>6.14</td>
<td>.000</td>
</tr>
<tr>
<td>MISPL</td>
<td>72.42</td>
<td>84.20</td>
<td>5.82</td>
<td>.000</td>
</tr>
<tr>
<td>MOKV</td>
<td>16.25</td>
<td>18.84</td>
<td>1.87</td>
<td>.036</td>
</tr>
<tr>
<td>MKOP</td>
<td>11.52</td>
<td>17.53</td>
<td>5.56</td>
<td>.000</td>
</tr>
<tr>
<td>MD30</td>
<td>17.14</td>
<td>21.20</td>
<td>5.65</td>
<td>.000</td>
</tr>
<tr>
<td>MCUČ</td>
<td>15.30</td>
<td>14.12</td>
<td>2.93</td>
<td>.070</td>
</tr>
<tr>
<td>MTAP</td>
<td>39.46</td>
<td>33.45</td>
<td>4.95</td>
<td>.003</td>
</tr>
<tr>
<td>MTAN</td>
<td>34.25</td>
<td>26.36</td>
<td>4.54</td>
<td>.000</td>
</tr>
</tbody>
</table>
Legend: arithmetic mean of experimental group (Means (ek)), arithmetic mean of control group (Means (ko)), F-test value (F-ratio) and level of significance (P-level)

Table 2. presents a univariate analysis of covariates of motor skills tests by comparing the results of the arithmetic mean of the experimental and control group in the final testing. Based on the coefficients of the F-ratio and their significance (P-Level), it can be concluded that a statistically significant difference was found between the level of .01 in eight motor tests. With a single test (MČUČ), the difference is not statistically significant at the level of .05, while in the test (MOKV), the difference is not statistically significant at the level .01.

Table 3. Multivariate analysis of covariance between the experimental and control group in the functional capabilities in the final testing with the neutralization of differences in the initial testing.

<table>
<thead>
<tr>
<th>Wilks’ Lambda</th>
<th>F</th>
<th>df 1</th>
<th>df 2</th>
<th>P-level</th>
</tr>
</thead>
<tbody>
<tr>
<td>.738</td>
<td>4.39</td>
<td>3</td>
<td>54</td>
<td>.004**</td>
</tr>
</tbody>
</table>

Legend: the values of Bertlet's test (Wilks' Lambda), Ra's F-approximation (Rao's R) and level of significance (P-Level).

Multivariate analysis of covariance in the area of functional capabilities (Table 3) indicates that there is a statistically significant difference on the multivariate level between the experimental and control group subjects at a significance level of more than .01 (L-level = .004), as evidenced by the value of Wilks' Lambda test (.738) and F-test (5.39). The existing difference occurs under the influence of experimental treatment of the running speed which effectively influenced the development of functional abilities in the experimental group.

Table 4. Univariate analysis of covariance between the experimental and control groups in functional capabilities in final testing with neutralizing differences in initial testing.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>FMARG</td>
<td>3.18</td>
<td>3.74</td>
<td>5.94</td>
<td>.000**</td>
</tr>
<tr>
<td>FVKPL</td>
<td>2840.00</td>
<td>2760.00</td>
<td>1.81</td>
<td>.231</td>
</tr>
<tr>
<td>FPPOP</td>
<td>154.00</td>
<td>162.00</td>
<td>4.64</td>
<td>.000**</td>
</tr>
</tbody>
</table>

Legend: The arithmetic mean of the experimental group (Means (ko), the arithmetic mean of the control group (Means (ko), a value of F-test (F-ratio), and the level of significance (P-level).

The univariate level of covariance analysis between the experimental and control group in evaluation tests of the functional abilities in the final testing, with the neutralization and partialisation of the results at the initial testing (Table 4), indicates that there are statistically significant differences in the Margaria test (FMARG .000) and the pulse frequency after loading. In the case of vital lung capacity (FVKPL .231), no statistical significance was found at the level of .05.
4. DISCUSSION

The results of this study show that the subjects of the experimental group in the final measurement quantitatively differ in motor (tables 1 and 2) and functional abilities (Tables 3 and 4) and that the adaptive sprint program influenced the positive changes in the tested capabilities of the subjects.

The identified intergroup differences in both motor and functional area are in favor of the experimental group, and it can be concluded that the implemented sprint program induced adaptive changes in both motor and functional abilities, and influenced the improvement of the results between two studies in most of the applied tests for the assessment of motor and functional abilities.

The justification of the obtained results can be confirmed by the results of other studies (Šnajder, 1994; Matković, 1998) in which authors emphasize the importance of a properly, methodically designed sprint speed motoring program to increase the level of examined skills.

The statistically significant and better results of motor abilities in the experimental group compared to the control group of the subjects, were certainly achieved, besides the correct choice of exercises, as a result of proper dosing, distribution and control of the applied loads in accordance with the authentic needs of the subjects. This caused the creation of appropriate adaptive processes in the experimental group of subjects and positive changes in their organism.

On the basis of the statistically significant differences in the functional indicators shown in the chapter Results (Tables 3 and 4), it can be argued that the length and structure of the applied sprint training program were adequate, and led to an improvement in the level of cardiorespiratory endurance in the experimental group of subjects.

It can be concluded that the sprint program, applied in the experimental group of subjects, was adequately conceived in accordance with the so-called FIDT training process guidelines (frequency, intensity, duration and type of training), and can be applied as a conditional form for planning physical activity in teaching physical education in improvement of functional and motor skills.

CONCLUSION

The conducted research confirmed that there are apparent effects of sprint training on the motor and functional abilities of elementary school students. It has been demonstrated that the proper intensity, duration and frequency of sprint exercises can provide an effective way of continuous improvement in motor and functional abilities in the experimental group of elementary school students.

The research, as an original contribution to science, answered the question of the appropriateness and efficiency of the application of sprint speed training program. The results showed that the experimental group of subjects achieved better results in the tested areas of motor and functional abilities, and that there were significant effects in the final testing.

We believe it is necessary to conduct an extensive research in which the effects of sprint speed training on the motor and functional skills of students are examined. Such knowledge could serve as a basis for the development of training programs that could be applied in the teaching of physical education of primary schools.

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THE INFLUENCE OF PHYSICAL ACTIVITY ON REDUCTION OF BODYWEIGHT FOR 10 YEAR OLDS

Summary
The goal of this work is to determine the state of nutrition in children of school age of 10 years based on the level of their physical activity. The prevalence of excessive body weight and obesity between children is at rise in many countries in the world and even in Serbia. According to the information gathered in Institute of Public Health of Serbia “Dr. Milan Jovanović – Batut”, there is about 18% of moderately obese and obese young adults. Wrong diet and insufficient physical activity are considered as two of the most important causes of obesity with children and adolescents. The health of young people is important in every community, not only from the medical aspect, but also for the economic, social and demographic future of every country. That means that we should pay special attention to improving the health of young adults through healthy nutrition and regular physical activity. Results that are gotten with this research lead to the conclusion that one third of the examined children were inappropriately fed and 20% are overweight and obese.

Key words: body mass index, obesity, FA, health of young adults

1. INTRODUCTION
Obesity (lat. obesitas) is a chronic disease that is expressed with excessive accumulation of fat in organism and increased bodyweight. Each bodyweight increase that is more than 10 percent in comparison to the ideal weight is labeled as obesity. Every person whose body mass index (BMI) exceeds 30 kg/m² is considered obese (WHO, 2004). Many scientists consider that obesity is an illness of modern civilization and that an epidemic of obesity is on constant rise in almost all countries in the world. Excessive obesity creates complications on many organs and organ systems so it is considered to be main risk factor for occurrences of different illnesses, which directly influences the quality of life. Obesity can be equally present in all stages of life. In childhood it is equally present with boys and girls, and after puberty it is more common in women than in men. The prevalence of obesity with children is very concerning. Biggest percentage of obese children and young adults is marked in the USA where, according to some information, obesity of children aged 6-11 years old, has grown for 54% from 1960.

Increase of obese children is noticed with countries in development, in which the most prominent are countries of Middle East, North Africa and Latin America. As obesity is a consequence of imbalance between intake of calories originating from food, and spending energy and calories that are needed for basal metabolism and physical activity, physical activity has a very big influence in regulating body mass. Every factor that increases intake of energy in small measures or reduces energy consumption in longer period, can lead to obesity (Jovanović, Nikolovski, Radulović & Novak, 2010). Industrialization and urbanization and also economic-technological development have greatly changed food diet...
and due to accelerated lifestyle have reduced physical activity and energy consumption. Although children obesity still isn’t properly diagnosed, it is known that the prevalence of children obesity in the span of ten years in some countries has increased two to three times, and in some countries even four times (Ilić, Jelenković, & 2009). Children obesity is mostly tied to eating habits: irregular intakes and skipping meals, choice of groceries and excessive intake of certain foods (snacks, dough, candy and sodas), amount and frequency of physical activity, parental factors and influence of educational institutions. As the lack of physical activity in children nutrition is always ranked second by importance, it is obvious why regular physical activities are insisted on from the early stages of life. The level of physical activity among children depends on individual influences, also from the parental influences and environment, gender differences are also present (boys are mostly physically more active than girls), and age differences (children are more active than adolescents). The level of physical activity is in certain measures influenced by economic conditions, closeness of play and recreation place, parental support, socio-economic status and parental education and other factors (Zdravković, Banićević & Petrović, 2009). In order for the problem of children obesity to be reduced as much as possible, the primary task is to include regular physical activity at the earliest age.

2. FACTORS INFLUENCING OBESITY

There are many factors that influence obesity, among which are the most prominent (Despotović,Aleksopoulos, Despotović, & Ilić, 2013):

- overeating;
- physical inactivity;
- heredity;
- endocrine disorder;
- psychological factor and habits.

2.1 Nutrition

It is known that food intake is regulated by the nutrition center located in the hypothalamus. Food intake is regulated by the activity of one group of centers in the hypothalamus, while the neighboring centers in the brain regulate when to stop with food intakes by inhibiting the first centers. If the inhibiting centers are damaged, it comes to excessive overeating. Research has shown that food is taken excessively if it is easily available. It is proven that in 80% of the cases, obesity is a consequence of overloading with food, while only in 20% of the cases it is a consequence of endocrine disorder or a hereditary factor (Bukara-Radujković, & Zdravković 2008). Psychological factor is of great importance, not only for irregular, but also for the insufficient food intakes. Clinically depressed people often seek comfort in food. Some individuals enjoy food and drinks, and there are some who have created a habit of always having a snack. Creating regular eating habits in early childhood is of great importance in fighting obesity. However, it is often parents’ fault for bad eating habits of their children, because they overfeed them, trying to show their affection and love for them that way.

2.2 Physical activity

Physical activity is a very important health factor, not only for the individual, but for the whole population as well. Its role is reflected not only in primary prevention of many chronic illnesses, but also in the secondary prevention that slows down and reduces the symptoms of chronic illnesses (Stoiljković, Živković, & Stošić, 2011). Aside from that role, physical activity also affects the mental stability of humans. According to WHO (World Health Organization), insufficient physical activity is a risk factor of its own. This organization has
sent an open letter a couple of times to all the governments in the world, in which it pointed out the exquisite importance of physical activity for total health of the population.

3. THE CONCLUSIONS OF TO-DATE RESEARCHES
A great deal of researches that has been implemented in the last two decades, came to the same or similar conclusions (Mahan, 2004; Bitar, Vernet, Coudert & Vermorel, 2006; Ilić, Jelenković, Vasić, 2009):
Frequency of the excessive body mass for children is on a very concerning increase;
Obesity is the second in line risk factor for occurrence of the disorder of children health;
Obesity in the period of childhood and adolescence is a prerequisite for obesity in mature age;
Health disorder due to obesity is the most frequent in the period of childhood and adolescence;
Physical activity has a significant influence in regulating excessive body mass for children;
Society must be involved in affirmation of physical activity which goal is to prevent obesity.

4. METHOD
A research was carried out in two elementary schools in Loznica during 2017. In this research participated a total of 70 students, 38 girls and 32 boys, and all of them were 10 years old.

<table>
<thead>
<tr>
<th>Children’s age</th>
<th>Sex</th>
<th>N</th>
<th>Total N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 year olds</td>
<td>Girls</td>
<td>38</td>
<td>36 (54,3%)</td>
</tr>
<tr>
<td></td>
<td>Boys</td>
<td>32</td>
<td>32 (45,7%)</td>
</tr>
<tr>
<td>Total N (%)</td>
<td></td>
<td>70</td>
<td>100%</td>
</tr>
</tbody>
</table>

Evaluation of nutrition for kids was based on the following anthropometric indicators:
Height
Body mass and
Body mass index
Height was measured with floor anthropometer with a possibility of reading values closest to 0,5cm. Head was positioned in a “Frankfurt level”, in a horizontal position, so that the line that connects tragus helix of the left ear with the lower edge of the eye orbit is positioned to be parallel with the surface.
Body mass is measured with a digital scale with a precision of 0,1kg. Body mass index (BMI) is calculated with formula: BMI= BM (kg) / H2 (m²)

The calculated values of height, body mass and body mass index, were compared to referenced values in the table of children’s growth and development of World’s Health Organization. Standard questionnaire is used for the evaluation of physical activity, socio-economic parameters and food habits. The questionnaire consists of questions from which the information was gotten about the time spent doing some physical activity during seven days, with answers: never, occasionally, often and always.

5. THE RESULTS OF THE RESEARCH
Average value for height (H) was 137,82cm for boys (the minimum was 131cm, and the maximum was 148cm). Average value for height was 138,42cm for girls (the minimum was 129cm, and the maximum was 149cm). Average value for body mass was 30,63kg for boys (the minimum was 27kg, and the maximum 37kg), while it was 31,58kg for girls (the minimum was 28kg and the maximum 38kg).
Average value for body mass index was 19kg/m² for boys (the minimum was 17kg/m², and the maximum 26kg/m²).
Evaluation of obesity in the examined group estimates that 26 respondents have a problem with body weight, which is 32.85% from the total number of respondents, and that is a percentage that can’t be ignored. Also, the fact about the number of children that are malnourished or obese can’t be overlooked. Tests that are used for evaluating the physical activity of respondents point out that both the boys and the girls are not enough physically active and that only 8 respondents are active in sports, while the rest are mostly physically active in P.E. classes. Most of the surveyed children said that they spend their free time in front of the TV and the computer and that they don’t spend enough time outdoors doing physical activity.

Looking at table 2 we can see that only 8 boys and girls were actively included in doing sports, and that is a negligible number in contrast to the number of surveyed children and their age. Overly fed and obese children are mostly physically inactive. The number of kids that are occasionally or completely physically inactive is also very concerning.

During the talk with the surveyed children the most used reasons for physical inactivity are listed below:

- Lack of adequate sports;
- Small number of sports facilities and training grounds;
- Lack of time because of the extensive material that they have to master.

Based on the received responses about the presence of certain foods in the diet in the examined group, there is a moderate correlation between obesity and frequency of sugar intake, intake of non-alcoholic drinks and so called fast foods. It can be concluded that consummation of these foods has a certain influence on obesity in the examined group.

Information on the parent employment shows that there is an insignificant correlation between parent employment and children obesity.

6. DISCUSSION

This research has also confirmed the thesis that the physical activity, beside the food diet, is an important factor for regulating children’s body mass. The examined group is obviously physically inactive, and most of the children don’t have a revelation how much the regular physical activity can contribute in regulating elevated or excessive body mass. Their disinterest for engaging in sports has been expressed through bigger number of surveyed children who have a problem with increased body mass. The reasons that children state for physical inactivity are not acceptable, especially if it is known that in Loznica exist adequate sport contents, that there is a large number of playgrounds and one sports Hall and that with little will you can always find time for necessary physical activity. The problem with obesity
mostly have children that are physically inactive, and at the same time have a problem with food diet (have irregular feeding patterns, take big amount of sweets and non-alcoholic soda drinks). If possible genetic factor is added to these data information, there is a precondition that those children will become obese at mature age. Because of these reasons it is necessary that with diet correction, children become active according to their abilities. In this process an important role have both teacher and parents and they can contribute to the physical activities of their children (Bojic-Milicevic, 1986). That role is not reflected only in limiting the time that their children spend watching TV or playing video-games, but also in giving good personal example and giving different possibilities to children to be physically active, whether it be going to the park, to the pool, the playground or having an active engagement in sports. Besides that, it is necessary for kids to be informed that obesity is a serious problem and that curing obesity is a long and complex process, and that in that process regular physical activity has a significant role. Exercising program for obese children should be based on medical knowledge, because the same exercises can't be applied to prevent obesity, curing obesity and maintaining the desired weight. Children of school age, besides the regular classes of P.E., should have the time for free activities of at least 15 minutes a few times a day, for example playing football in school yard, riding a bicycle, playing hide-and-seek etc. Physically active children have stronger muscles and bones (it represents 70% of total body mass), which will prevent deformity occurrence and improve metabolism with which we regulate body weight (Jevtovic, 2002). Thereby, they will have a good body posture.

7. CONCLUSION

Results that are gotten by this research lead to the conclusion that one third of surveyed children had an inappropriate diet, and that 20% of children are overweight and obese. Most of the surveyed children, aside from having irregular and bad food diet, are physically inactive. One of the possible causes gotten from the results is a professional disability and organization of work with children during the classes of P.E. Children mostly come to the classes of P.E., but their activity on these classes is not enough. Objective methods of measuring height, body mass and BMI, should have an advantage in regard to subjective answers of respondents which are given by answering the questionnaire. Different studies have shown that physical activity in early childhood is connected with better physical health, which includes better body posture, stronger bones and muscles, and also a better respiratory and cardiovascular function. Children that have regular physical activity are less susceptible to have chronic health problems. They have reduced risk of suffering chronic diseases and obesity. Physical activity has a positive effect on boosting confidence and reducing stress etc. Children usually don't need formal shapes of physical activity. Younger kids strengthen their muscles through games on playgrounds. Children should participate in activities that are appropriate for their age. Parents can influence their children’s behavior in great measure regarding their physical activity. It’s very important to encourage children to be physically active, be that through informal active games or organized sports. Because of its great importance, physical activity, as a proven preventive measure in fight against obesity and many other illnesses, must be present enough at all ages, and especially with kids. In advocacy of physical activity for healthier life, it is needed to have a support of whole society so that with healthy and content off-spring we could secure our future. Results of this research have confirmed this conclusion.

8. REFERENCES


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**SPORT MANAGEMENT THEORY, RESEARCH, AND PRACTICE: SPORT MANAGEMENT AS PROJECT MANAGEMENT IN MARTIAL ART CURRICULUM**

**Abstract**

Members of the sport management academic community have diligently debated theory development in the discipline and the place of sport management in academia. One common theme includes the challenges of developing an all-inclusive theory of sport management. The lack of academic sovereignty and the absence of a clear and distinct theoretical foundation have hampered the development of a sound theory of sport management. Due to the challenges with theory development and a clear direction of sport management as a unified academic discipline, one should consider the nature of sports and recognize the practical and academic relationship between sports management and project management. Sport management as project management is a new direction for the discipline and is a means to establish a common understanding of sport management in a practical and academic sense.

**Key words:** sport management, theory, theory development, projects, project management

**INTRODUCTION**

Scholars of sport management have zealously attempted to develop a distinct theory of sport management. Theory development has been hampered by the lack of academic sovereignty and the influence of outside academic disciplines. In addition, the successful development of a theory has been hindered by the nature, types, and forms of what one may consider sports. The intent of this work is to evaluate the specific reasons why a theory of sport management has not been developed and why a single theory of sports management will most likely never exist. Moreover, the intent is to propose that sport management in reference to martial art curriculum be categorized as a project management focused academic discipline, based on the practices and models of project management.

**RESEARCH METHODS**

**Lack of Academic Sovereignty**

Cunningham (2013), Doherty (2013), Fink (2013), and Irwin and Ryan (2013) outline the importance of identifying and developing a theory of sport management, martial art curriculum being no exception. Specifically, the need for a theory is relevant to current
research, practice, and teaching in the discipline (Cunnigham, 2013; Doherty, 2013; Irwin & Ryan, 2013). On the other hand, Chelladurai (2013), Cunnigham (2013), Doherty (2013), and Fink (2013) agree that developing one sport management theory that is all-encompassing is an arduous task. Even though Cunningham (2013), Doherty (2013), Fink (2013), and Irwin and Ryan (2013) recognize the challenges with martial art theory development it is evident that scholars are seeking answers to develop a theory that will establish the sport management community as a theory based discipline among other theory based academic disciplines.

**Academske discipline Academic disciplines**
According to Doherty (2013, p. 5), “The strength of an academic discipline is its distinct body of knowledge that is not covered by another discipline.” University sport management curriculums and degree programs are mainly based on academic subject matter with roots in other academic disciplines, theories and practices. Disciplines such as law, sociology, fiscal management, marketing, ethics, and leadership are the basis for the majority of sport management post-secondary courses and programs. The outside disciplines are based on theories, which influence not only the teaching, research and practices in their specific fields, but also sport management. In a sense, the outside disciplines define the sports management curriculum and research.

**Academic phenomena and concepts**
Doherty (2013) states that academic disciplines include phenomena that are based in academic theory, research and scholarship. The academic phenomena contribute to the strength and viability of the specific academic discipline, and the development or strengthening of academic theory (Doherty, 2013). The viability of an academic discipline is based on the correlation between academic theory, research and scholarship, and the identification and relevance of the discipline’s specific phenomena (Doherty, 2013). Furthermore, Chelladurai (2013) notes that theory development involves identifying and comparing discipline specific phenomenon through scholarly research.

With this in mind, Zanger, and Groves (1994) review the feasibility of developing a sports and leisure management specific theory. The work includes identifying a framework based on issues and related components of sport and leisure management. The issues and components of sport and leisure management identified in the research include, “…liability, profits, image, social responsibility, change, management philosophy, organization, working conditions, marketing, selling, legal issues, resources and reputation” (Zanger, & Groves, 1994, p. 61). These elements fall in other general academic disciplines, such as law, human resources, marketing, public relations, management, financial management, and ethics. Based on these findings it is evident that the attempt to identify a framework for theory development in sports and leisure management, martial art courses in particular, established that the significant issues and components have roots in other academic disciplines (Zanger, & Groves, 1994).

**Theory Adaptation**
When reviewing the influence of outside academic theories on sport management it has been considered appropriate to use and adapt other academic disciplines’ theories; however, this can inhibit the development of sports management as a stand-alone academic discipline (Doherty, 2013; Fink, 2013). Doherty (2013) notes that “While both extending and generating theory make a contribution, the latter stands apart in that it involves building truly domestic or indigenous theory that is founded on the phenomenon of interest in sports management” (p. 10). Fink (2013) concur and argues that sports management as an academic discipline may be diluted when other academic theories are applied to sports management research.

The lack of academic sovereignty is not a one-time occurrence or a minor challenge for sport management. The lack of sovereignty is apparent in sport management research, the attempt
to develop theory, and sport management practices. This is a major challenge for scholars in sport management. Academic sovereignty is not the only variable that inhibits the development of sport management theory. The basic elements of sport management practices, including martial art, also contribute to the uncertainty and direction of the academic discipline.

The Theoretical Dilemma
According to Doherty (2013), “Theory, quite simply, explains how things work and why” (p. 6). For the purpose of this work, things, as included in Doherty (2013), will refer to phenomena/concepts/practices of sport management as they relate to academic research in theory development. In other words, a theory of sport management should explain how phenomena/concepts/practices of sport management work and why. The basis for a theory must be rooted in the observed and researched practices in the field of sports management, the identified phenomena, and established concepts. The major concern with developing a research based theory of sport management includes the questions, 1) Which phenomena?, 2) Which concepts?, and 3) Which practices?

The nature and form of sports
To answer these questions one must review the nature, scope, and forms of sport management. Sport management as a field includes a vast array of sports programming, level of competition, individual versus team sports, demographic factors of the participants, amateur versus professional sports, and international sporting events and competitions. Furthermore, organizations and institutions that offer and oversee sports programs include local/regional private organizations, school districts, colleges/universities, municipal agencies, state organizations, national associations, professional franchises, and international federations. When considering the several types and forms of sports, focusing on martial art in the venue of this paper, and the organizations that influence and manage the specific sports, the ability to identify and narrow the focus of the phenomena/concepts/practices of sport management seems almost impossible.

Sports in society
Sports of any kind are influenced by society as a whole. Society specific factors that contribute to the theorist’s dilemma are social, political, economic, and legal elements (Doherty, 2013). The macro level factors significantly influence the practice and management of all types and levels of sports. Sports exists within a greater external environment that influence sports management practices (Doherty, 2013). The number of societal variables that impact sports are extensive, which makes it difficult to identify the specific research based phenomena/concepts/practices of sport management.

Sport management curriculum
Sports management curriculums in colleges and universities are based on several outside academic disciplines. As was mentioned in section 1.1, disciplines such as law, sociology, fiscal management, marketing, ethics, and leadership are the basis for the majority of sport management degree courses and programs. The different subject matter in the field allows for scholars to conduct research that is diverse and permits for insights to several aspects of sport management practices. However, the diversity of the subject matter researched fosters a wide range of topics and findings that polarize sport management into several sub-content areas of the discipline (Doherty, 2013). The subject matter specific research will contribute to the scholarship within a narrow area of sport management. On the other hand, the research also solidifies that the phenomena/concepts/practices of sport management are diverse and that the development of one specific sport management theory is a tireless effort.
New dialogue

It is evident that sport management is facing challenges as an academic discipline. One can argue that research and academic dialogue on theory development and the impact of outside academic disciplines are an attempt to solidify sport management as an independent academic discipline. However, the author of this work suggests that these continued efforts do not contribute value or a deeper understanding of the current status or future of sport management as an academic or practicing discipline. The same debate was emphasized and addressed more than twenty-five years ago (Paton, 1987). Paton (1987) argues, “Due to the disparate pattern of sport management research, the studies as a group do not meet the criterion of reductiveness. Thus, if we were challenged to identify our body of knowledge, it would be difficult to develop a picture of what we know” (pp. 30-31). Continuously coming to the same conclusion, without significant progress, does not foster the growth of sport management as an academic discipline. The academic community of sport management scholars must go beyond traditional aspirations, and recognize that sports management falls in the academic and practical discipline of project management.

Sport Management as Project Management

In the attempt to establish the future direction of sports management, Costa (2005) concludes the following, “Debates about theory vs. practice reflect a concern about whom the field should serve, and what it should seek to achieve” (p.133). To further the review of sports management as it exists today, the author of this work suggests that sport management falls in the academic and practitioner discipline of project management. Munns and Bjeirmi (1996) define a project as “A project can be considered to be the achievement of a specific objective, which involves a series of activities and tasks which consume resources. It has to be completed within a set specification, having definite start and end dates” (p. 81). Moreover, “In contrast, project management can be defined as the process of controlling the achievement of the project objectives. Utilizing the existing organizational structures and resources, it seeks to manage the project by applying a collection of tools and techniques…” (p. 81).

Projects and project management

According to Larson and Gray (2014), the definition of the project includes identifying the direction and purpose of the project, identifying project scope, defining operational activities and responsibilities. In addition to the definition of the project, project planning is based on setting time lines and schedules, identifying financial and physical resources, determining staffing needs, and risk assessment (Larson and Gray, 2014). The execution of the project is based on controlling and monitoring of the project, which involves analyzing scheduling and budget management, and the review of the execution of the project in comparison to set project scope and expectations (Larson and Gray, 2014). The closing stage, as defined by Larson and Gray (2014), “Closing includes three activities: delivering the project product to the customer, redeploying project resources, and post-project review” (p. 9). With an insight to the general scope and process of project management one can apply this practical process to the example of a sports management program.

Sport management as project management

To categorize sport management as an academic and practitioner discipline of project management one must review what practitioners do in sports management. It is well known that sports management is a broad and inclusive field; however, it is feasible to define sports management in the terms of projects and project management. The significant majority of sports management practices have a start and an end date. Please consider the following:
1) Youth individual and team sports are based on seasons and individual events/games.
2) Instructional sports lessons, classes and clinics are offered for a period of time.
3) Collegiate athletics involves several sports that are based on seasons.
4) Athletic/sports competitions, games, events and activities have a beginning and an end.
5) Professional team sports are based on seasons and individual games.
6) Team sports include a pre-season, season, and post season.
7) Professional individual sports such as Golf, Tennis, and PBA are based on seasons and individual events.
8) High school athletics are based on seasons and individual games.
9) Special needs programs in sports have a beginning and end.
10) NASCAR and Formula 1 are based on seasons with individual events.
11) International sporting events, such as the Olympics, world championships, and other international competitions have a beginning and an end.
12) Facilities and arenas that house sporting events, matches, games, and programs are influenced by the seasonality of the specific sports.

Based on the 12 general examples it is obvious that the significant majority of sports management activities are based on macro-level projects (seasons) and micro level projects (games, clinics, and competitions) during a specific season. The macro and micro level projects may vary in length and scope; however, each is based on a beginning and an end. The macro and micro level sports projects can also be defined as projects due to the application and use of resources to coordinate and manage the activities. Sports activities are based on the application of resources, such as people, time, money, and equipment. During a season or individual events the effective coordination and management of the resources are the foundation of successful sports programming. These resources are the tools utilized to execute the macro and micro level sports projects.

It is important to recognize that the macro and micro level sports projects do not exist in a vacuum. The outside academic disciplines, such as law, human resources, financial management, leadership, and ethics will have a significant impact on how the macro and micro sports projects are developed, implemented, and executed. The academic disciplines’ specific subject matter and theories will not only contribute to overall coordination and management of projects, but will also contribute to sports management as project management research.

Based on the Larson and Gray (2014) definition of project management one can consider the following example. Private and municipal youth basketball programs are offered to the general public throughout communities in the United States. Sports managers that coordinate the youth basketball programs begin by determining the what, where, when, who and how of offering the youth basketball programs. This initial step includes the definition of the project as defined by project management. Based on the definition, the sports managers will identify the specific resources and means to offer and implement the program, which is the planning phase of the project. The execution of the basketball program is the monitoring, coordinating and management of the resources such as staffing, use of facilities and equipment. The closing stage of the program involves playing the games, and offering the participants and parents with a safe and positive experience. Furthermore, the closing phase of the youth basketball program involves ending the season and identifying the successes and challenges during the season (Larson and Gray, 2014).

Anyone with practical experience and background in offering sports programming will understand and recognize that project management is a viable means to define and identify sport management as an academic discipline and practitioner field. This is relevant in any
type and level of sports. With this in mind, the academic community of sport management must consider future research and scholarship from the perspective of sports and project management. The initial step of accepting sport management as a form of project management will allow scholars the opportunity to initiate research and scholarship that will strengthen sport management as an academic and practical discipline.

CONCLUSION
Scholars in the academic community of sports management have made several attempts to unify the discipline under a common theory. However, it is apparent that theory development has been hampered due to lack of academic sovereignty and influence of outside academic disciplines. The successful development of one distinct theory has also been hindered by the nature, types, and forms of what one may consider sports. Due to the challenges with theory development and a clear direction of sports management as a unified academic discipline, one should consider the nature of sports and recognize the practical and academic relationship between sport management and project management. Sport management as project management is a new direction for the discipline and is a means to establish a common understanding of sports management in a practical and academic sense.

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THE RELATIONSHIP OF SITUATION EFFICIENCY IN THE BASKETBALL PLAYER REPRESENTATIONS PARTICIPANTS AT EUROPEAN CHAMPIONSHIP 2017

SUMMARY
The subject of this research is the standard situational features of basketball teams at the European Championship 2017. On the basis of the given subject, we defined the aim of this research to determine the connection of situational efficiency in basketball with the achieved placement of national teams participating in the 2017 European Championship. The sample of variables in this survey includes fourteen variables for assessing situational efficiency in basketball, determined by the World Basketball Federation (FIBA). On the basis of the obtained results, we came to the conclusion that the representations of the participants with a better overall percentage of the shot, the percentage of two-and-three points, more jumps and more points scored per game during the European Championship have a better performance.

Key words: European Championship 2017, situational efficiency

INTRODUCTION
A basketball game can be viewed as an ordered series of activities that each player has to perform with respect to the place and role of the team in the particular concept of the game. For the purpose of monitoring events at the basketball game, FIBA has standardized the situation-based performance indicators that are monitored at every official match. The suggested indicators of situational efficiency are: the number of balls in the game in the basket for two points, the number of attempts to throw the ball out of the game to the basket for two points, the number of balls in the game in the basket for three points, the number of attempts to throw the ball out of the game to the basket for three points, the number of balls in the basket behind the free throw line (one, two, and three), the percentage of success for all the listed shots, defense leap, jump in attack, assists, personal errors, lost balls, won balls and blockade shots. In this paper, we analyzed the fourteen parameters of situational efficiency in the game (percentage of penalty for 1, 2 and 3 points, the number of attempts to throw a ball for 2 and 3 points, jump in attack and defense, jump total, assisted, scored balls and lost balls and total number of points.

METHOD OF WORK
Sample respondents
The survey was conducted on a sample of twenty-four (24) representations of the participants of the European Championship 2017. The data has been collected from all matches of the 2017 European Championship.
Sample variables
The data was downloaded from the official website of the European Basketball Championship 2017. The sample of variables consists of fourteen variables for the assessment of situational efficiency, as determined by the World Basketball Federation (FIBA), which are: average number of shots per game (ŠUTG); percentage of total penalty (ŠUT%); number of attempts to score 2 points (ŠUT2P); percentage of shots for 2 points (ŠUT2P%); number of attempts to score 3 points (ŠUT3P); 3-point penalty score (ŠUT3P%); percentage of inserted free throws (FT%); total rebounds achieved (SKOK); jump in attack SKOKOF); defense rebounds achieved (SKOKDF); Assisted Assistance (ASS); lost balls (TOURN); the winning balls (STOL); average number of points scored in the match (POENG).

RESULTS WITH DISCUSSION
The research was conducted on the basis of an analysis of basketball matches at the European Championship 2017. In the formation of the database, standard indicators from all played matches in the championship were used. Appropriate mathematical-statistical methods and procedures were used for processing, data entry and analysis of results. For all applied variables, mean, Mean and Minimum values (MIN and MAX), standard deviation (SD) are calculated. Data processing is done in the SPSS software package for Windows. Of the statistical procedures, we used the T test for differences between successful failing teams and regression analysis for the connection of predictor variables with the criterion variable.

Table 1 shows the average achieved values of all situational efficiency parameters for all representations of the participants at the European Championship 2017. By comparing the values obtained with the values of the previous research (Korjenic et al., 2013), in a survey carried out on a sample of twelve (12) players representing the Olympic Games in 2012 in London, we found that basketball players from 24 national teams at the European Championship of 2017 had better percentages shot for 2 points (48.97-50.85), significantly better percentage of free-throw shots (68.70-75.44) and almost identical percentage points for 3 points (34.37-34.07). A similar study was carried out (Džajić and al, 2009) on a sample of basketball teams that took part in the 2008 Beijing Olympic Basketball Tournament. A comparison with the results from this survey suggests that basketball players who took part in the 2017 European Championship achieved better Results in the offensive jump (6.35-10.10) in the defensive jump is a drastic difference (14.12-25.06), as well as in the assisted assists (8.13 to 18.41).

Table 1. Descriptive statistical parameters of basketball players at the European Championship 2017

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>ŠUTG</td>
<td>24</td>
<td>61,46</td>
<td>55,00</td>
<td>69,00</td>
<td>4,02</td>
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<tr>
<td>ŠUT%</td>
<td>24</td>
<td>44,69</td>
<td>37,90</td>
<td>50,70</td>
<td>3,85</td>
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<tr>
<td>ŠUT2P</td>
<td>24</td>
<td>38,17</td>
<td>28,30</td>
<td>45,80</td>
<td>4,81</td>
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<td>-0,20</td>
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<tr>
<td>ŠUT2P%</td>
<td>24</td>
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<td>41,50</td>
<td>58,40</td>
<td>4,87</td>
<td>-0,25</td>
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<tr>
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<td>15,00</td>
<td>28,60</td>
<td>3,48</td>
<td>-0,46</td>
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<td>ŠUT3P%</td>
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<td>26,30</td>
<td>39,90</td>
<td>4,02</td>
<td>-0,41</td>
<td>-0,97</td>
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<tr>
<td>FT%</td>
<td>24</td>
<td>75,44</td>
<td>62,40</td>
<td>84,40</td>
<td>6,28</td>
<td>-0,77</td>
<td>-0,31</td>
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<td>ASS</td>
<td>24</td>
<td>18,41</td>
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<td>0,24</td>
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<tr>
<td>TOURN</td>
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<tr>
<td>STOL</td>
<td>24</td>
<td>6,82</td>
<td>4,80</td>
<td>9,20</td>
<td>1,29</td>
<td>0,07</td>
<td>-0,91</td>
</tr>
<tr>
<td>POENG</td>
<td>24</td>
<td>77,32</td>
<td>63,20</td>
<td>91,60</td>
<td>7,838</td>
<td>0,23</td>
<td>-0,55</td>
</tr>
</tbody>
</table>

Legend: N - number of respondents; Mean - arithmetic mean; Min. - minimum score; Max. - maximum score; Std.Dev. - standard deviation of the arithmetic mean; Skew - the asymmetry of the distribution curve; Kurt. - Flexibility of the results distribution curve.
Table 2 shows whether there is a statistically significant difference and what are the variables that contribute to the difference between the successful teams (the top 12) and the unsuccessful teams (last 12) at the 2017 European Basketball Championship. Data analysis showed that there is a statistically significant difference ($p = .00$) between the observed variables ($ŠUT\%$, $ŠUT2\%$, $ŠUT3\%$, $SKOK$, and $POENG$), which means that there is a very high correlation between the achieved placements and the mentioned variables. We can conclude that the representations with a better percentage of the total penalty, the percentage of shots by 2 points, the percentage of shots by 3 points, the better total number of jumps and the higher number of points achieved, on average per match, achieved better placement in this competition.

Table 2. Differences in Arithmetic Meanings between Successful and Unsuccessful Teams at the European Championship 2017.

<table>
<thead>
<tr>
<th>Varijabla</th>
<th>Mean-U</th>
<th>Mean-N</th>
<th>df</th>
<th>t-test</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ŠUTG$</td>
<td>60,60</td>
<td>62,32</td>
<td>22</td>
<td>-1,04</td>
<td>0,30</td>
</tr>
<tr>
<td>$ŠUT%$</td>
<td>46,96</td>
<td>42,42</td>
<td>22</td>
<td>3,53</td>
<td>0,00</td>
</tr>
<tr>
<td>$ŠUT2%$</td>
<td>36,92</td>
<td>39,43</td>
<td>22</td>
<td>-1,29</td>
<td>0,20</td>
</tr>
<tr>
<td>$ŠUT3%$</td>
<td>53,76</td>
<td>47,94</td>
<td>22</td>
<td>3,61</td>
<td>0,00</td>
</tr>
<tr>
<td>$ŠUT3P$</td>
<td>23,68</td>
<td>22,89</td>
<td>22</td>
<td>0,54</td>
<td>0,58</td>
</tr>
<tr>
<td>$ŠUT3P%$</td>
<td>36,06</td>
<td>32,09</td>
<td>22</td>
<td>2,73</td>
<td>0,01</td>
</tr>
<tr>
<td>$FT%$</td>
<td>76,79</td>
<td>74,10</td>
<td>22</td>
<td>1,05</td>
<td>0,30</td>
</tr>
<tr>
<td>$SKOK$</td>
<td>36,19</td>
<td>33,30</td>
<td>22</td>
<td>2,09</td>
<td>0,04</td>
</tr>
<tr>
<td>$SKOKDF$</td>
<td>25,84</td>
<td>24,29</td>
<td>22</td>
<td>1,11</td>
<td>0,27</td>
</tr>
<tr>
<td>$SKOKOF$</td>
<td>10,37</td>
<td>9,83</td>
<td>22</td>
<td>0,71</td>
<td>0,48</td>
</tr>
<tr>
<td>$ASS$</td>
<td>19,10</td>
<td>17,73</td>
<td>22</td>
<td>1,30</td>
<td>0,20</td>
</tr>
<tr>
<td>$TOURN$</td>
<td>12,70</td>
<td>13,46</td>
<td>22</td>
<td>-1,19</td>
<td>0,24</td>
</tr>
<tr>
<td>$STOL$</td>
<td>6,50</td>
<td>7,13</td>
<td>22</td>
<td>-1,19</td>
<td>0,24</td>
</tr>
<tr>
<td>$POENG$</td>
<td>81,87</td>
<td>72,76</td>
<td>22</td>
<td>3,80</td>
<td>0,00</td>
</tr>
</tbody>
</table>

Legend: Mean successful - arithmetic mean of the group successful; Mean unsuccessful - group's arithmetic unsuccessful; t value - the value of the t-test coefficient for testing the significance of the differences; Df - degrees of freedom; p - coefficient of significance difference arithmetic mean; * - statistically significant level of differences in arithmetic meanings.

Chart 1. Percentage of the success of the total penalty at the match

The mid-range chart for the percentage of shots indicates that better placed teams are four percent more successful in overall squad play than the weakly placed teams.

Chart 2. Percentage of success of two-point shots
The mid-range figure of the variable percentage of the two-point shot indicates that the better placed teams are for six percent more successful than the weakly placed teams.

Chart 3. Percentage of success of the penalty for three points

The mid-range figure of the variable percentage of the shot for three points indicates that better placed teams are four percent more successful than weakly placed teams. For example, the results in the work (Ćeremidžić, D.) from 2010 in a survey conducted on the sample of basketball teams of the NLB and NBA League in the regular part of the season when the distance of the line for three points was 6.25 meters indicates that the teams from the then NLB League have a lower percentage of shots for three points 35.73% of the team from Euroleague 37.25%. When we compare these percentages with the percentages of successful teams from this research we can notice that the differences are minimal (36.06), which is not the case with unsuccessful teams, which achieved far less percentages in this variable (32.09).

Graph 4. Number of jumps per game

The chart of mean values of the variation total jump shows us that better placed teams for three jumps on average per game are more successful than weakly placed teams. When we compare the data with the survey (Ćeremidžić D) conducted on the team from Euroleague, we can conclude that the total jump in the match differs in one attempt (36,19-34,37) in favor of the successful teams from the 2017 European Championship.

Graph 5. Number of points per game
The average median score of the variable total number of points scored in the match indicates that the better placed teams for 9 points were average per match more successful than the weakly placed teams (81-72).

**Regression analysis**

Regression analysis has determined the connection of the predictor variables (fourteen parameters of situational efficiency) with the achieved placement at the European Championship 2017. The value of the multiple correlation coefficient is R 0.962, and it serves to determine the quality of the prediction of the dependent variable, in this case the placement of the team. The value of 0.962 represents a good predictor level. The "R Square" column represents the decision-making coefficient, i.e. the proportion of the dispersion of a dependent variable that can be explained independently. Our value of 0.925 is 92.5% of the variability of the dependent variable that can be explained by the independent variable, so the binding strength is very strong.

<table>
<thead>
<tr>
<th>MODEL</th>
<th>R</th>
<th>R²</th>
<th>Adjusted R²</th>
<th>Std.Error of estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.962</td>
<td>0.925</td>
<td>.844</td>
<td>2.90</td>
</tr>
</tbody>
</table>

The F-value in the table ANOVA, which is shown below, tests whether the regression model is good for these values. The table shows that independent variable well-statistically predict the dependent variable that has been placed in this study. In other words, the regression model is good.

**Table 4. Analysis of variance**

<table>
<thead>
<tr>
<th></th>
<th>Sums of - Squares</th>
<th>df</th>
<th>Mean - Squares</th>
<th>F</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regress.</td>
<td>1160.72</td>
<td>12</td>
<td>96.72</td>
<td>11.43</td>
<td>0.00</td>
</tr>
<tr>
<td>Residual</td>
<td>93.01</td>
<td>11</td>
<td>8.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1253.74</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CONCLUSION**

It can be noted that the situational efficiency in the basketball game is in direct relation with the achieved placement, i.e., the connection directly influenced the general placement of national team representations at the European Championship 2017. The distribution of situational efficiency parameters on average follows the "usual" distribution of events at the basketball level and basketball competition as a whole, which are statistically significantly related to each other. On the basis of the given variables for the assessment of situational efficiency, we have established that the representations of the participants with a better overall percentage of shots, the percentage of shots for two and three points, more achieved jumps
and higher points on average per game during the European Championship have a better performance.

REFERENCES

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ADDITIONAL EXERCISES FOR DEVELOPMENT OF MOTOR SKILLS OF YOUNG KARATE PLAYERS

Summary

The study was done on a sample of 80 selected cadet karate players aged 14 and 15, chosen from the following karate clubs: KK "Omladinac", KK "Glasinac", KK "Sokolac", KK "Iliđa", Istočna Ilidža, KK "Pale", KK "Rogatica", and KK "Sarajevo", Sarajevo. The subject of this study is assessment of quantitative and qualitative changes in motor skills during a three-month experimental treatment applied in the main part of karate training of young karate players. The main aim of this study is to determine the impact of additional exercises on the development of basic motor skills in segmental and sprint velocity of participants in the experimental group. The sample was divided into two homogenous subsamples on the following way: the first subsample counted 40 and made the experimental group. In that group were karate players who, in the process of regular training realisation, in the first part of the training, did the exercises from planned contests in 60% time, while the other 40% was reserved for the realisation of the model additional exercises for motor skills development of karate players. The second subsample with 40 participants made the control group. There were karate players who, in the process of regular training realisation, in the first part of the training, did the exercises from planned contests in 100% time. For assessment of basic motor skills we applied a set of tests assessing the areas of hypothetical factors which are supposed to be responsible for the realisation of specific movement structures in karate. Variables which are used in this work are: Segmental velocity (foot tapping, hand tapping, tapping foot against the wall); Sprint velocity (Running 20 m high start; Running 40 m high start; Running 60 m high start).

The results gained in this study show the positive impact of the experimental treatment, based on statistically significant difference between initial and final measurements made in the experimental group. The significant impact of the applied model of exercises is probably the result of the appropriate methodological model of experimental program of additional exercises and adequate intensity timing and volume of burdening which was tailored to abilities and characteristics of the practitioners. According to the carried out statistical analyses, it can be concluded that programmed training, with main and additional exercises, had influenced on quantitative and qualitative changes in motor skills of children karate players, in terms of basic motor abilities.

Key words: experimental treatment, motor skills, karate
INTRODUCTION
Karate is arguably one of the most popular martial arts practiced worldwide and it is
consisted of twocompetition disciplines- kata and combat.In the earlier periods of karate
development it had similar requests according to the training and assessment of the
competitive practice in both disciplines and traditional training contained the techniques of
practice,kata and sparing (Imamura et al. 1998). Changes in judmental rules,especially in
sport combats, have led to significant differences in trainings and competitive requests in kata
and combats(Jovanović i Mudrić, 1995), thus in modern karate we rarely can find cases of a
competitor taking part in in both disciplines.

Researches have shown that systematical longlasting karate trainings can affect the
improvement of basic motor skills, which are mostly exercises aimed for development of
burst strenght,speed andcoordination (Simonović, 2010Kuleša, 1985., Arlov, 1997., Kovača.,
2003 i 2008., Blažević, Katić i Popović, 2006). Exercises which are applied in practising
a customer activate the whole musculature and develop left and right part of the
body equally,avoiding developing of just one part,which happens in some sports.The main
features of karate are fast, explosive movements with controlled strenght of realisation to
opponent.

Training work with school children ,as in all other sports,is distinguished from older-aged
practitioners in applied methods and means.In this age more attention is given to technical
preparation,thus the work is objected to acquisition of basic karate techniques.The purpose of
this study was to determine the influence of additional exercises on the development of basic
motor skills,segmental and sprint velocity of practicioners in the experimental group.Special
aim of the study in control group practicioners is to determine the influence of the exercises
on the development of motor skillisin segmental and sprint velocity,tailored by plan and
programme.The research was aimed on valorisation of additional exercising model on the
development of anthropological features of young karate players.

It is expected that gained results will contribute to better quality realisation of training
processes of young karateists by making inovations in plan and programmes of a training
process.

The methods
Sample of participants
The sample was made up by 80 boys, mean age 14-15,and then divided into two equally
homogenous subsamples in the following way:
The first subsample consisted of 40 participants who made experimental group.It was made
by karateists who attended regular katate trainings and who did in the first part of training
exercises from plan and program contests in 60% time,while the other 40% was reservedfor
realisation of the additional exercise models aimed to develop the motor skills of karate
players.

The second subsample consisted of 40 participants who made control group.It was made by
karate players who,in a process of karate training realisation,in the main part did the exercises
set by plan and programme in 100% time.

Average height and mass of the experimental group:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Arithmetic mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body height</td>
<td>157,32</td>
<td>6,15</td>
</tr>
<tr>
<td>Body mass</td>
<td>47,15</td>
<td>7,30</td>
</tr>
</tbody>
</table>

Average height and mass of the control group:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Arithmetic mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body height</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body mass</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
For all participants involved in the research there were earlier defined conditions to be fulfilled:

- To be healthy;
- To be involved into regular trainings during experimental period (experimental group);
- To be involved into all measurements of motor skills.

Before the experimental programme was started and after its three-month completion, both groups of participants were tested motor skills with 6 measuring instruments (tests) for estimating segmental and sprint velocity. Tests were selected on base of instructions and recommendations of Kurelic and associates, 1975.

The experimental programme of additional exercises lasted three months with three training (60 minutes individually) per week on regular karate training. During the experimental period two measurements of motor skills were carried out (at the beginning of the experiment, the initial measurement and at the end of the experiment final measurement) for all participants of the experimental and control group.

<table>
<thead>
<tr>
<th>Table 1. Programme of additional exercises for the experimental group.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Initial diagnosis of motor skills</strong></td>
</tr>
<tr>
<td>Sprint exercises</td>
</tr>
<tr>
<td>Coordination exercises</td>
</tr>
<tr>
<td>Explosive power exercises</td>
</tr>
<tr>
<td>Flexibility exercises</td>
</tr>
<tr>
<td>Agility exercises</td>
</tr>
<tr>
<td>Shape exercises</td>
</tr>
<tr>
<td>Stretching exercises</td>
</tr>
<tr>
<td><strong>Final diagnosis of motor skills</strong></td>
</tr>
<tr>
<td>The whole number of lessons</td>
</tr>
</tbody>
</table>

**Sample of variables and measure instruments**

For the assessment of basic motor skills a set of tests measuring segmental and sprint velocity. Tests for assessment of segmental velocity:

- Hand tapping MTAPR
- Foot tapping MTAPN
- Tapping foot against the wall MTAPZ

Tests for assessment of sprint velocity

- Running 20 m high start M20VS
- Running 40 m high start M40VS
- Running 60 m high start M60VS
Applied set of motor variables was taken from the research Kurelic, Momirovic, Stojanovic, Sturm i Viskic-Stalec, 1975.

The participants in the control group did the main part of the karate training which was made earlier for that age group of karatists.

Work in the experimental group, within the model of additional exercises for development of segmental and sprint velocity, was based on applying the following exercises:

**Sprint exercises**
- *Increase in sprint frequency:* fast skipping, exercises with a rope, sprints with fast heel striking, short pace running
- *Development of maximum acceleration with variable content:* Different pace running (the same frequency) running with changing the position of the knees, running under, above and around the high-jump uprights
- *Progressive increase of speed:* running in alternative acceleration until the maximum speed
- *Maximum speed running:* Running 20-40m high or flying start.

**Coordination exercises**
- *Acrobatics:* forward roll + standing-up, flying forward roll + standing –up, backward roll + standing-up.
- *Skipping the rope:* in place, in pair, in a group
- *Walking and running:* inversion and eversion of lower leg, walking on the line, on tiptoes, on heels, on the inner and outer sides of feet.

**Explosive power exercises**
- *Half squat jumps:* from half squat position jump laterally, zig-zag or backwards
- *Jump on the hurdles:* one-foot or two-feet jump on the hurdles (30 - 40 -50 cm).
- *Explosive power jumps:* long-distance jump, triple jump, fifth jump, high-jump from place or in short flying.

**Flexibility exercises**
- *Rotation of torso leaning forward:* stretching of hips, belly and thigh; while bending forward move right hand to the left foot, left arm hold up for 4 to 6 seconds. Then return to start position
- *Leaning forward while sitting with feet on the ground:* extension of the shoulder muscles, upper thigh and calves.

**Agility exercises**
- *Running from different positions:* from lying on the stomach-forward; : from lying on the back-forward; : from lying on the stomach-forward-rotation for 90°; from lying on the back-forward-rotation for 90°; from lying on the side-forward-rotation for 270°; forward-rotation for 90°;
- *Running with direction change:* running in winding directions, zig-zag running around marks, forward-backward with stops, running in triangle, running around eight-shaped uphold
- *From slow running forward change direction to linear movement in high skipping:* focus is on fast change of way of moving, focus on jump with a leg (from direction of frontal movement)

**Shape exercises**
- *Exercises for shaping shoulder muscles:* front and side cicles with both arms higher amplitude, turning hands around and moving backward, stretching the rubber rope in pose of moving backward.
• **Exercises for torso shaping**: moving hands backward with higher amplitude in standing, kneeling and lying position, hyperextensions in standing and sitting position, moving torso to the left and to the right.

• **Exercises for pelvic and legs**: Hypertensions of torso, moving torso in circles, moving legs forward and backwards with high amplitude, circular body movements in feet and hips joints circles, squats ful leg flexion.

**Streching**
- Stretching of shortened muscles, especially large chest muscles, bicepces, muscles for moving hand and fingers, pulling both feet with hands; deep body movement forward with bended legs "cats sat"; sitting with bended legs, pushing hands forward, pulling knees to the chest.

For determination of the intergroup differences between initial and final measurement, Multivariance (MANOVA) and Univariance analysis of variance (ANOVA) were counted, and significance of differences between initial and final measurement were counted in cannonical discriminative analysis.

**RESULTS**

**Variance analysis**
Multivariante analysis of variance in motor skills between experimental and control group of participants on initial measurement.

**Table 2.** Multivariate analysis of variance in motor skills between experimental and control group of participants on initial measurement

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean (E)</th>
<th>Mean (K)</th>
<th>F-relation</th>
<th>P-Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTAPR</td>
<td>37.57</td>
<td>36.57</td>
<td>1.34</td>
<td>.126</td>
</tr>
<tr>
<td>MTAPN</td>
<td>25.64</td>
<td>26.33</td>
<td>1.37</td>
<td>.135</td>
</tr>
<tr>
<td>MTAPZ</td>
<td>14.87</td>
<td>15.43</td>
<td>1.44</td>
<td>.165</td>
</tr>
<tr>
<td>M20VS</td>
<td>4.20</td>
<td>4.48</td>
<td>1.55</td>
<td>.149</td>
</tr>
<tr>
<td>M40VS</td>
<td>6.55</td>
<td>6.45</td>
<td>1.48</td>
<td>.165</td>
</tr>
<tr>
<td>M60VS</td>
<td>8.46</td>
<td>8.64</td>
<td>1.43</td>
<td>.152</td>
</tr>
</tbody>
</table>

*Legend: Aritmethical mean experimental group (Mean (e)), ritmetahical mean control group (Mean (k)), value F-test (F-relation) and level of significance (Q)*

Analysing table 2.in which are shown the results of testing the significance of importance on the level of arithmetic means in all motor tests between intial measurement of samples in experimental and control group. It is not determined statistically important difference, because WILK'S LAMBDA is .725, what Rao's F-aproximation from 1.46 gives significance in differencies on the level of Q= 252. According to that, in applied system of motor skills of participants statistically signnificant differences are not distinguished.

**Table 3.** Univariate analysis of variance in motor skills between experimental and control group on initial measurement.
Table 3 shows univariate analysis of variance motor abilities compared with results of arithmetical mean of experimental and control group on initial level. On the basis of coefficients F-relations and their significance (P-Level) it could be said that statistically significant difference in levels of motor skills between experimental and control group is not distinguished.

**Multivariate analysis of variance in motor skills between experimental and control group of participants on final measurement**

Table 4. Multivariate analysis of variance of motor abilities between the experimental and control group at the final measurement

<table>
<thead>
<tr>
<th></th>
<th>Wilks' Lambda</th>
<th>Rao's R</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.182</td>
<td>10.88</td>
<td>.001</td>
</tr>
</tbody>
</table>

*Legend: values of Bertletes test (Wilks' Lambda), Raova F-approximation (Rao's R) and level of significance (Q)*

Table 4 shows the results of the multivariate analysis of the variance between the participants of experimental and control groups on the final measurement indicate that there is statistically significant intergroup difference in WILK’S motor skills since LAMBDA is .182, which by Rao’s F-approximation of 10.88 gives the significant difference at the level of Q = .001. Accordingly, statistically significant differences were found in the applied motor skills of participants.

**Table 5. Univariate analysis of variance of motor skills between the experimental and control group at the final measurement**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Means (E)</th>
<th>Means (K)</th>
<th>F-relation</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTAPR</td>
<td>39.87</td>
<td>41.30</td>
<td>5.65</td>
<td>.000</td>
</tr>
<tr>
<td>MTAPN</td>
<td>27.32</td>
<td>28.24</td>
<td>4.50</td>
<td>.000</td>
</tr>
<tr>
<td>MTAPZ</td>
<td>15.54</td>
<td>17.05</td>
<td>4.94</td>
<td>.003</td>
</tr>
<tr>
<td>M20VS</td>
<td>3.54</td>
<td>4.35</td>
<td>4.47</td>
<td>.000</td>
</tr>
<tr>
<td>M40VS</td>
<td>5.84</td>
<td>6.34</td>
<td>5.52</td>
<td>.002</td>
</tr>
<tr>
<td>M60VS</td>
<td>7.95</td>
<td>8.58</td>
<td>6.43</td>
<td>.004</td>
</tr>
</tbody>
</table>

*Legend: arithmetic mean of experimental group (Mean (e)), arithmetic mean of control group (Mean (k)), value F-test (F-relation) and level of significance (Q)*

Table 5 shows a univariate analysis of variance of motor skills tests by comparing the results of the arithmetic mean of the experimental and control group at the final measurement. Based on the coefficients of F-ratio and their significance (P-Level), it can be concluded that a statistically significant difference in the level of motor abilities between the experimental and control group in all motor tests: in hand tapping (MTAPR .000), foot tapping (MTAPN .000), tapping foot against the wall (MTAPZ .003), running 20 metres (M20VS .000), running 40 metres (M40VS .002) and running 60 metres (M60VS .004).

**Cannnonical discriminative analysis**

**Differences between initial and final measurements of motor skills in control group**

**Table 6. Significance of isolated discriminative function of experimental group**

<table>
<thead>
<tr>
<th>Disc Func.</th>
<th>Eigenvalue</th>
<th>Canonical R</th>
<th>Wilks' Lambda</th>
<th>Chi-Sqr.</th>
<th>df</th>
<th>P-Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.272</td>
<td>.74</td>
<td>.237</td>
<td>93.77</td>
<td>6</td>
<td>.000</td>
</tr>
</tbody>
</table>

*Legend: coefficient of determination (Jenta (Eugen value), coefficient of canonical correlation (Canonical R), values of Bertletes test (Wilks’ Lambda), size of Hi square test (Chi-Sqr), degrees of freedom (df) and level of importance of coefficient of determination (P-Level)*

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We got significant discriminant function of high intensity (CR = 74%) which shows correlation set of data which was base for discriminative analysis gained results (table 13). Results of discriminative strength of motor variables are shown in test Wilks-Lambda (.237), what indicates that differences between initial and final measurement in space of experimental group motor skills are significant (p = .000). Because size of Hi square test has high value (Chi-Sqr = 93.77).

**Table 7.** Factor structure of isolated discriminative function in experimental group.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Root 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTAPZ</td>
<td>0.601</td>
</tr>
<tr>
<td>MTAPN</td>
<td>0.586</td>
</tr>
<tr>
<td>M60VS</td>
<td>0.544</td>
</tr>
<tr>
<td>MTAPR</td>
<td>0.514</td>
</tr>
<tr>
<td>M40VS</td>
<td>-0.500</td>
</tr>
<tr>
<td>M20VS</td>
<td>0.400</td>
</tr>
</tbody>
</table>

Table 13 gives the structure of discriminant functions of involving motor abilities variables in forming significant discriminant functions. Shown centroids of groups represent arithmetic mean of results from initial and final measurement of additional exercises models, measured with six motor tests. These test are supposed to be good predictors of space research. Shown results indicate that greatest contribution in discriminant function has tapping foot against the walls (MTAPZ 0.601), foot tapping (MTAPN 0.586) and running 60 meters (M60VS 0.544). The obtained results of the discriminatory analysis of motor skills in the final versus the initial measurement in the experimental group indicate that under the influence of the model of additional exercises, there were significant changes in the motor skills of the participants.

**Differences between initial and final measurements of motor skills in control group**

**Table 8.** Significance of the isolated discriminatory function of the motor abilities of the control group

<table>
<thead>
<tr>
<th>Disc</th>
<th>Eigenvalue</th>
<th>Canonical R</th>
<th>Wilks' Lambda</th>
<th>Chi-Sqr</th>
<th>df</th>
<th>P-Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Func</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.624</td>
<td>.27</td>
<td>.786</td>
<td>17.28</td>
<td>6</td>
<td>.196</td>
</tr>
</tbody>
</table>

**Legend:** Coefficient of discrimination (Eigenvalue), coefficients of canonical coleration (Canonical R), values of Bertletos test (Wilks' Lambda), size in Hi square test (Chi-Sqr), degrees of freedom (df) and level of significance of coefficient of determination (P-Level)

A discriminating medium-intensity function CR = 27% was obtained which shows the correlation of the data set on the basis of which a discriminatory analysis of the results obtained was performed (Table 16). The results of the discriminative strength of the variables were given by the Wilks' Lambda test (.786), which confirms that the differences between the initial and final measurements in the area of motor control capabilities of the control group are not significant (P-Level = .196), since the size of the square of the test has a low value (Chi-Sqr = 17.28).

**Table 9.** Factor structure of the isolated discriminative function of the control group

<table>
<thead>
<tr>
<th>Variables</th>
<th>Root 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTAPR</td>
<td>0.398</td>
</tr>
<tr>
<td>MTAPN</td>
<td>0.286</td>
</tr>
<tr>
<td>MTAPZ</td>
<td>0.275</td>
</tr>
<tr>
<td>M20VS</td>
<td>0.183</td>
</tr>
<tr>
<td>M40VS</td>
<td>0.146</td>
</tr>
<tr>
<td>M60VS</td>
<td>0.100</td>
</tr>
</tbody>
</table>
Table 9 shows the structure of the discriminatory function of the participation of variables of motor skills in the formation of significant discriminatory functions. The indicated centroid groups represent the arithmetic means of the initial and final measurement results. In order to determine the significance of differences between the initial and final measurements, the control group measured six motor tests, which are assumed to be good predictors of the investigated space. The results shown are all the coefficients of the value set, and on the basis of the total contribution of all motor tests it can be concluded that there were not statistically significant transformation processes in the motor space of the control group of the participants.

**DISCUSSION**

Technique learning or technical preparation begins with teaching and continues with training aimed to acquisition of movement habits. To do a karate technique properly and effectively it is needed to have a certain level of motor skills. Development of motor abilities and technical preparation are connected and dependable, which means that the development of karate techniques is affected by development of motor skills and vice versa. It is widely known (Malacko, 2008) that giving action to one part of anthropological characteristics has effects on the whole range of other organic systems and segments, which is especially remarkable in situations when good results are required.

Anthropological characteristics of school children (acc. Malacko, 2002; Pržulj, 2007) could be developed in "sensible phases", which are made in periods when on the basis of natural laws the most significant speed of development of particular skills and characteristics happens, increase adaptional possibilities compared to egsogene factors and favourable assumptions gaining certain motor abilities are formed. In period aged between 10-15 child organism is liable to outer influences although they are similar to elementary tendencies of natural flow of changes.

Changes of anthropological dimensions of school children are featured with longer trainings, material needs and teacher's or trainer's knowledge whose field of work should be based on knowing the global manifestations and rules which are fundamental for successful planning of appropriate transformation treatment.

Because of all these things application of adequate scientific processes for assignement of the dimensional structures, their relations and development rules and diagnostics procedures which enable control of work effects are extremely important. Beside that, it is essential to determine reliable measure instruments for tracking states and dimensional changes which are intended to be developed with the application of physical exercises.

The results gained in this study show the positive impacts of experimental treatment, based on statistically significant difference between initial and final measurement in the experimental group. Significant impact of applied programme model of exercises probably occurred because of appropriate methodological plan of experimental programme of additional exercises, adequate intensity timing and volume of burdening which was tailored to abilities and characteristics of the practitioners.

**CONCLUSION**

Based on the conducted statistical analyses, it can be concluded that the programmed training, with main and additional exercises, influenced qualitative and quantitative changes in the motor skills children-karate players in the area of basic and specific motor skills.

Furthermore, it was noticed that programmed karate training with its contents significantly improved the motor status of the entity relative to the initial state. Both the initial and final states of both groups in the tested motor variables are statistically significant.
This study has shown that the motor skills of boy karate players aged 14 to 15 under the influence of karate training are developed linearly, and if they want to achieve the same effects at the age of 14 to 15, transformation processes must be strengthened by applying higher values of extensiveness and intensity of load.

In order to determine the influence of additional exercises for the development of motor skills of the selected young karate players we analyzed the results obtained on a sample of 80 participants - young karate players. A canonical correlation analysis was used to determine the influence of additional exercises for the development of motor skills.

REFERENCES

SHOULDER JOINT INJURIES IN SPORTS WITH SPECIAL EMPHASIS ON HUMEROSCAPULAR LUXATION

Summary
This paper attempts to address shoulder injuries in sports, with a special emphasis on the luxation of the humeroscapular joint. The most common sports with this type of injury are also listed. The anatomy of the joint is described, the pathoanatomical damage that occurs after injury, symptomatology, diagnosis and therapy through a conservative operative approach. It should be noted that the incomplete or unsatisfactory process leads to the return of the injury and thus to the prolongation of treatment and to longer absence from sports activities and in some cases causes the termination of the sporting career. It is therefore necessary to take a serious approach to the treatment of this injury and that only fully recovered athletes continue to engage in sports.

Key words: luxation, humeroscapular joint, injuries, pathoanatomical damage, symptomatology, diagnostics, treatment

INTRODUCTION
The shoulder joint is anatomically and functionally composed of two joints, scapula and humerus and acromion and clavicle. It is vulnerable to injury in almost all sports, especially in martial arts. Injuries can be caused by the action of a direct or indirect force, usually by falling on an arm or by a collision with an opponent. The injury is diagnosed by the position of the arm that is adducted and rotated in the field, and the injured person holds it with another hand. First aid is given on the spot if a physician or trainer is present, who can easily relocate the joint by a simple maneuver. If this fails, the patient is sent to a health facility where they can be treated in general anesthesia. After the relocation comes the period of immobilization and then the rehabilitation treatment and the introduction into the training process. Recurrence of such injuries is frequent, and if the physician fails to stabilize the condition, then surgery is necessary. After the surgery comes the rehabilitative treatment and finally assessment whether the injured party has fully recovered to be able to respond to the requirements of the sport.

DISCUSSION
The anatomy of the shoulder joint
The shoulder joint is extremely maneuverable and allows the hand that free-floating in space. The glenoid cavity is very shallow and considerably smaller than the head of the humerus, so the bone congruence is considerably smaller. On the edge of the glenoid cavity is the glenoid labrum, a fixed and partially movable fibrous structure, wedge-shaped on the cross-section, stretching along the edge of the glenoid, increases the congruency of the joints of the body, allowing for a certain degree of mobility and amortizing impacts. Joint capsule is quite wide. The ligaments are thin but are enhanced by muscle tendons that penetrate into the caura.
Muscles with tendons next to the capsule are: supraspinatus, infraspinatus, subscapularis and teres minor. They give the stability to the joint and are usually called rotary cuffs. Especially important is the supraspinatus muscle. The peripheral muscles around the shoulder joint, trapezius deltoideus, biceps and others give additional stability to the joint. Despite this, the shoulder joint is the most unstable of all joints. The reason for this is its high mobility. The shoulder joint is vulnerable to injury in almost all sports, especially martial arts, rugby, wrestling, skiing, boxing, athletics, games with balls, some gymnastic disciplines and others.

Humeroscapular joint luxation. Pathoanatomical joint damage after injury, clinical picture, diagnosis and treatment. Luxation is a complete loss of contact of the joints, and subluxation is a partial loss of contact. The luxation of this joint is the most common in the following sports: rugby, wrestling, skiing, football, gymnastics, etc. The mechanism of luxation occurs when the shoulder movements are stopped by an object, a teammate, etc, but the body continues to move. Great force puts pressure on the shoulder joint, the capsule breaks and the head drops out of the scapula. Sometimes raising a hand over the head (throwing) and sudden muscle twitching (throwing) can lead to luxation. Repetition of activities in these sports can lead to stretching of the capsule and ligaments. Luxation can also be created by indirect force, by falling on an arm, especially if rotation occurs at that moment. During luxation, the capsule and ligaments, especially the glenohumeral, are sprained, more often torn, especially at the first luxation. Often an avulsion arises from the clavicle of the glenoid cavity of the bone. Considering the character and poor vascularisation of the same, its recovery is very slow. This process will lead to the looseness of the joint capsule and tendons of the subcapsularis, and thus to the damage of the rotary cuff. Bankart lesion is best diagnosed by ultrasonography and magnetic resonance.

When luxation occurs, a large tuberculum is rarely rejected. It is often dislocated, but it can be relocated during the relocation. If after the relocation it remains five or more millimeters apart, or in rotation greater than 50 degrees, then surgical therapy is required. Anterior dislocations are more frequent, with the head in front of the glenoid below the coracoid. They are clinically recognized by the position of the arm, which is in abduction rotated in the field and the patient supports it with the other hand. Locally there is a gap at the point of the joint, and in front of the shoulder is the head of the humerus. There may be a dislocation of the head below the glenoid in armpit. It usually occurs with a fall on an outstretched arm. The arm remains raised upward so this injury is called luxatio erecta.

The diagnosis of anterior and erectile luxation is easy. In cases where this is possible, the injury should be verified by a two-way x-ray scan. It will then be easy to see the possible fracture of the large tuberculum. Prior to each intervention, attention should be paid to the possible presence of a neurological lesion. The first aid is to place the patient on a flat surface and to monitor the movements of the arm. It is performed with an arm strap under 90 degrees in relation to the longitudinal axis of the body. The traction is performed gradually, with a soft massage of the arm to relax the muscles. The successful relocation is easily felt by the repositioning phenomenon, and the arm returns to its physiological position. The pain quickly disappears. In muscular athletes this maneuver often fails. Then it is necessary to refer to an institution where there is a possibility of general anesthesia with relaxation. Then the relocation is very easy and relatively successful. The rough techniques called Kocher's Method and Hippocratic Method are no longer recommended.

After relocation and radiological verification of the quality of the position, it is necessary, especially for repeated luxations, to carefully analyze the head of the humerus, or its convexity. Sometimes there is an impression on the back of the calotte that facilitates future luxations. If this impression affects more than 1/5 of the head's convexity, an operative procedure is needed. This procedure requires a lot of experience. After the achieved
relocation, orthopedically or by a surgical procedure, the arm is immobilized for three to six weeks. The neurological damage must be examined again.

**Posterior luxation of the shoulder joint**

This luxation is quite rare. It occurs by sliding the humerus head behind the glenoid, usually when the arm is held back, and the body falls forward. Diagnosis is easily overlooked. The arm is abducted inside, and the hand is facing backwards. Diagnosis is best confirmed by radiography. The relocation should be performed in general anesthesia and immobilized in an induced position in the outer rotation of the arm. More frequent radiological control is necessary because recurring luxations are frequent. In case of unstable relocation, there is a surgical stabilization of luxation, closure of the capsule and sewing of torn ligaments.

**Recurrent luxation of the shoulder joints.**

It is a dislocation that occurs if the previous one hasn't healed properly. The mechanism of emergence is the same, but less force is required. Diagnosis is set in the same way, the relocation is easier, sometimes so easy that the patients themselves can do it with the other hand. Risk factors are: insufficient or rather insufficiently long immobilized first luxation, torn of ligaments and capsule, separation of labrum from the glenoid.

A separate labrum prevents the healing of the articular capsule, rarely coalesces to the bone, so that the capsule attached to it remains looser. If sports activities continue, the loosening of the entire joint will occur, a precondition for the weakness of the rotary cuff. These injuries are most common in young people, especially women who train contact sports. Constant injuries can lead to the loss of capacity for a greater number of sports.

**Preventive measures**

In order to ensure the stability of the shoulder joint and to minimize injury, it is necessary to strengthen the shoulder musculature and especially the m subscapularis, supra et infraspinatus and teres minor, which is partially or wholly inserted into the joint capsule.

After an injury to the shoulder, regardless of whether it is luxation or subluxation, the treatment must be fully implemented: diagnostic, relocation, immobilization and physical treatment. The timing of the return to sports activities is determined by full restoration of muscular strength and painless movement in the shoulder.

**CONCLUSION**

Shoulder joint injuries, most commonly luxation of the humeroscapular joint, is a common occurrence in certain sports. Primarily in martial arts, gymnastics, athletics, throwing disciplines, the ball game where the hand is in the foreground, by a direct or indirect force which leads to a complete loss of contact of the articulate bodies.

The treatment of the injury must be complete and after that it is decided whether the person can return to the sports activities. Any injuries that are not fully remedied will lead to repetition of the same, prolonging the absence from sports activities. Recurring injuries tend to weaken the entire shoulder belt and in some situations the consequences are so pronounced that the injured person is not able to continue with the sport. Therefore, it is necessary to properly strengthen the musculature of shoulders, and to work on the improvement of technique in sports where hands are in the foreground. Any injury to the shoulder joint and humeroscapular joint must therefore be fully remedied in order to continue to engage in sports and to avoid new injuries.
REFERENCES


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