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THE SYSTEM OF FUNCTIONING OF THE SPORTS FEDERATION, DEPENDING ON STRUCTURAL AND FINANCIAL INDICATORS

SISTEM FUNKCIONISANJA SPORTSKOG SAVEZA U ZAVISNOSTI OD STRUKTURALNIH I FINANSIJSKIH POKAZATELJA

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ABSTRACT

Sports clubs are the bearers of sport development in every community. The Municipal Sports Associations in Serbia (e.g. municipality of Mionica) recorded very poor results in an overview of regular physical exercise among the general population. Indeed, 96.45% of the residents of the municipality of Mionica do not exercise regularly. Of the total number, 88.7% of Mionica's population lives in rural areas. Estimates put approximately 1,000 Mionica's residents per one sport club. The municipality annually allocates only 445 dinars (3.7 euros) for sports per resident. Considering the financial constraints, administrative and HR-related solutions were proposed in order to increase the population's participation in sports activities. For more significant changes, urgent, active action is needed in terms of cooperation between all sports organizations, in addition to the health, educational and business organizations on a local level. Offered activities must rely on the interest of the population and their tradition. In the newly envisioned system, the Secretary General of the Municipal Sports Association would have the active leading role, with greater authority, as well as performance-based funding. The newly defined model for sports organization on the territory of the municipality needs to be researched in practice, so as to examine the pros and cons of the new system.

Key words: *evaluation, sport strategy, annual program, promotion, general secretary*

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INTRODUCTION

Sports clubs are the bearers of sport development in every community. The primary role of sports clubs as sports organizations is to be able to satisfy the community's needs, and interests regarding sport, in terms of an organized gathering for athletes of various ages, creating suitable conditions for their successful education, development, training and competing in the chosen field of sport, in order to achieve the best possible results, as well as organizing sport functions, maintenance, and construction of sport facilities and so on.

The topic of this paper is to identify the activities, specifics, structures and financing of sports clubs in the municipality of Mionica (The Republic of Serbia).

Aside from regular reports about work done on a local community level, there need to be further analyses of the purpose of sports clubs' work from the angle of strategic sports development, a decision made by Ministry of Youth and Sports („Službeni glasnik RS", number 1/15, 2014).

Therefore, measures were suggested for a fundamental change in the working of Municipal Sports Organizations that would lead not only to a better performance of sports clubs in municipalities, but would also contribute to the overall health, condition and capability of municipalities' residents.

Basic information about the municipality of Mionica

The municipality of Mionica administratively falls under the Kolubara district (municipalities: Valjevo, Mionica, Ljig, Osečina, Ub and Lajkovac). With an area of 329km^2, this municipality includes parts of two geographical regions Podgorina and Kolubara (Opština Mionica, 1995). In the aforementioned publication of the Geographical Insititute "Jovan Cvijić" of SANU, published on the 100th anniversary of Mionica being declared a town by king Aleksandar Obrenović, it is noted that the municipality of Mionica stretches to the borders of the Maljen and Suvobor mountains at the North and to the right bank of the Kolubara river, south of Belgrade in the North-Western region of Serbia. In close proximity to the municipality are several significant traffic routes (Ibar Highway lies 15km away from Mionica), as well as the highway route from Belgrade to Čačak, currently in construction. The distance between Mionica and the Belgrade-Bar railway and between Mionica and the airport for small aircraft in Divci is 7km. Regional traffic routes Divci-Mionica-Ljig and Županjac-Mionica-Divčibare connect Mionica with Belgrade (86km via Bogovađe, 94km via Divci), Valjevo (20km) and other places.

According to the results from the latest census of the population, households and dwellings in the Republic of Serbia (http://popis2011.stat.rs/?page_id=2162), which was organized in 2011, by the Statistical Office of the Republic of Serbia, in 36 populated places in the municipality of Mionica lives 14,355 residents, while 1,620 residents live in the municipal seat. The largest majority of the overall populations are Serbs with 96%. The national minorities make up 4%, the Roma being the largest with 2.45%, while the remaining 1.55% consists of ethnic Muslims, Croats, Montenegrins, Slovenians, Hungarians, etc. When taken into account, the official statistics published by the Statistical Office of the Republic of Serbia, pertaining to the population census over the past period, show a reduced number in the overall population, as well as demographic aging.

The average age of the municipality's population according to the

2011. census is 44.38, which is unfavorable when compared to the national average of the Republic of Serbia (42 years) (http://popis2011.stat.rs/?page_id=2162).
The rural population makes up 88.7% (12,715) of the municipality's residents, while the urban population only 11.3% (1,620). However, keeping in mind the constant prominent migratory patterns from rural to urban areas, this ratio has changed in the interim. In the municipality of Mionica, the populated areas are scattered with some households in the mountainous area inaccessible.

METHODS

This paper employs the method of theoretical analysis of official information previously obtained from the records of the Sports Association of the municipality of Mionica, and contents from scientific and professional literature, as well as the causal method with systematization of the author's professional experiences in the field of physical education, sports, and recreation, by applying logical, inductive and deductive reasoning.

RESULTS

Besides the rare newspaper articles, there is no exact information or saved documents about partaking in the sports, and physical culture during the 19th century, and the first half of the 20th century, although there are a few remnants, and passed down memories about the endeavours, and achievements of members from various sports clubs and organizations, like the 'Sokolsko Društvo' gymnastics club, 'Streljačka Družina' shooting clubs, football clubs, achievements in equestrian sports, and other competitions. The development of sports in the municipality's area during the interwar period was marked by the forming of the football club "Vojvoda Mišić" in Mionica which exists to this day under the name FC "Ribnica - Mionica" (Program razvoja sporta u opštini Mionica za period od 2016. do 2018. godine, 2016). The development of sports after World War Two, and especially during the 1970s and 1980s was marked by the forming of basketball, karate and chess clubs, followed by the women's first sports collective with its handball and volleyball clubs.

During the past few decades, many successful athletes that achieved notable results on both national and international level, in both individual and team sports, came from Mionica's sports clubs. Among Mionica's sports collectives, the chess club "Ribnica" from Mionica went the farthest in senior competitions, earning second place in a state tournament for two seasons in a row. Football club "Ribnica" from Mionica held the title "srpskoligaš" (third tier in Serbia's professional football League) for ten whole years starting from the 1995/6 season and was, on two occasions, on the brink of joining the Second League at the beginning of the 21st century. Basketball club "Mionica" was a regular member of former Yugoslavia's First League in the 1980s (third tier), while the women's volleyball club "Ribnica" has been competing for several years in the Second League (fourth tier competition).

However, it is the young athletes from Mionica who have achieved the most meaningful results, primarily the karatekas from the karate club "Mionica". Pioneer Nikola Sekulić is Serbia's current champion in katas in the blue belt rank, while Đurđa Rakić, and Jovan Belošević earned bronze

medals in the category for potential in katas. With this year's accomplishments, the karatekas from Mionica have kept up the tradition of excellent results that's been going on for three decades now. Jelena Tufegdžić (winner of the bronze medal in Balkan's Junior Championships, 7th place in Europe's Junior Championships), Milica Strainović, and Marija Starčević have as representatives of the karate club "Mionica" in junior categories, in addition to winning gold on national championships, also achieved considerable results internationally during the late 90s and the first decade of the 21st century. It is also worth pointing out the accomplishments of the women's volleyball club "Ribnice" whose juniors have reached Serbian League's semi-finals twice in the last five years. Additionally, the junior selection of football clubs "Ribnica" and "Vojvode", are members of Western Serbia's football league.

There are 14 active sports clubs on the territory of Mionica today with around 500 male and female athletes of different ages currently competing and achieving results in sports.

Active sports clubs in the municipality of Mionica

According to the records of the Sports Association of Mionica (Knjiga članova Sportskog saveza opštine Mionica, 2018), there are 14 active sports clubs on the territory of the municipality of Mionica (table 1). The most represented branch of sports in Mionica is football, with 9 active football clubs in the municipality's area. Karate, basketball, moto sport, women's volleyball, and swimming are represented with one active club each. More than half (8) of the active clubs are located in Mionica's center, the only urban area of the municipality. The rural areas seat 6 sports clubs, dedicated only to football, and found in villages Popadić, Komanice, Rajković, Donja Toplica, Gornji Lajkovac and Tolić.

Table 1. *Active sports clubs in the Municipality of Mionica*

Ser. Nu.	The name of the club	Head office	Sport
1.	Karate Club "Mionica"	Mionica	Karate
2.	Basketball Club "Mionica"	Mionica	Basketball
3.	Hard enduro Club "Ravna Gora"	Mionica	Moto sport
4.	Volleyball Club "Ribnica"	Mionica	Volleyball
5.	Swimming Club "Ribnica"	Mionica	Swimming
6.	Football Club "Ribnica"	Mionica	Football
7.	Football Club "Popadić"	Popadić	Football
8.	Football Club "Komanice"	Komanice	Football
9.	Football Club "Borac"	Rajković	Football
10.	Football Club "Toplica"	Donja Toplica	Football
11.	Football Club "Gornji Lajkovac"	Gornji Lajkovac	Football
12.	Football Club "Tolić"	Tolić	Football
13.	Football Club "Joks junajted"	Mionica	Football
14.	Football Club "Vojvode"	Mionica	Football

The oldest club on the territory of the municipality is the football club "Ribnica" from Mionica. It was founded in 1922 under the name "Vojvoda Mišić" and was inactive only for a short period of time during World War Two. The club changed names several times, and in 1950s was finally renamed to FC "Ribnica", a name it operates under to this day. The senior selection of the football club "Ribnica" competes in the Kolubara-Mačva League (fourth tier), the junior selection is a member of the Serbian League West (third tier), and the football club itself has a school for beginners.

Karate club "Mionica" is Mionica's sports collective that continues to achieve excellent results in their work with junior categories. Founded in 1986, it works predominantly with young athletes and consistently has representatives in katas at important national competitions in junior categories. The club boasts over fifty athletes today, both male and female, and among them is also Serbia's current pioneer champion in katas in the blue belt rank.

Basketball club "Mionica" had many ups and downs in its long history that spanned more than four decades. The club that was a regular member of the Serbian League in former Yugoslavia (third tier), and was responsible for spawning high caliber basketball players, Marjan Đurić ("Metalac" Valjevo), and Aleksandar Dragičević ("Partizan" Beograd), ceased to exist in the first decade of the 21st century. It was re-established in 2009, however due to the high costs of training, and practice in Valjevo which was unavoidable since Mionica didn't have its own sports facilities, the club soon fell into financial troubles. It was on the brink of extinction again in 2016, but the club managed to pull through, and since then, has worked on training solely junior selections of boys, and girls.

Volleyball club "Ribnica" was established in 2005, and competes exclusively in the women's sports category. The club trains more than 80 women of all ages. The seniors currently play in the Second League (fourth tier), with their junior, cadet and pioneer selections also participating in various tournaments.

Swimming club "Ribnica" was established in 2014 and, up until 2018, it only featured a summer school for non-swimmers, but since then it has gained several registered swimmer athletes that regularly participate in rallies and championships organized by the Serbian Swimming Federation.

Hard enduro club "Ravna Gora" is the only hard enduro club on Kolubara District's territory. It was established in 2017, and brings together the lovers of this extreme, very attractive, and costly sport, that has the hardest format for off-road moto races.

Football club "Borac" from Rajković was founded in 1948. It closed down near the end of the 1990s, but has become active again in the last decade or so, and currently competes in the Inter-municipal League Kolubara (sixth tier). Although the club used to have a junior selection, today they have none.

Football club "Komanice" exists since 1990. They have been a member of the Inter-municipal League Kolubara for a few seasons now. There is no junior selection. Football club "Popadić" was established in 2013. During the 2017/18 season, it won first place in the Ljig-Mionica District League, and for the second time in its short history achieved the right to compete in the Inter-municipal League Kolubara. There is no junior selection. Football club "Toplica" is the second longest-running football club since FC "Ribnica". It was founded in 1966,

has participated several times in County League tournaments and is currently a member of the lowest football tier of Ljig-Mionica District League. The club used to have a junior selection, but has none today. Football club "Gornji Lajkovac" was formed in 2005. Since then, it has been playing in the Ljig-Mionica League. Has no junior selection. Football club "Tolić" exists since 2014 and, since its inception, has been playing in the Ljig-Mionica District League. It has no junior selection. Football club "JOKS United" is the youngest sports collective on the territory of the municipality of Mionica. It joined the competitions for the first time during the 2018/19 season. The club is a member of the Ljig-Mionica District League and has no junior selection. Football club "Vojvode" was established in 2014. Senior selection was shut down at the end of 2016 and from 2017 onwards the club has been working exclusively with junior categories. The pioneer selection competes in the Kolubara-Mačva group of Serbian League West (second tier), while the youngest plays in City League Valjevo.

Total number of athletes, age and gender structure

For the purposes of this paper, the information about the total number of athletes in sports clubs was obtained directly from authorized personnel of all active clubs on the territory of the municipality of Mionica during December 2018. Even so, the obtained data about the total number of athletes should be taken with reservations, especially in regards to the number of young athletes, considering the well known fact that a certain number of athletes in junior categories tends to participate in two or more sports clubs at the same time.

It is important to note that athletes who perform in the local sports clubs are almost exclusively from Mionica's area. The number of athletes who reside in other municipalities compared to the total number of athletes is negligible.

According to obtained data, the total number of athletes in sports clubs on the territory of the municipality of Mionica is 509. Junior athletes comprise 59.33% of the total number of athletes in sports clubs (302 athletes), while senior athletes, the number of which is 207, make up 40.67%. When it comes to gender structure, women, with a representative 26.33% (134 athletes) make up a little more than a quarter of the total number of athletes in sports clubs on Mionica's territory, while men hold 73.67% (375 athletes) of the total number of athletes in Mionica's sports clubs. Female athletes are concentrated in five clubs. Volleyball club "Ribnica" has 87 female athletes, the biggest number, followed by karate club "Ribnica" with 28, basketball club "Mionica" with 18 and football club "Ribnica" one female athlete, while there are no female athletes in nine clubs, of which eight are football clubs, one swimming club and the hard enduro club.

Table 2. *Total number, age and gender structure of athletes in clubs in the municipality of Mionica*

Name of the club	**Overall athletes**	**Younger categories**	**Seniors**	**Woman**	**Man**	**Number of coaches**
Karate Club "Mionica"	55	52	3	28	27	3 hon
Basketball Club "Mionica"	64	64	0	18	46	1 hon
Hard enduro Club "Ravna Gora"	10	0	10	0	10	0
Volleyball Club "Ribnica"	87	73	14	87	0	1 hon
Swimming Club "Ribnica"	4	2	2	0	4	1 hon
Football Club "Ribnica"	86	68	18	0	86	2 hon
Football Club "Popadić"	26	0	26	0	26	1 vol
Football Club "Komanice"	22	0	22	0	22	1 vol
Football Club "Borac"	22	0	22	0	22	1 vol
Football Club "Toplica"	25	0	25	0	25	1 vol
Football Club "Gornji Lajkovac"	25	0	25	0	25	1 vol
Football Club "Tolić"	22	0	22	0	22	1 vol
Football Club "Joks junajted"	18	0	18	0	18	1 vol
Football Club "Vojvode"	43	43	0	1	42	1 hon
Overall	**509**	**302**	**207**	**134**	**375**	**16**

Furthermore, going by data obtained from the sports clubs' authorized personnel, on the territory of Mionica there are currently 16 licenced coaches, 7 of which are volunteers, while the remaining 9 are temporary hires. Of those, karate club "Mionica" has 3 coaches, football club "Ribnica" 2 coaches, volleyball club "Ribnica", basketball club "Mionica, football club "Vojvode" and swimming club "Ribnica" one licenced temp-coach each, while other sports clubs have only one licenced volunteer-coach each and hard enduro club "Ravna Gora" has no coaches at all (Table 2). Therefore, not one coach was hired on a contract basis, which is a bad indicator since experience so far has shown that sports clubs that hire sports experts on a temporary basis rarely manage to achieve noteworthy accomplishments.

Sports facilities for training and tournaments

The recent completion of a modern Sports Hall in Mionica signals the beginning of further sports development in the municipality. The Hall, with the surface of 2,900m² and the maximum capacity to accommodate about 2,800 people, is expected to be put to use in 2019, which will be especially beneficial to the athletes of the volleyball club "Ribnica", basketball club "Mionica", and karate club "Mionica", who are currently using the limited resources of "Milan Rakić" primary school's gym in Mionica, thus giving them best possible

conditions for their future practice and tournaments.

A notable sports facility on the territory of Mionica is also the Stadium located near Ribnica. It was carefully reconstructed in 2009, and is currently being used for practice and tournaments by all selections of FC "Ribnica" and FC "Vojvode". However, because of the lack of a spare playing field, maintenance of the sole field is fairly hard. The remaining football clubs use football fields that are appropriate for their tier rank with no compensation, except FC "Komanice" and FC "Popadić" which don't have their own football field and have to book "Vrujci" Hotel's playing field in Vrujci in advance for their matches. Members of the swimming club "Ribnica" use the outdoor public pools of SRC "Lepenica" in the village Mionica during the summer season with no compensation, while during winter season they practice at indoor pools of hotel "Vrujci" in Vrujci, technical school in Valjevo, or SC "Valis" in Petnica, near Valjevo, with their terms booked in advance.

Financial Sources

All clubs from the territory of the municipality of Mionica compete in amateur tier Leagues and the main financial source for these are funds from the local government's budget. Mionica's Municipal Council has approved the financing of sports clubs' yearly programs in 2018 (Table 3), after conducting procedure in accordance with articles 137 and 138 of the Sports Law (Službeni glasnik RS, number 10/2016, 2016), and the statute about the approval and financing of a program that satisfies the needs and interests of residents in regards to sports in the municipality of Mionica (Službeni glasnik Skupštine opštine Mionica, number 1/2017, 2017), by issuing a decision about approval of yearly programs that satisfy the needs and interests of residents in regards to sports in the municipality of Mionica.

Table 3. *Clubs of Mionica Municipality with granted funding* for 2018

Football Club "Ribnica"	1.800.000 dinars
Volleyball Club "Ribnica"	1.099.900 dinars
Karate Club "Mionica"	1.000.000 dinars
Football Club "Vojvode"	800.000 dinars
Basketball Club "Mionica"	350.000 dinars
Football Club "Borac"	180.000 dinars
Football Club "Komanice"	180.000 dinars
Football Club "Popadić"	180.000 dinars
Swimming Club "Ribnica"	140.000 dinars
Football Club "Toplica"	110.000 dinars
Football Club "Tolić"	110.000 dinars
Football Club "Gornji Lajkovac"	110.000 dinars
Football Club "Paštrić"	110.000 dinars
Football Club "Gornji Mušić"	110.000 dinars
Sport Association "Osvajači"	100.000 dinars
Overall	**6.379.900 dinars**

By reviewing the Yearly programs of sports clubs from the territory of the municipality of Mionica found in the documentation of the Sports Association of the municipality of Mionica (Knjiga odluka Sportskog saveza opštine Mionica, 2017), it can be concluded that even for the lowest tiered football clubs in the municipality's territory, these funds would largely cover the expenses necessitated by tournaments during a calendar year, in addition to costs of medical check-ups, partial travel costs for games and tournaments, costs of buying sports equipment and props, as well as giving out an eventual monetary award to certain athletes or coaches. For other clubs from Mionica's territory, these funds would cover the costs of employing officials, tournament registration fees, and yearly membership fees for athletes, athlete registration and partial traveling, and nutrition costs for athletes. Other expenses, like medical costs, remaining tournament travel and nutrition costs for athletes, compensation costs for coaches, costs of the service agreement with athletes that aren't alimentation, costs of organizing a diet for athletes when traveling to hosted events, costs of buying sports equipment and certain props, are covered by other sources, primarily by sponsorships, with the help of donations from individuals or by membership fees from clubs that work with junior categories. The donation amount mostly depends on the abilities of the members of the sports clubs' management boards, and frequently, the clubs' leaders are the main financiers. It is interesting to note that none of the sports clubs, not referring to athletes, included the income received from ticket sales and club membership fees in their income statements. However, finances aren't always the determining factor when it comes to the functioning and survival of sports clubs. Supporting this is the fact that three clubs granted financial aid from the municipality of Mionica's budget for the year 2018 are no longer active. Football club "Paštrić" from Paštrić, football club "Gornji Mušić" from Gornji Mušić, and the Sport Association "Osvajači" from Osečenica weren't able to secure the required number of registered athletes for furthered participation in league tournaments, even though they didn't have any serious financial problems.

DISCUSSION

This discussion knowingly and deliberately employs two levels when reviewing the analyses, criticisms and suggested solutions in regards to the work of Municipal Sports Associations. The first level is typical, often found in reports on various levels and it covers superficial, but not fundamental changes. The second is an altruistic, nonconforming and a distinctly critical level that's in conflict with the prevailing thinking and understanding of the sports reality in Serbia, which it is trying to change.

The typical analysis, and propositions for improving the work of the Municipal Sports Associations on the example of Mionica

Today there are 14 active sports clubs on the territory of the municipality of Mionica, with about 500 male and female athletes of various ages that compete and achieve results in sports. By reviewing the information about the number of athletes in sports clubs, their age and gender structure, sports facilities used by the clubs, financial sources, in addition to the information acquired for the purposes of this paper,

certain conclusions were reached, in terms of propositions that could help better the performance of sports clubs in Mionica.

It is crucial to work continuously on promoting sports in the municipality of Mionica, in order to increase the number of athletes in sports clubs, as well as to motivate them to achieve best possible results. This provides a lot of room for advancement and one of the propositions is for the sports clubs to launch a joint initiative, so that the Sports Association of the municipality of Mionica, and the local government can start organizing an election event for "Athlete of the Year in the Municipality of Mionica" as of 2019, following a previous example set by many other municipalities in Serbia (Vladisavljević, 2009; Vladislavljević, 2011).

The fact remains that sports clubs from Mionica's territory are largely reliant on the financial backing of their own municipality. On account of this, it is necessary to raise the clubs' capacity for applying for funding from republic funds which would gradually lead to financial independence. The role of the Sports Association of the Municipality of Mionica is to organize professional platforms and lectures starring distinguished speakers for sports clubs' managing authorities (https://www.mionica.rs/sr-rs/).

There is a noticeable lack of media promo, endorsements from donors and sponsorship deals for sports clubs that would lead to development of socially responsible behavior and attract new donors, and sponsors. This would be easy to rectify with an arrangement, and collaboration between sports clubs' managers, and the municipality's PR officer, by publishing media content about this topic on the official Web site and Facebook page of the municipality of Mionica, as well as publishing articles in the newspaper "Bilten opštine Mionica".

Besides the primary match games that are planned for by the Association's calendar, sports clubs on Mionica's territory do not have any other sports events arranged, such as tournaments, revue matches and so on. This especially concerns sports clubs from the municipality's more rural areas, where football matches are the only opportunity for a local gathering and, because of this, it can be concluded that sports clubs have a certain social responsibility as well. Organizing tournaments could also benefit sports clubs monetarily.

Outside of Mionica's center, which is also the only urban area on the territory of the municipality, there is no sports club that works with a junior selection of athletes. That is why it is necessary for the Sports Association of the municipality of Mionica, and the local government to provide certain financial incentives, and other kinds of support for the sports clubs in rural areas, so that they can work, and achieve results with athletes in junior categories.

The atypical analysis, and propositions for improving the work of the Municipal Sports Associations on the example of Mionica

In the first part of the discussion, the typical, and commonplace reflections in regards to the work of Municipal Sports Associations were stated. However, assessment of the real value of the work was presented only in the latter half, where with generalizing, and a deeper versatile approach, the less noticed, more hidden possibilities for the work of Regional Associations were revealed, in addition to the evaluation and possible change to the

roles of general secretaries as official personnel.

Using the information disclosed by the Sports Association, when the total number of residents (14,335 residents) is proportionally compared to the number of athletes (509 athletes), it is revealed that a disappointing percentage of municipality's population (3.55% residents) exercises regularly in sports clubs. This unfortunately coincides with results from unofficial research, and the rough 4% of residents in Serbia who regularly partake in physical activities.

When the total number of the residents (14,335) is divided by the number of sports clubs (14 clubs), we get an approximate number of 1,000 people per one sports club. Even though this calculation is pointless, it can nonetheless be thought-provoking, and lead to either forming of a greater number of sports clubs or coming up with new ways of organizing regular physical exercise on the territory of the municipality.

When the total influx of money allocated for the running of sports clubs (6,379,900 dinars) is analyzed, and then divided by the total number of residents (14,355 residents), the calculated sum is 445 dinars (3.7 euros) a year per resident for sports, which is truly insufficient.

When the given information is reviewed, it can be concluded that it corresponds with the average recorded in municipalities, and regions of the Republic of Serbia, including regions of former Yugoslavia, and even of the Balkans, since similar patterns are observed in Bulgaria, Romania, and Albania, as well. However, just because the corresponding average is so pervasive in wider regions does not mean that work should be continued in this direction. "When you board the wrong train, all the stops are wrong," is a modern saying that can be applied to the analysis of the work of Municipal Sports Associations in Serbia.

The listed sports achievements of sports clubs lose significance when presented with the fact that 96.45% of the population is inactive. It is well known that the whole financing system for offshoot sports associations depends on the success at international championships. That's how it is possible for Serbia to have a valuable place among fellow medal winners, while around 80% of children at physical examinations get diagnosed with postural disorders and deformities.

Collaboration among the Ministries remains a problem and gets passed on from government to government in an equal or worse degree of uncooperation, as if we don't belong to the same family, same house, same firm, same country. This is felt on the local level as well, where the use of school gyms by sports clubs is an established practice, yet significantly imposed on the sports clubs, and athletes who indirectly cover those costs. Furthermore, the Ministry of Health charges medical check-ups in a very complicated, centralized, and ineffective system.

Despite being small, the listed sums of money can become quite large if it is assumed they were spent wrongly or in a way that doesn't achieve the desired results calculated by sports strategy.

Although the analysis mentions the average age of 44 for residents of the municipality of Mionica, there is no regular physical exercise scheduled, and no sports activities envisioned for the aforementioned and the elderly population.

The insistence on implementing the commonplace sports system in certain rural areas in the municipality of Mionica where

88.7% of the population (or more specifically 12,715 residents) live in a very rugged landscape also hasn't yielded results in making physical exercise a regular widespread occurrence among the population.

Sports clubs on the territory of the municipality exist, and survive independently of each other. The imposed sports system encourages rivalry on all levels, thus even sports clubs on the territory of a sole municipality compete for top achievements, considering their financing depends on their scores and, as such, there is no cooperation among the different clubs.

The construction of the grand sports facility of 2,900m² on the one hand improves the quality of future training for many aforementioned sports clubs, but on the other it also burdens the municipality's budget with the greater number of employed workers at the sports hall, as well as the money needed for the upkeep of such a facility which only becomes a bigger burden with age (Đukić, V., & Đukić, B. 2010).

The general secretaries of Municipality Sports Associations have a very passive role in the proceedings, as distributors of money for sports clubs, as well as bearing witness to the collapse by keeping records, yearbooks and annals.

"If you want something you've never had, you must be willing to do something you've never done," a famous English saying, is a good guideline for coming up with possible solutions.

In that way, all the previous problems examined in this paper can be approached from a different angle, and presented with possible ways to solve the current situation.

The municipality's strategy could afford to be original, and innovative, so it doesn't depend solely on the inert ways of the country's system. In short, the municipality shouldn't wait for the neighboring or central administration to come up with a solution, but needs to act independently in its own surroundings, and find the specific solutions for the various specific concerns and conditions.

The never properly developed relationship between the Ministry of Education, and the Ministry for Youth and Sports could experience a shift on the local level in its executive, and experimental approach. The most efficient approach would be for the Ministry of Youth and Sports to employ trainers for chosen sports, and for the Ministry of Education to finance their employment. In this way, there would be a greater inclusion of people participating in sports, and the problem of sports facilities would be solved. Thus, a coach could get paid by the municipality for a certain period of time, while physical exercise and training would be free of charge for the rest of the population. During a time when school is in recess, the unused space (gyms, hallways, classrooms) could be of great use to sports clubs for their practice or for scheduled physical exercise (Đurđević, Mitić, Atanasov & Vujović 2014).

Sports physical examination should be free of charge or financially covered by the Ministry of Health by its program for preventive healthcare. This can be organized, and financed on a local level even without the assistance of the Ministry of Health, by cooperating with the local health department.

It is necessary to change the default approach where certain sports are imposed on the population, regardless of that population's traditions, specific geographical conditions, scattered settlements and financial abilities. The new approach would be more personalized with an analysis of the

population's perspective in all age brackets (not just the young demographic), pertaining to their preferred content, and the frequency and intensity of the activities. In reviewing the proposal, a financial review is also necessary to determine how to get top long-term results with minimum financial spending.

The cooperation of sports clubs crosswise on the territory of the municipality is possible, needed and useful. Free terms at a sports facility could be given to another sports club, and it should be possible to secure material resources for mutual use by making an agreed upon schedule beforehand. A club working with junior categories can easily involve the young athletes' parents in its activities (possibly during the same session), and in that way, increase the number of residents partaking in physical exercise.

The content of sport programs needs to be specialized and personalized for all age brackets, with appropriate investments in more smaller-sized sports facilities, instead of the typical grand, but ultimately unsuccessful investments.

There needs to be a sports development strategy made specifically for rural conditions and particular to every region.

The new working arrangement for the General Secretary of the Municipal Sports Associations could have both a managerial (Tomić, 2001) and a leadership (Živković, 2009) role, with a greater degree of freedom in solving the local government's strategy, along with a possible change in the way they manage their funding, such as basing it on variables, like dependence on the percentage of the population partaking in regular physical exercise, which could also be evaluated by a newly formed independent system, so as to avoid misuse.

CONCLUSION

In the 36 populated places of the municipality of Mionica live 14,355 residents, with the average age of 44.38, out of which 88.7% (or 12,715 residents) live in rural areas. The municipality of Mionica was chosen as a representative of the large number of the municipalities that are located in rural areas on the wider territory of the Balkans, as a result of patterns equally found throughout the whole region, such as the increase in the elderly population, the phenomenon of rural-urban migration and "white plague", also known as natural decrease, where the death rate is greater than birth rate during a year in a certain area.

Sports clubs are the bearers of sports development in every community and it remains to be seen if they have enough influence to put an end to the aforementioned patterns and changes. In any case, a regular analysis of the work of sports clubs and municipal sports associations is required, as well as a reassessment of their roles in today's society.

The analysis of the obtained information reveals the inefficiency of the current system's way of managing sports clubs, like the poor participation results in an overview of regular physical exercise among the general population. In the municipality of Mionica, only 3.55% of the population (509 athletes) exercises regularly in 14 sports clubs. The inclusion of women among the number of athletes makes up a disappointing 26.33% (134 athletes), found likewise over the region.

The regular reports from the General Secretary of the Municipal Sports Associations do not differ from the information disclosed in this paper under the heading "Results", as well as the first part under "Discussion". That is why they are shown as something commonplace, but also

something that cannot bring better quality to the organization.

Limiting factor are the numbers obtained by a simple calculation of the researched information: 1,000 people per sports club, 12,534 dinars for sports a year per athlete, in addition to a mere 445 dinars (3.7 euros) for sports a year per resident of the municipality.

If there is to be any noticeable result regarding regular physical exercise among the general population, serious changes are required. There needs to be a "revolution" in the way the problem is approached, and thought about. The task is hard, considering the poor and limited resources, with the only solution being the limitless use of time with defining and creating of new personnel and organizational solutions (Jovanović, 2006).

Above all, an effort must be made on the territory of every individual municipality without waiting on big systemic resolutions from the government. The existing material resources, such as sports facilities, equipment and props, have to be reorganized and used in their full capacity with joint usage and booking all available terms that remained unused (Petrović, 2010). Cooperation between all municipal structures is of utmost importance, so that the healthcare, education, sports and economy systems are all connected on a municipal level.

The choice of activities must rely on the population's interests and traditions. A particular challenge lies in organizing regular physical exercise for both working age, and elderly population, with an emphasis on the female population and a special approach to contents of their activities.

The newly defined model for sports organization in the municipality needs to be researched in practice, so as to examine the pros and cons of the new system. An experimental program requires more careful preparation with the choosing or voluntary participation of a municipality that possesses similar characteristics as described earlier.

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SAŽETAK

Sportski klubovi su nosioci razvoja sporta u svakoj zajednici. Opštinski Sportski Savezi u Srbiji (primer Opštine Mionica) beleže veoma slabe rezultate u sveobuhvatu stanovništva redovnim fizičkim vežbanjem. Čak 96,45% stanovnika Opštine Mionica ne vežba redovno. Od ukupnog broja, 88,7% stanovništva Opštine živi u ruralnoj sredini. Na jedan sportski klub dolazi oko 1000 stanovnika Opštine. Opština izdvaja svega 445 dinara (3,7 evra) godišnje po stanovniku za sport. Obzirom na finansijska ograničenja, predložena su kadrovska i organizaciona rešenja u cilju većeg obuhvata stanovništva sportskim aktivnostima. Za značajnije promene potrebno je hitno, aktivno delovanje, u smislu saradnje između svih sportskih organizacija međusobno, ali i sa zdravstvenim, prosvetnim i privrednim organizacijama na lokalu. Ponuda aktivnosti mora se oslanjati na interesovanje stanovništva i njihovu tradiciju. Poseban izazov predstavlja organizovanje redovnog vežbanja radno sposobnog stanovništva i starih uz naglasak na obuhvat žena i specifičan pristup sadržajima njihovih aktivnosti. U novo predviđenom sistemu vodeću i aktivnu ulogu trebalo bi da ima Generalni sekretar Opštinskog Sportskog saveza, uz veća ovlašćenja, kao i finansiranje po učinku. Novo definisani model organizacije sporta na Opštini potrebno je ispitati u praksi, kako bi se ispitale dobre i loše strane novog sistema.

Ključne reči: *evaluacija, strategija sporta, godišnji program, promocija, generalni sekretar*

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ETHICAL CONTROVERSIES OF FAIR PLAY IN MIXED MARTIAL ARTS

ETIČKE KONTROVERZE FER – PLEJA U MEŠOVITIM BORILAČKIM VEŠTINAMA

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ABSTRACT

Fair play in sport, except for the respect of written rules, applies to respecting unwritten rules that fall within the domain of morality. General moral principles are also sporting principles, and the morality of athletes depends largely on whether a fair play manifests itself in sport. In the paper, the author deals with the ethical issue of fair play in sport, as moral principles manifest themselves in sport through fair play and the importance of moral principles for sport and social values. Also, the author deals with the origin of mixed martial arts and their development as a sport, the manifestation of fairness through respect for established rules, the moral dilemmas that athletes can find in and outside sports arena, as well as the actions of athletes to win them. Lately, it is not uncommon for athletes to act dishonestly, both at and outside sports arena, in order to reach a specific goal in competitions, and therefore, they are led by various discussions regarding the fair play in sport.

Key words: *normative approach, teleological approach, aretistic approach, utilitarianism.*

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Ethical problematization of fair play in mixed martial arts

In contemporary society, under the influence of increasing commercialization of sports, and therefore under the influence of large amounts of money that go with the popularization of these sports, the concept of fair play in sports is also associated with negative connotations of unfair practices, corruption and the giving of unauthorized substances to athletes by the physician who, in each major club has in its composition (Brkljačić 2007; Sturza Milić, & Šekeljić 2012; Savić, & Aleksić 2015). "Therefore, clearing with critical mind and visionary awareness is one of the most important tasks of sport. It is the education of man by ruling relations and values that receive mythological value" (Simonović, & Simonović, 2005: 13). Fair play in English means a fair game, representing the attitude of the athletes' actions, refers to the respect of the rules of the game and is a set of unwritten rules, that is, a set of moral principles relating to the treatment of athletes according to the code of honor, chivalry and virtues that adorn and emphasize each individual. Respect of the rules of the game depends, in addition to sports federations and persons in charge of controlling the implementation of certain rules, on the morality of athletes (Kozarčanin, 2008). Through sports, a man tries to maximally improve his motor skills and physical abilities of his body. A true athlete in his opponent sees no obstacle on the way to achieving his goal, but sees him as an instrument for assessing his ability to advance (Brkljačić, 2007).

Fair play in sport is reflected in the moral dilemmas that occur in certain situations, both in sports and outside. In every sport discipline, whether it's a collective sport or an individual, there are certain rules of the game. The rules of the game, except that they represent the laws by which the competition is played, are imbued with moral norms. Moral norms in sport are reflected through a fair play that triggers the rehearsal of their intentions during the game. Fair play, as part of sport, intends to awaken athletes' sports spirit in order to adopt the true values of sports, which are actually moral values (Brkljačić, 2007; Čeh, 2013).

Sport is divided into two basic groups: collective and individual. A person can be engaged in sports professionally, recreationally or as amateur. According to a further division, sport is divided into: professional, amateur, recreational, and school sports (Ilić, 2012).

The significance of fair play is also reflected in the education of young people, who can learn sportsmen from something that is good, and these are moral values that adorn the game and sport. Young people can learn fair play in sports and that victory is not the most important thing by observing the example given by Mike Pantangco in an amateur MMA match when he handed over the sword he received because he saw that he too hurt his opponent and that he would permanently hurt if you continue the fight (Sport News, 2018).

"Every country leads a certain policy in the field of social activities, and so does in sport, that is, sports (physical) culture. Peaceful active existence, change of political systems, competition, national, religious and racial discrimination, no doubt, are issues that are necessarily reflected in sports" (Brkljačić, 2007: 232).

By some authors cite (Radovanović, & Ponorac, 2014) "sport morality belongs to the general field of morality in the context of sports. It is manifested in the beliefs, courts and procedures that relate to what is right and what is wrong and immoral in sport, and

includes fair play, sportiness and character" (Radovanović, & Ponorac, 2014: 127).

If a true sports spirit is awakened in every individual based on moral principles, then the fair play will be developed (Brkljačić, 2007). In this way, the rules of the game will be esteemed. At one of the most prestigious competitions, Nick Diaz approached

his opponent (Frank Shamrock) while lying defeated on the floor, saying, "You have to get up, you're a legend" ("You gotta get up, you're a legend"), and Matt Serra's defeat, he raised his opponent (Georges St-Pierre) and celebrated his victory with him, the judges and other participants in some sporting event (Sport News, 2018). "The most valuable contribution to the sport is the acceptance of defeat. Accepting defeat in sport ensures victory in solving and worn with problems in life" (Brkljačić, 2007: 232).

Mixed martial arts (MMA) date back to ancient Greece. The origins of mixed martial arts are related to the sport Pankration (pan - all, short - power or strength) that originated around the year 648 BC and represented a mixture of wrestling and boxing, with very brutal rules that the match would end if one contestant raises his hand or remains unconscious, and often the fight ends with the death of one or both competitors. In this sport, it was forbidden to eat an opponent and "dig" his eyes, and that was the only rule. This sport was so popular that it was included in the Olympic Games, and for the benefit of popularity it is a fact that the Romans took over this sport and updated it through famous gladiatorial struggles (Šiljak, 2007; Mitrić, 2013; Soldo, 2015).

Data on the development of mixed martial arts indicate that many nations, from different parts of the world, have for centuries had in their tradition a certain combination of martial arts that were included in traditional competitions and rituals (Šiljak, 2007).

"Japan can freely be called the father of MMA, and America is the mother of that sport" (Soldo, 2015: 1). It is believed that the MMA in Japan gained worldwide popularity in the Pride Fighting Championship sports competitions purchased by another UFC (Ultimate Fight Championship) from America to quit and thus become the leader in the sport. "Therefore, MMA gets great media attention and becomes the fastest growing sport in the world" (Soldo, 2015: 1).

"Contemporary MMA mostly originates from the competition without rules (Vale Tudo), which became popular in Brazil in the early 20th century. This sport has achieved international success only since 1993 through the Ultimate Fight Championship, which was launched by Rorion Gracie in the USA" (Soldo, 2015: 1). The MMA includes boxing, kickboxing, mai tai boxing, wrestling, judo, aikido, taekwondo, Brazilian Jiu-Jitsu and others, hence the very name of mixed martial arts (Soldo, 2015:1).

Many believe that in the modern MMA there are no rules by which competitors participate, but that it is a breast fight in the chest where everything is allowed. In favor of this, it is not so, say that there are rules for professional MMA, and for amateur MMA, which includes a lot more rules regarding the protection of competitors than for professional MMA, which does not mean that the professional is not accounted for the safety of the competitors, which was prescribed by the US Athletic Commission under the Unified Rules of Mixed Martial Arts (Association of Boxing Commissions and Combative Sports, 2016).

Normative approach - Fair play as a respect for established rules

Ethics and morality drag their roots to the very first living communities of people, in which there were certain rules of behavior in order to better the function of the group.

For the sake of the benefit of the human community, such code of conduct or norms have led to the allocation, acceptance and approval of only good behavioral patterns. The development of civilizations and societies in the world also develops morale. Moral principles represent a code of conduct and involve the constant review of intentions and actions of both their own and others (Singer, 2004).

Sport represents the human need for movement and involves various activities (Đorđević, 2010), that is, it encompasses all activities with a common goal – competition ie. by weighing "your strength in the processes of creativity" (Čeh, 2013). One of the basics of sports are the rules of the game that are different depending on sports discipline (Kozarčanin, 2008).

Ethics, as a philosophy of morality, is also permeated through sports. At the very beginning, there must be a clear distinction between morals and laws. Law is not the same as morality. It must have been related to the procedures behind which the intention is primarily, and for the actions as such, we have the possibility of moral evaluation (Perović, 2013).

Sport has a great impact on social values and is therefore also useful for them. "There is no country in the world that does not pay special attention to sports and sports activities. Sports fights have become some kind of polygons on which countries (through their competitors) check and confirm their prestige. The top results and successes in the one competitions are ranked as the highest social values" (Radoš, 2004: 11). As the best example of respecting the rules of this sport and honoring him, one of the best MMA athletes of all time, the Russian representative of this sport, Fedor Emelianenko can be taken without any sting in his career, who is popularly called the Last Imperator precisely because of his honorable and great careers.

The theological aspect - Victory justifies the means

Outside arena, there are certain dilemmas. When it comes to ethics in sports, the most often first consideration is the use of illicit substances, that is doping, by athletes to move their own physical boundaries and achieve better results. Then, a competitor can have a moral dilemma whether to defeat the opponent in an improper way in the sports competition that follows. In a professional MMA sport, a case has been reported that a well-known fighter, Thiago Silva, went as far as to hand over a doping control sample with urine of animal origin so as not to be discovered to have used illicit means to win the match, which cost him being punished, banned from MMA sports for a year, and a fine of $33,750. Due to the enormous amount of money that can be earned in a professional sport in a short time, athletes often use unfair ways to earn money that sets as a priority against a fair play. Simonović and Simonović state that "the faster the capital turnover, there are less places for human" (Simonović, Simonović, 2005: 7). Hence the famous maxim that sport is too big a business to be just a game.

"A sports ethic that can and should be emphasized is the one that respects the participants as people, but also the one that avoids making a double error: that is, on the one hand, there is not enough room left to

manipulate ideas in sports that advocate for the intelligent use of force , on the other hand, individuals (athletes) in search of a win (profit) would not be able to do something wrong, which would violate the moral principles of the sport, but also themselves" (Anastasovski, 2014: 1). In the context of profit, egoism appears in the function of putting its own interests above the interests of other people.

Egoism will not be considered something bad if an athlete wants to improve his interests, unless he does something that is morally unacceptable in order to achieve those interests.

Piter Singer, according to Kurt Bajer, according to psychological egoism as one of five versions of egoism, "as a rule, egoists are characterized by desires or motivations governed by self-esteem, and by non-egoists with desires and motives that »adequately« respect others" (Singer, 2004: 291). "After the work of Kant, Rid and Bentham, it has become widely accepted that the basic principle of morality must be the principle that everyone can use" (Singer, 2004: 222).

Artistic approach - Fair play in the function of moral behavior

In addition to linking different cultures and removing barriers of racial affiliation, the experiences of these cultures also exchange. In this way, the sport represents multiculturalism, racial intolerance is eliminated, the feeling of belonging to the world community develops, there is awareness raising among all actors of sports events, from players to fans of a sports club.

According to Milenko Perović, Kant's "the principle of morality is an inner conviction (intentio), not an external consequence of the action (operatio). The principle of morality is the basic subject of ethics. Ethics rests on the notions of freedom, need, duty, moral law and categorical imperative" (Perović, 2013: 34). The categorical imperative refers to the duty that is the driver of the rightful act.

"Deontological ethics or ethics of conscience refer to the consciousness, that is, it considers it a duty to follow moral attitudes and attitudes, where *sine legeautem poena conscientia est* (when there is no law, punishment is consequence). In her considerations she calls the so-called. A golden rule of respect for others in practicing sports, with possible references to a whole array of philosophers like I. Kant and his categorical imperative, but also the imperatives in the way Kung Fu Tse, Tales, Jesus expressed them ..." (Škerbić, 2014: 60).

Regarding moral dilemmas at the battlefield, they are reflected through internal rehearsals of the competitor himself of his actions, or of his intentions during the game. In a competitor, driven by a desire for victory, there is a struggle between what is good and right and what is not. A fair play and a sports spirit can manifest if a competitor notices that an opponent has injured himself and points to an opponent's injury by requesting assistance, like MMA fighter Danny Missin, who asked that the match be interrupted in order to help his opponent, or I helped him like a professional MMA fighter Bakhtiyar Arzumanov in one match, wading a protective mouthguard from his opponent's mouth to prevent this from suffocating. Namely, if the competitor notices or does something that is bad and is not allowed, and the judges and other contest participants do not notice it, there is a dilemma in the competitor whether to act properly and report to the judge that procedure, or not (Sport News, 2018).

This dilemma relates to an in-depth review by an athlete of what is beneficial to

him in such a situation, how he sees the benefit at all, whether he will be happy or not, if he notifies or does not report to the judge what he has noticed. "The classic form of utilitarian attitude was given by Bentham. He tried to justify moral, political, legislative and government fields a lucratic - calculating principle. On the basis of the hedonistic attitude, it sets the principle of utility as the highest principle of judging morals and rights.

The principle of usefulness equals the principle of happiness" (Perović, 2013: 365). According to Peter Singer, Bentham argued that his utilitarian principle - that we need to achieve as much happiness as possible - is at first sight rational and provides a rational method for making moral decisions" (Singer, 2004: 222), and that "it is no coincidence that Bentham and his philosophy were at the center of an active group of political reformers" (Singer, 2004: 222).

If a contestant reports to the judge a bad procedure he noticed or confesses his mistake alone, there is a manifestation of fair play and the construction of a real sport spirit, both in the individual and in the whole sport, and the competitor himself, by his own actions, leaves the situation as a moral winner. "The consequential or consequential ethics is a widespread form of sports ethics with a number of problem situations and issues, among which in particular the dominant" utilitarian behavior "of athletes in deciding which series of actions to take, and to take it or not only considerably well (benefit) for your own team (or yourself) or good (advantage) for the game (or sport) as a whole" (Škerbić, 2014: 61).

CONCLUSION

From the ethical point of view, the fair play can be viewed through the actions of central players in sporting events in certain situations, at and outside sports arena, relating to the respect for written and unwritten rules to be followed. An athlete's career, which is based precisely on his career paths, is represented by the respect of these rules. The understanding of utilitarianism by athletes can be said to have the most significant effect on their moral dilemmas before which they are often found. Athletes' procedures in situations where they morally "break" can be characterized as chivalry and honorary treatment, or condemnation because their actions were dishonest and wicked.

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SAŽETAK

Fer – plej u sportu osim što se odnosi na poštovanje pisanih pravila, odnosi se i na poštovanje nepisanih pravila koja spadaju u domen morala. Opšta moralna načela predstavljaju i sportska načela, a od moralnosti sportista umnogome zavisi da li će se u sportu manifestovati fer – plej. U radu, razmatrano je etičko pitanje fer – pleja u sportu, kako se moralna načela manifestuju u sportu kroz fer – plej i kakav značaj imaju moralna načela za sport i društvene vrednosti. Takođe, autor se bavi poreklom mešovitih borilačkih veština i njihovim razvojem kao sporta, manifestovanjem fer – pleja kroz poštovanje ustanovljenih pravila, moralnim dilemama pred kojima se sportisti nalaze na sportskim borilištima i van njih, kao i postupcima koje čine sportisti kako bi došli do pobede. U poslednje vreme, neretko se dešava da sportisti postupaju nečasno, kako na sportskim borilištima tako i van njih, da bi došli do određenog cilja na takmičenjima pa se samim tim vode različite diskusije u vezi sa fer – plejom u sportu.

Ključne reči: *normativni pristup, teleološki pristup, aretistički pristup, utilitarizam.*

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ENHANCEMENT OF PHYSICAL PREPAREDNESS OF ATHLETES WITH VISUAL IMPAIRMENTS BY ADAPTIVE SPORTS

POBOLJŠANJE TJELESNE SPREMNOSTI SPORTISTA OŠTEĆENOG VIDA KROZ ADAPTIVNI SPORT

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ABSTRACT

The analyses of existent scientific knowledge of taking into account level of vision loss at the construction of sportsmen's preparation in adaptive sport testifies about lack of information on the extent of adaptive sports training impact on the level of physical preparedness of people of visual impairment. The aim of the research is to determine the influence degree of adaptive sports training on the physical preparedness of people with visual impairments. Theoretical analysis, pedagogical observation, pedagogical experiment, mathematical and statistical methods were applied. 34 people with visual impairments took part in our research. It has been established that the level of vision loss of people with visual impairment affects the indicators of physical preparedness. There were found significant differences in the level of speed development, flexibility and coordination the blind in comparison with indicators of people with severe visual impairment, and people with moderate visual impairment before and after experiment. As a result of the experiment, there was a significant increase in the indicators of all tests for people with visual impairment. It's indicating the positive impact of adaptive sports training on their physical preparedness. The obtained results indicate that there is a relationship between the level of vision loss of people with visual impairment and the impact of adaptive sports training on their physical preparedness.

Key words: *blind, adaptive sports, strength, coordination, endurance, flexibility.*

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INTRODUCTION

In modern society, the search for solutions for problem solving of persons' with disabilities social integration is considered within framework of the new special means of substantiation, methods and technologies of persons' with disabilities adaptation to the external environment (Blauwet & Willick, 2012; Herasymenko, Mukhin, Pityn & Kozibroda, 2016; Rudenko, Hlozhyk, Guzii & Prystupa, 2017). At the same time, one of the most effective socialization means for persons with disabilities has been actively developing - adaptive sports (Dehghansai, Lemez, Wattie & Baker, 2017). It's as unique social phenomena that has no analogues in modern society allows to create conditions for the attraction persons with disabilities to social life by providing the opportunity to realize their own potential in activities that have a social significance (Sahlin & Lexell, 2015; Lastuka & Cottingham, 2015; Jaarsma, Dekker, Geertzen & Dijkstra, 2016; Fagher, Jacobsson, Timpka, Dahlström & Lexell, 2016). For adaptive sports, as a type of social practice that aims at satisfying self-actualization needs of people with disabilities as members of society and realization of their capabilities in competitive activities, the tendency is to focus on achieving sporting results (Weiler, Van Mechelen, Fuller & Verhagen, 2016; Willick, Cushman, Blauwet, Emery, Webborn, Derman et al., 2016; Kozina, Chebanu, Prokopenko, Korobeynikov, Korobeynikova, Korobeinik, et al., 2018). A demonstration a sporting result, improvement of functional capabilities and a sense of "victory" contributes to the formation of a sense of self-realization, personal growth and overcoming social isolation in persons with disabilities (McNamee, 2017). One of the ways for realization of sports potential in the process of achieving maximum possible result is the conformity of the scientific and methodological level provision of preparation to the needs of sports practice. It is connected the need to account the level of saved motor potential and specific peculiarities motor activity persons with disabilities in the process of adaptive sports training (DePauw & Gavron, 1995; Winnick & Porretta, 2017). In the researches of some authors there was substantiated the necessity of adaptation athlete's preparation provisions, means and methods, volume and intensity of loadings in accordance with the nosological group of athletes with disabilities (Roztorhui, Perederiy, Briskin & Tovstonoh, 2018; Pisapia & D'isanto, 2018). But the nosological group as a combination of diseases, which are united by common features, can't be the main criterion for adapting the methodological guidelines of athletes' preparation in adaptive sports. It is because in one nosological group there can be athletes with different severity of manifestations and symptoms of diseases and concomitant diseases. Thus, the nosological group of athletes with visual impairments include the blind, persons with moderate and severe visual impairments. (Mann & Ravensbergen, 2018). Therefore, it is more correct to take into account the level of saved motor and functional possibilities in the process of constructing the athletes' preparation in adaptive sports.

The analysis of available scientific knowledge about the athletes' preparation in adaptive sports shows that there is no information about the impact of sports training on the physical preparedness of persons with different levels of vision loss.

The aim of research is to determine the effect of the adaptive sports activities on the quality of life and physical preparedness of athletes with visual impairments.

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METHODS

Entity sample. 34 people with visual impairments took part in our research. Among them: 8 blind (B1), 10 persons with severe visual impairment (B2) and 16 – with moderate visual impairment (B3). The study participants included 16 women and 18 men. The average age of them was 26,44 ± 6,35 years old.

Procedures. Athletes with visual impairments were included in the groups of physical and rehabilitation preparation at the regional centers of physical culture and sports for people with disabilities "Invasport". The training program for people with visual impairment provided 3 training sessions per week the duration 120 minutes. The total amount of training sessions was 40 hours. The features of implementation, structure and content of the training program for groups of physical and rehabilitation preparation people with visual impairment are detailed in our previous researches (Roztorhui, Perederiy, Briskin, Tovstonoh, Khimenes & Melnyk, 2018).

*Testing***.** The level of physical preparedness of athletes with visual impairment was determined. It was done in order to determine the impact of adaptive sports activities on the physical preparedness of persons who were researched before and after implementation of the training program. Exercises were chosen and adapted according to the athletes' nosological characteristics, the requirements of sports metrology and technical simplicity for use in the training process. The list of exercises that have been selected to determine the level of physical preparedness of people with visual impairment is shown in Table 1.

Table 1**.***Tests to determine the level of physical of preparedness people with visual impairment*

№ i/o	Name of test	Directivity
1.	Push-ups, number of times	Strength
2.	Running at 30 m, s	Speed-strength abilities
3.	Cooper's 12-minute test on a stationary bike, m	Endurance
4.	V-Sit flexibility test, sm	Flexibility
5.	Keep balance on the right leg, s	Coordination abilities
6.	Keep balance on the left leg, s	Coordination abilities

The level definition of strength development of people with visual impairment was carried out on the results basis in the exercise «push-ups», speed-strength abilities – with the help of running at 30 m, endurance – Cooper's 12-minute test on a stationary bike, flexibility – V-Sit flexibility test and coordination was determined on the basis of the results in the exercise «keep balance on one leg».

Factors that could affect the reliability of tests were taken into account in the process of determining the level of physical preparedness. In particular, determining the level of physical preparedness before and after the experiment was conducted in one time interval.

Before the beginning of determining the level of physical preparedness of people with visual impairments, a preparatory part was carried out. It included the complex workout of general exercises. For realization of running at 30

m, V-Sit flexibility test, push-ups and keep balance on one leg the athletes had three attempts. The best result was recorded in the research protocol.

The study was approved by the local research ethics committee, performed in accordance with the ethical standards of the journal, IJSM and conformed to the recommendations of the Declarations of Helsinki. The current study was undertaken in Ukraine after the approval of the Institutional Research Ethics Committee at Lviv State University of Physical Culture. Participation was voluntary; participants received no incentives.

Statistical analysis. The results were analyzed with the statistica for Windows software (version 6.00). Previously, all variables were analyzed for normality with the use of the Shapiro-Wilk test. The Student's test and Mann-Whitney test was applied to assess the value of statistical differences in the physical preparedness results of athletes with different levels of vision loss. The Student's test and Wilcoxon signed-rank test were used for comparison of studied parameters between groups before and after experiment. The values of $p < 0.05$ were considered statistically significant.

RESULTS

The analysis of the results of determining the level of physical preparedness of people with visual impairment before experiment made it possible to detect differences in the indexes for tests «running at 30 m», «V-Sit flexibility test», «keep balance on one leg (right and left)», that depending on the level of their vision loss.

Indexes of physical preparedness of researched persons in group B1 for tests «running at 30 m» and «V-Sit flexibility test» differ from those of groups B2 and B3 at the $p < 0.05$ significance level as described in Table 2. In tests «keep balance on the right leg» and «keep balance on the left leg» of researched persons in group B1 differ from the indexes of the other two groups with a significance level $p < 0.01$.

According to the results of tests «push-ups» and «Cooper's 12-minute test on a stationary bike», the indexes of three groups researched persons do not differ statistically. There were not found significant differences among the researched persons of B2 and B3 groups in the indexes for all tests that determine physical preparedness before the beginning of adaptive sports training.

Table 2. *Physical preparedness indexes of people with visual impairment before experiment*

Name of test	Groupe B1 (n=8) $\overline{x} \pm SD$	Groupe B2 (n=10) $\overline{x} \pm SD$	Groupe B3 (n=16) $\overline{x} \pm SD$	Differences B1-B2	Differences B2-B3	Differences B1-B3
Push-ups, number of times	4.47±0.94	9.40±5.50	12.94±6.63	*U*=37.5	*t*=1.4	*U*=41.5
Running at 30 m, s	8.11±0.73	7.37±0.68	7.28±0.61	*U*=18**	*t*=0.4	*U*=27.5**
Cooper's 12-minute test on a stationary bike, m	3466.13± 1000.74	4014.80± 965.34	4007.56± 1474.34	*U*=27	*U*=78	*U*=51
V-Sit flexibility test, sm	3.13±0.94	4.49±1.03	4.26±1.97	*U*=15**	*t*=0.3	*U*=42.5
Keep balance on the right leg, s	10.94±3.40	18.80±2.89	19.61±2.48	*U*=4*	*t*=0.8	*U*=3*
Keep balance on the left leg, s	10.28±3.30	17.37±2.46	18.78±3.10	*U*=3*	*U*=60.5	*U*=0*

*Statistically significant results (p<0.01); ** Statistically significant results (p<0.05); $\overline{x}$ – mean; *SD* – standard deviation; *U* – Mann-Whitney test; *t* – Student's test.

Indexes for re-determining the physical preparedness level of persons with visual impairment after experiment are presented in Table 3. It has been established that significant differences among people with different levels of vision loss after experiment are available exclusively among researched persons of B1 group in the same tests as before experiment, namely «running at 30 m», «V-Sit flexibility test», «keep balance on one leg (right and left)». There were not found differences in the test indexes in other groups.

Table 3. *Physical preparedness indexes of people with visual impairment after experiment*

Name of test	Group B1 (n=8) $\overline{x} \pm SD$	Group B2 (n=10) $\overline{x} \pm SD$	Grope B3 (n=16) $\overline{x} \pm SD$	Differences B1-B2	Differences B2-B3	Differences B1-B3
Push-ups, number of times	12.38±4.72	12.20±5.92	15.13±6.47	*U*=36	*U*=50.5	*U*=44.5
Running at 30 m, s	7.47±0.51	6.83±0.44	6.82±0.44	*U*=22	*U*=77.5	*U*=31**
Cooper's 12-minute test on a stationary bike, m	4031.50± 1069.65	4400.20± 823.76	4358.75± 1275.37	*U*=29	*t*=0.1	*U*=55
V-Sit flexibility test, sm	3.84±0.41	5.57±0.98	5.26±1.58	*U*=3,5*	*t*=0.6	*U*=29.5**
Keep balance on the right leg, s	12.32±3.73	20.97±3.20	22.02±2.59	*U*=2*	*t*=0.9	*U*=2*
Keep balance on the left leg, s	11.69±3.77	19.50±2.98	21.27±3.40	*U*=4*	*U*=58	*U*=0*

*Statistically significant results (p<0.01); ** Statistically significant results (p<0.05); $\overline{x}$ – mean; *SD* – standard deviation; *U* – Mann-Whitney test; *t* – Student's test.

As a result of the experiment, there was found a significant increase in the physical preparedness indexes at a $p<0.01$ level of significance in all researched persons in six tests (Table 4). The most essential increase in the indexes of physical preparedness in all tests was found at researched persons of group B1. Among six tests, the most significant changes in physical preparedness indexes at all researched people were found in the tests «V-Sit flexibility test» and «push-ups». The lowest growth of physical preparedness indexes were found in the results of running at 30 m and Cooper's 12-minute test on a stationary bike.

Table 4. *Percentage indexes of physical preparedness indexes growth of people with visual impairment*

Name of test	Group B1 (n=8)		Group B2 (n=10)		Group B3 (n=16)	
	%	Statistical test	%	Statistical test	%	Statistical test
Push-ups, number of times	47.76	T=0.01*	29.79	T=0.01*	16.91	T=0.00*
Running at 30 m, s	7.86	T=0.01*	7.33	t=6.8*	6.31	T=0.00*
Cooper's 12-minute test on a stationary bike, m	16.31	T=0.01*	9.60	t=5*	8.76	T=0.00*
V-Sit flexibility test, sm	26.00	T=0.01*	24.05	t=12*	23.64	t=6.7*
Keep balance on the right leg, s	12.65	T=0.01*	11.54	t=13.6*	12.30	t=30.2*
Keep balance on the left leg, s	13.70	T=0.01*	12.29	t=12.6*	13.22	T=0.00*

% – percentage of increase; *Statistically significant results ($p<0.01$); t – Student's test; T – Wilcoxon signed-rank test.

The obtained results testify about significant influence of adaptive sports on the physical preparedness indexes of persons with visual impairment. In this case, the magnitude of the effect depends on the level of vision loss and the orientation of adaptive sports training.

DISCUSSION

As a result of the research, it has been found the level of vision loss has a significant effect on the level of preparedness people with visual impairment. Physical preparedness indexes the blind in four of the six tests are lower than with moderate or severe visual impairment. Despite the significant impact of adaptive sports on the physical preparedness level of athletes in group B1, after the experiment, the indexes of speed, flexibility and coordination qualities in the blind are the lowest among the researched persons. The greatest differences in the level of preparedness are observed in the indexes by the results of keep balance on the right leg and keep balance on the left leg. The indexes of keep balance on the right leg after the experiment in the researched persons of group B1 are only 55.94% from the same index in group B3. This indicates that the level of vision loss directly affects the development level of coordination capabilities of people with visual impairment. This assertion was confirmed by the researches of Joseph Winnick, David Porretta (2017) and Roman Tolmachev (2004), who studied the peculiarities of studying exercise techniques for athletes with visual impairment. In comparison with people with moderate or severe visual impairment

the blind spend much more time studying techniques of new exercises. This requires a narrow individualization of the training process people with visual impairment during studying sports techniques and especially this is important in the complex coordination sports.

One of the most significant research results is the confirmation of the positive influence of adaptive sports activities on the physical preparedness of people with visual impairment. Reliable indexes of physical preparedness increase in six tests at all researched persons as a result of the experiment xperiment that allowed us to conclude that, with the help of the adaptive sports means, adaptive and compensatory mechanisms can be created in the bodies of persons with disabilities. It allows to increase motor activity level to restore muscular strength and joints mobility, to expand the arsenal of motor skills. The results of our research are confirmed by certain number of scientific works, that are devoted to the rehabilitation orientation of adaptive sports as a means of strengthening health, restoring lost functions, adapting to external conditions, physical development and preparedness improvement (DePauw & Gavron, 1995; Houwen, Visscher, Hartman & Lemmink, 2007; Blauwet & Willick, 2012; Lastuka & Cottingham, 2015; Dehghansai, Lemez, Wattie & Baker, 2017).

The obtained results analysis allows us to conclude that there is a correlation between the increase of physical preparedness indexes after experiment and the level of vision loss. The highest indexes of physical preparedness growth after experiment among the researched persons for all tests are observed in group B1. For example, indexes growth in the test «push-ups» in the B1 group was 47.76% and in groups B2 and B3 – 29.79% and 16.91% respectively. A high level of vision loss greatly affects the possibility of people with visual impairment to move independently and engage in sports.

Therefore physical preparedness indexes of B1 group are significantly lower than in the researched persons of group B2 and B3. The highest indexes of physical preparedness increase that were found in the blind could be caused by a low initial physical preparedness level of researched persons.

CONCLUSIONS

It has been established that there is a correlation between physical preparedness level of people with visual impairment and the level of their vision loss. The blind have significantly lower indexes of speed, flexibility and coordination development, than persons with moderate or severe visual impairment before and after the experiment.

Experimental testing of adaptive sports activities impact on physical preparedness of people with visual impairment has confirmed the effectiveness of using adaptive sports as a means for the improvement of the level of physical qualities development. In all researched persons, there were found positive dynamics of physical preparedness indexes for the tests «push-ups», «running at 30 m», «Cooper's 12-minute test on a stationary bike», «V-Sit flexibility test» and «keep balance on one leg». The highest indexes of growth in the level of physical qualities development by the tests results after experiment were found in the blind. This indicates that it is possible to create adaptive and compensatory mechanisms in people with a high level of vision loss by adaptive sports means.

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SAŽETAK

Analize postojećih naučnih saznanja, kada se uzima u obzir nivo gubitka vida pri izgradnji pripreme sportista u adaptivnom sportu, svjedoče o nedostatku podataka o stepenu uticaja adaptivnog sportskog treninga na nivo tjelesne spremnosti osoba s oštećenjem vida. Cilj istraživanja je utvrditi stepen uticaja adaptivnog sportskog treninga na tjelesnu spremnost osoba sa oštećenjem vida. Primijenjene su teorijska analiza, pedagoško promatranje, pedagoški eksperiment, matematičke i statističke metode. U istraživanju je učestvovalo 34 osobe sa oštećenjem vida. Utvrđeno je da nivo gubitka vida kod osoba sa oštećenjem vida utiče na pokazatelje tjelesne spremnosti. Otkrivene su značajne razlike u stepenu razvoja brzine, fleksibilnosti i koordinaciji slijepih u poređenju s pokazateljima osoba s teškim oštećenjem vida i ljudi s umjerenim oštećenjem vida prije i nakon eksperimenta. Kao rezultat eksperimenta, došlo je do značajnog porasta pokazatelja svih testova za osobe sa oštećenjem vida. To ukazuje na pozitivan uticaj adaptivnog sportskog treninga na njihovu fizičku spremnost. Dobijeni rezultati pokazuju da postoji povezanost između nivoa gubitka vida kod osoba sa oštećenjem vida i uticaja adaptivnog sportskog treninga na njihovu fizičku spremnost.

Ključne riječi: *slijepe osobe, adaptivni sportovi, snaga, koordinacija, izdržljivost, fleksibilnost.*

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РЕЗЮМЕ

ПОВЫШЕНИЕ ФИЗИЧЕСКОЙ ПОДГОТОВЛЕННОСТИ СПОРТСМЕНОВ С НАРУШЕНИЯМИ ЗРЕНИЯ С ПОМОЩЬЮ АДАПТИВНОГО СПОРТА

Анализ имеющегося научного знания по учету уровня сохраненного зрения в построении подготовки спортсменов в адаптивном спорте свидетельствует об отсутствии информации о степени влияния занятий адаптивным спортом на уровень физической подготовленности у лиц с нарушениями зрения, что снижает эффективность реализации их спортивного потенциала. Целью исследования является выявление влияния занятий адаптивным спортом на физическую подготовленность спортсменов с нарушениями зрения. Для реализации поставленной цели были использованы следующие методы: теоретический анализ, педагогическое наблюдение, педагогический эксперимент, математические и статистические методы. В исследовании приняло участие 34 спортсмена, среди которых 8 с тотальной слепотой, 10 человек с легкими нарушениями зрения и 16 с тяжелыми нарушениями зрения. С целью определения уровня физической подготовленности у лиц с нарушениями зрения были использованы тесты на сгибание и разгибание рук в упоре лежа, бег на 30 м, 12-ти минутный тест Купера на велотренажере, наклон туловища вперед из положения сидя и удержание равновесия на одной ноге. Установлено, что уровень сохраненного зрения значительно влияет на показатели физической подготовленности. Выявлены достоверные различия в уровне развития быстроты, гибкости и координационных качеств у лиц с тотальной слепотой по сравнению с показателями лиц с легкими и тяжелыми нарушениями зрения до и после эксперимента. В результате эксперимента произошло достоверное повышение показателей по всем тестам у лиц с нарушениями зрения, что свидетельствует о положительном влиянии занятий адаптивным спортом на их физическую подготовленность. Полученные результаты свидетельствуют о наличии зависимости между уровнем сохраненного зрения и влиянием занятий адаптивным спортом на физическую подготовленность у лиц с нарушениями зрения.

Ключевые слова: *слепота, адаптивный спорт, сила, координация, выносливость, гибкость.*

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INTERNAL AND EXTERNAL VARIABLES IN THE SPORTS MANAGEMENT

UNUTRAŠNJE I VANJSKE VARIJABLE U SPORTSKOM MENADŽMENTU

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ABSTRACT

Sports organizations are subject to a permanent movement, having to plan correctly and systemically towards the future. This research analyzes the different concepts, theories and research of different authors on which are the internal and external variables on which the public and private sports organizations base their management. In this sense, a documentary investigation was designed, with explanatory level depth, oriented in a phenomenological, interpretative epistemological approach, of qualitative nature. The data collection technique is a documentary analysis; using arching of sources and triangulation, the instrument was a digital word processor. Among the findings, it was observed that many sports organizations based their planning mainly on theoretical facts, unrealistic to their situation, always considering the same internal and external variables. In their management these organizations mainly consider the managerial level, and a little to their personnel, being more interested in the results of the teams or of their athletes, the typical operating management is highly qualified to solve current problems and resist a change of paradigm to get involved and to investigate more deeply on other internal variables of their organism equally on external variables that impact on their organization. Finally, the research reflects other variables to be considered in order to optimize the management process in sports organizations, which, when properly considered, can support their management and will result in sustainable development, fulfilling their activities and achieving the stated goal.

Keywords: *planning process, sports organizations, resources, variables.*

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INTRODUCTION

In sports organizations, whether public or private, for profit or not, it is the boards of directors and/or their coordinators who are responsible for preparing planning activities that must be completed in a given time. In the natural case of sports that may be or annual operational plan, medium term or olympic cycle, four years, or long-term five years or more, always depending on the objectives of the organization. These organizations often have to change their structures constantly, as expressed by Gabaldon (2008), due to the complexity and the continuous and conflictive process that generates problems and confusing processes that occur in the scenario in which they develop, where each sports organization must consider and plan based on the internal variables that it manages, as well as external variables that impact the achievement of their goals.

Chiavenato (2004 and 2006), called these variables "Basic Administrative Variables" (VAB), and expresses that the common variables of the organizations are: Task Structure, Person, Environment and Technology. These represent five main areas that every organization has, which define its style and personality. Subsequently, Chiavenato incorporates a new variable that improves, reinforces, and updates the existing ones and calls it Competitiveness.

The different administrative theories emphasize one or more of these Basic Administrative Variables (BAV) cited by this author. In such a way that most, and perhaps all, any organization, refers to or considers any of these variables and that sports organizations could adapt to their own management processes.

With respect to the relevance that different administrative theories give to these variables, the following can be pointed out:

a) The task or activity carried out by the organization in question. This variable is emphasized by the theories that consider management as a science applied to the rationalization and planning of operational activities.

b) The structure, which refers to both the organizational structure and the physical resources of the organization. This variable is emphasized by those theories that consider the Administration as a science in charge of configuring and structuring the components of the organization.

c) The people, human resources, and talents that integrate it. This variable is relevant for theories that consider the Administration as a science applied to people and their activities in organizations.

d) The environment, the place where the organization is developed. The theories that consider the Administration as a science that seeks to adapt organizations to the demands and situations that occur in their external context emphasize the importance of this variable.

e) The technology or methods and techniques used. The theories that consider the Administration as a science in charge of the successful application of technology in organizational activity give special emphasis to this variable.

f) Competitiveness, defined as the "ability of an organization to offer better and cheaper products and services, tailored to the needs and expectations of the market, providing innovative solutions to the client. This variable is

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especially emphasized in the new approaches to Administration that have emerged since the 1990s. This new variable complements each and every one of the previous variables, because it incorporates the necessary drive to mobilize that complex whole in the search for overcoming, thus avoiding conformity. It injects the dose of effort necessary not to eclipse oneself by remembering past achievements and thus give up spaces that may be unrecoverable by the increase of competitors in a market of constant change, evolution and uncertainty.

This new variable connects the organization with its environment and evaluates its position before the organizations dedicated to the same field. It is agreed that the main challenges for the administration are related to adapting and integrating the six variables mentioned above. Competitiveness or competition is related to the Strategic Points of Excellence Points (SPE). In this regard, Chiavenato (ibid) points out that: "The adequacy and integration between these six variables are the main challenges of the administration".

He also mentions that: As administration faces new situations that arise with the passage of time and space, administrative doctrines and theories need to adapt their approaches or modify them to remain useful and applicable. This explains, in part, the gradual steps of the General Theory of Administration, to the passage of time and the gradual amplitude and complexity that have just been exposed, and as an example we can mention the use of the variable technology that has been included as fundamental part for the good sport development as example the use of VAR (Video Assistant Referee) in the basketball games of NBA as well as by FIFA in the world cup.

Among the external variables, organizations commonly study and analyze the following: Political, Economic, Social and Technological, which compose the PEST matrix, these are essentially external, or the macro environment, generally existing as a consequence of: a business measuring tool , used to evaluate the market in which a business or unit is found as highlighted by Humphrey (2004), in which he states that the PEST analysis can sometimes extend up to seven or more factors, including ecological, legislative among others, we can specify:

a) Political Variable: At this point, the political and legal factors affecting the industry where the company operates are analyzed: how it relates to the government, consumer attitudes toward the industry, as well as lobbying efforts on the part of companies and consumers. Here, we also include a legal analysis about the regulations that companies, channels and consumers must comply with, as well as possible changes.

b) Economic Variable: In this component, distribution and use of economic resources of society is analyzed. This is, of course, a very important aspect because consumer habits are heavily influenced by the unemployment rate, disposable income, exchange rate, and others.

c) Social Variable: The social component of the environment contains factors such as the illiteracy rate, the culture of the society, ethical norms, customs, lifestyle, educational level, ethereal distribution, and others.

d) Technological Variable: These are the changes in technology that affect the sector both in its industrial part and its

commercial and administrative part. The author explains that the PEST model is robust because it contemplates the main factors that can affect the performance of a company outside the industry.

Under this theoretical supports it is possible to interpret how each of the variables will affect the performance of sports organizations, depending also on the person or group of people who develop in them and the knowledge they posses about the objectives of the organization, the variables of the environment, and its probable impact. On the other hand, the social and political variables involved in the PEST model sometimes manifest unpredictable behavior with a continuous dynamic. Therefore, these variables should be checked continuously.

This research takes special interest as expressed in the work of Cook (2012), who wrote a thesis entitled "Analysis of the Business Environment of the United States of America", expressing that given the number of unexpected events occurring in the U.S. environment and the pace of change in today's world, there is a new imperative for the understanding and management of these complex dynamics and associated emerging risks, the contribution of Cook's work for this article of sports organizations, is that the author tries to verify whether the current method of analysis of external variables known as PEST remains a useful and relevant tool given the complexity and rapid evolution of global business environments.

It is also important to mention that each sports organization, such as a club, league, association or federation, contains several, or all, of these internal and external variables, regardless of the size or turn of the same; because every organization has at least one activity to be developed (task), at least one position or position defined and minimal material resources for its activity (structure), has at least one member (person), it develops its activities in a specific place (environment), implements some form or style of work (technology) and there may be others of the same category (competitiveness).

Paris (2003), argues that the management process of a sports organization must be continuously updated, and this is precisely what allows strategies to be adapted to the changes taking place in the world of sport, and that this updating must be one of the characteristics of sports management. The author goes on to say that, for example, in the last fifteen years many things have changed and sport has not been an exception. The situation in a given time is very different from the current situation, and can be mentioned as an example: society's disposition towards sport, fashions of practice, there are sports that appear, develop and disappear in a decade, sports consumption habits, the media including new information and communication technologies, public contributions to sport. This leads us to deduce that the internal resources and external variables that were managed at a certain moment, or in the past, would not be as precise in their details as the current situation of a sports organization.

Steiner, quoted by Paris (ibid), reflects that there are some psychological causes by which some organizations do not keep up to date themselves or do not make changes in their management process. This can be transferred to sports management, and is motivated to:

a) Certain plans change information flows, decision making and authorities,

which generates insecurities, fears and resistance to change.

b) The typical sports manager is highly skilled in solving current problems and is reluctant to get involved with exploring other fields, which represent more risks and whose results are uncertain for a few years in the future.

c) Sports management demands new intellectual factors of managers, which may find difficult to satisfy. Paris also argues that there are managers who believe that it is better to continue doing things the same way, that delving into other aspects is not necessary because they have worked in sport for a long time and already know how everything works.

Rodriguez (2015), points out that sport associations mainly focus their management, with more interest, to competition calendars, neglecting a little important management elements such as internal resources and external variables. According to Paris, referred by Villamarin (2004), in a study carried out on sports organizations in Barcelona Spain, he obtained a result:

a) That the process of planning, organization, direction and control processes are scarcely formalized in smaller organizations;

b) Strategy is largely the weakest aspect;

c) The focus is excessively short-term;

d)The processes are scarcely participative;

e) Planning is based on almost exclusively financial variables. This last part is related to the present study in which it is observed that the great majority of these sports organizations consider mainly the managerial level, and a little of their personnel, more interested in the results of the teams or their athletes.

The purpose of this research was to carry out a critical documentary analysis of the concepts, theories and research of different authors, on what are and how are the internal resources and external variables on which public and private sports organizations base their management process with reviewing the literature regarding internal and external variables in sports organizations and determine the bibliographic sources on internal and external variables in sports organizations, including extraction and compile information related to internal and external variables in sports organizations and finally to apply a triangulation with the most relevant results and proposals that different scholars have carry out with respect to internal and external variables in sports organizations and finally perform a critical documentary analysis of internal and external variables for these organizations.

METHODS

This paper seeks to strengthen theoretically the action to research, through the Theoretical Framework and a Referential Framework thus constructing the logical moment of the research. From there it goes towards theoretical empirical integration, which constitutes the backbone of the study. For this purpose, a methodological bridge is necessary that connects the logical moment with the methodological moment.

This methodological bridge is constituted by the Investigator's Epistemological Perspective, also called the Epistemological Position or Epistemological Approach to the Object or Phenomenon of Study, where the effort is centered in those aspects that support the research project, that make it possible

to be read in an adequate way, as it is stated by Piaget, referred by Bernal (2000), who maintains that "the logic is the study of the formal conditions of truth in the field of sciences; the *methodology* is the theory of general research procedures that describe the characteristics adopted by the general process of scientific knowledge and the stages into which that process is divided, from the point of view of its production and the conditions under which it should be done ". This places us in an epistemological dimension, and is one of the motivation for initiating certain research where the object of study is unknown until it is known and deciphered. According to the treatment of the data and the conception of the reality of the present research it starts from the Phenomenological - Interpretive Approach.

The Nature of Research is qualitative. Qualitative studies are based on the interpretation of information and data. Three components are identified as configurators of the process of understanding: preconception, current understanding and interpretation, based on the use of a qualitative approach, theory based on data collection as a research method, which facilitates the approach of any exploration, which is related to behaviors, as well as organizational functioning, which adapts to the internal dynamics of the purpose of the research. As already mentioned in this method, there is a close relationship between data collection, analysis, and the theory that emerges from the data. In this way the theory originates from the data, so that theory may look more like reality than theory derived from concepts based on experience. Therefore, the possibility of generating knowledge that is capable of providing meaningful guidance for action within a given field of study is increased, in this case guidelines for the situational study process for strategic planning in sports organizations.

According to Corral, Fuentes, Maldonado and Brito (2012), this work allows to research and collect information through techniques and instruments, through the selection, arching of secondary sources and the use of triangulation, where the researcher reflects and exposes the procedures of analysis of the information, product of the data, methods and researchers, which the facilitate the approach of any exploration.

About the participants participating in this research, Martinez (2006) wrote that they are the authors who form part of the triangulation carried out by the researcher to study and analyze the internal and external variables in sports management.

For the information gathering process Arias (2006) was considered for the information gathering. The technique of documentary observation and content analysis used and the instrument was the word processor of a computer. It is important to clarify that, even when documentary sources provided secondary data, these in turn are classified into primary documentary sources: original works; and secondary documentary sources: works in which reference is made to the work of an author. Considering the arching of sources to specify the object of study, under a logical line by authors and researchers experienced in the area. In this work, it was proposed, as the result of readings, the technique of content analysis that others have previously developed based on the technique of triangulation, with different points of view, with critical

summaries, which led to the researcher to reflect and propose new information in a creative and original way.

This research was based on triangulation, where a list of data, researchers, methods and theoretical propositions on internal and external variables of sports management was elaborated, later a list of each one was made, and it was determined which supposed empirical relationships really existed, later only those that resisted the empirical contrast were taken, and the best were selected according to the researcher, finally all the contrasted were enumerated and the internal and external variables were presented to optimize the management in sports organizations.

The analysis of the documents was made through the content analysis technique, which according to Martínez (ibid), consist of examine the text making some kind of interpretation once its most important characteristics have been identified; according to the internal and external variables as well as the categories of analysis. The process comprises 4 stages, according to Martínez (ibid): categorization, structuring, contrasting and theorizing.The techniques mentioned above made it possible to collect the necessary information, it was considered sufficient at the time that the data provided were repeated, that no new information was produced; and the maximum point is reached at which the information is considered to be saturated. From this information, begins the process that will allow the emergence, as Martínez (ibid) points out, of the possible theoretical structure implicit in the material collected. It is important to bear in mind that the process of collecting, categorizing and interpreting data it is not carried out in successive times, but rather they are continuously interlaced.

RESULTS

With regard to this qualitative research, the results obtained from the primary and secondary sources analyzed are set out below:

The management of sports organizations has been based solely only on their previous managerial forms and not on their current situation, since because they do not consider other internal and external variables that are new or that simply already exist but cannot be detected and included in their work plans. Private organizations specifically amateur sport, such as clubs, leagues, associations and federations are created on a non-profit basis, and their members and directors do not receive wages or salaries, which has resulted in a lack of motivation when it comes to deepening planning, and determining other variables different from those that already exist, since this is a complex process and the dedication of time and intellectual aspect is fundamental to achieve it.

Many amateur sports organizations have good financial support, good name, good image, excellent structure, good sports facilities, but have certain internal resistance such as staff (director and managers) with very little or no knowledge about modern management in sport. It was observed that most sports organizations focus their planning on competition calendars and the results of teams or their athletes, neglecting and not thoroughly investigating all internal and external variables, which can influence or impact negatively or positively in the administrative process and therefore in the management results. As another

conclusion is that planning and control processes are poorly formalized in smaller sports organizations, it is planned in the short term and planning is based on aspects almost exclusively based of the economic or financier variable.

Sometimes the sports organizations analyze and work with variables other those of the government, as argued by Gutierrez (2009), which complicates the decisions and rules of the state government authorities, who are compromised in their period of government, and harm in some way to achieve the objectives set for these sports organizations.

It was observed that there are organizations such as equitation where this sport involves animals such as horses or mares and where they are not considered among the internal variables. In the documentation studied little interest has been given to it.

Time administration is hardly considered an important variable in sports organizations. It is observed that they usually include charts and graphs such as the AOP or Annual Operating Plan, as well as other functional and very useful tools such as flowcharts and Ghant diagrams, among others, but curiously they do not define it as an internal variable.

In some of the texts investigated, the competence variable is considered only as an internal variable and not as an external variable.

DISCUSSION

This research was constituted in the critical analysis, approaches and researcher own argument, which gives as evidenced and innovative research with credibility and scientific validity. It is mentioned below:

As a result of the content analysis, here are evidence that the internal variables found in a sports organizations correspond to Task, Structure, Person, Environment,Technology,Competitivenes s and Time; with a great approximation to what was expressed by the authors, among them Chiavenato (ibid), who consider as "Basic Administrative Variables" (VAB) to the internal variables:

Task, Structure, Person, Environment and Technology which can be updated according to Rodríguez (2016), becoming known as TIC's, where Competitiveness variable is latter annexed.

It can be deduced that depending on the need and reality of each sport organization other variables will be annexed later.

Another of the results reflects certain references where organizations in general include tables and graphs such as the AOP or Annual Operational Plan, as well as other tools that serve for the management process, among these flowcharts and Ghant diagrams, but curiously they do not determine it as a variable, and must be taken into account given its importance and without which no organization would function.

Whit respect to Cook's approach (ibid) and the results obtained, of his concern about investigating whether the PEST matrix is still useful for organizations, it can be said that this matrix has been updated as the complexity of the organizations and the competitiveness of their peers advances, and what was born with the acronym PEST (Political, Economic, Social and Technological) has been transformed by annexing other variables, and in this

research the nomenclature of PESTTLERCC (Political, Economic, Social, Technological, Time, Legal, Religious, Cultural and Competition) is evident. Although it is certain that whit the passing of time and unstoppable changes other variables could be annexed.

CONCLUSION

According to the results and objectives of this research, it can be concluded that the continuous interaction of man in the course of history with sport, and planning of this, has allowed different ways of planning this activity to have been considered over time thus evolving this knowledge in different facets, in which different authors can define it as complex, useful or necessary. In the case of sport facet it is important to recognize the role of the directors managers or in charge of the development, sustenance and the achievement of objectives in the sports organizations, which constitutes in itself one of the most important activities in the developing of those who practice it not only at the corporal level, but psychological and social. As a sport activity that can have a positive impact on children and young people, and on all people in general.

A review and literature concerning the internal and external variables processes by sports organizations can be concluded that this was achieved satisfactorily, as there is sufficient literature on the subject under study. Later the bibliographical sources were determined on the internal and external variables that the sports organizations process, it is concluded that this was concretely supported mainly in authors of theories of old date up to our days, giving solidity and support to the research. The research is based on the arching of secondary sources, data, and previous studies by researchers and authors that are experts in the field, by means of the analysis, comprehension and interpretation of the information, which was collected by separating the different processes from the internal and external variables processed by sports organizations through a word processor.

A triangulation was applied with the most relevant results and proposals that different scholars have made with respect to the internal and external variables processed by sports organizations. It is concluded that due to the varied information, as well as the different points of view of authors and researchers used with different methodologies, greater reliability was given to the results reflected in the results of this research.

It can be concluded that this analysis applied to the data of the different authors became interesting and complex, due to the extent of each of the variables and the dimension and complexity and types of different sports organizations, trying to extract the data of the different authors and how they obtained the knowledge through techniques and research instruments, achieving content analysis by examining each text and interpreting the most important characteristics in terms of internal variables and external variables processed by sports organizations.

It would be important to investigate and be creative, as Millar (2015) refers, in his qualitative research on the "Capacity for Creation of Community Sports Organizations", developing a theoretical base model that recognizes the components and factors necessary to achieve it, and annex other internal variables such as: the Time variable, which is present in every organization,

structure, plan and organizational operability, since there is evidence of the use of tables and graphs such as the AOP or Annual Operating Plan, as well as other functional and useful tools such as flowcharts and Ghant diagrams among others, which contribute to the development of sports organizations.

Other variables can also be annexed and are related to the task and people this could be the Power variable, in which the person has the availability and has their personal resources, skills and even physical and mental health to perform a certain activity, the other variable is the Intention or Want to Do, it is thought that the person has a high state of mind to fulfill their duties, to these are added the variable of Leadership that must have the director or manager of the sports organizations, where the variable of Empowerment, is annexed, where the sport leaders can create awareness in the employees and giving them to understand the importance of carrying out their work effectively and efficiently. In certain sports organizations such as the equestrian sport included in the Olympic Games by the IOC (2015), it is advisable to include the Animal variable to specify more precisely the plans and budgets of the organization. The sum of these new variables could be written like this: TEPATTPILEA (Task, Structure, Person, Environment, Technology, Time, Power, Intention, Leadership, Empowerment, Animal), but taking into account that including these variables would make the nomenclature or acronym of the internal variables very long and lend itself to confusion, it can be maintained as the title only that of "BAV" (Basic Administrative Variables) in short, what is relevant is to achieve optimal processes, with feasible and useful plans for sports organizations.

Probably for external variables, the competition or how it is managed in other sports organizations, is a useful variable when it comes to improving and standing out in the sports environment, in this sense it would be important to include it within the group of external variables to the sports organizations. Another element to conclude is that from the cultural point of view many sports organizations lack the knowledge and the techniques and methods to manage all the variables of the organization itself and not all the variables that surround it, together with this they cannot pay a specialist or professional consultant expert in management.

In view of the fact that some sports organizations do not fully embrace internal and external variables, it is concluded that in part it happens that these constantly change the flows of information, decision making and their authorities, which creates insecurities, fears and resistance to change, where the typical operational manager is highly capable of solving current problems and resists getting involved with other probable variables, which represent more risks and whose results are insecure for some years in the future, and that this type of planning demands new intellectual factors from the managers, which the latter may consider difficult to satisfy.

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SAŽETAK

Sportske organizacije podliježu stalnim promjenama i moraju pravilno i sistematski planirati svoj rad u budućnosti. Ovo istraživanje analizira različite koncepte, teorije i istraživanja različitih autora koji su se bavili analizom unutrašnjih i vanjskih varijabli na kojima javne i privatne sportske organizacije temelje svoje upravljanje. U tom je smislu osmišljeno dokumentarno istraživanje s dubljim objašnjenjima, orijentisano na fenomenološki, interpretativni epistemološki pristup, kvalitativne prirode. Tehnika prikupljanja podataka je dokumentarna analiza; koristili su se arhivirani izvori i triangulacija, dok je tekst obrađen digitalnim putem. Na osnovu prikupljenih podataka primijećeno je da su mnoge sportske organizacije svoje planiranje temeljile uglavnom na teorijskim činjenicama, nerealnim njihovoj situaciji, uvijek uzimajući u obzir iste unutrašnje i vanjske varijable. U svom menadžmentu ove organizacije uglavnom uzimaju u obzir menadžerski nivo, a malo se orijentišu prema svom osoblju, više zainteresovani za rezultate timova ili svojih sportista, tipično operativno rukovodstvo je visoko kvalifikovano za rješavanje trenutnih problema i opire se promjeni paradigme i ne uključuju se u dublje istraživanje unutrašnje varijable svoje organizacije jednako kao na vanjske varijable koje utiču na njihovu organizaciju. Konačno, istraživanje odražava i druge varijable koje treba razmotriti kako bi se optimizirao proces upravljanja u sportskim organizacijama koje, ako se pravilno razmotre, mogu podržati njihovo upravljanje i rezultirati održivim razvojem, ispunjavanjem svojih aktivnosti i postizanjem navedenog cilja.

Ključne riječi: *proces planiranja, sportske organizacije, resursi, varijable*

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RELATIVE AGE AND ANAEROBIC CHARACTERISTICS OF YOUNG SOCCER PLAYERS

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RELATIVNA STAROST I ANAEROBNE KARAKTERISTIKE MLADIH FUDBALERA

ABSTRACT

The aim of this study was to examine the impact of the relative age on the power, speed and agility of young U13 and U14 players. The study was conducted on a sample of 60 young soccer players born in 2001 and 2002. Within both age groups, players are divided into two categories according to relative age, whether they were born in the first or second half of the year. Anthropometric measurements and measurements of motor abilities were made to assess explosive power, speed and agility using the tests: standing long jump, vertical jump, sprint at 30 meters with passing time at 10 meters, zig-zag running without a ball and Ajax test 5x10m. Statistically significant differences were found in body height and weight, as well as in tests to assess power in a sample of U13 players. In U14 group, differences were found in tests of power and running speed, while there were no statistically significant differences in anthropometric variables. According to the results obtained, it can be said that the relative age is an important factor that leads to the appearance of differences in the test results of motor skills of young U13 and U14 soccer players. Therefore, the effect of relative age must be taken into account when selecting young soccer players during adolescence.

Keywords: *relative age, biological maturity, explosive power, speed, agility, young soccer players, talent selection and identification*

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INTRODUCTION

According to the Rules of Competition of the Football Association of Bosnia and Herzegovina, the competitive selections of young soccer players are formed on the basis of the chronological age of the players, and January 1st is taken as the cut-off date for the selection of players in a particular selection. The same is in other countries whose soccer federations organize competitions according to the regulations of the European Football Association (UEFA). As a consequence of such propositions, it happens that players born in the first part of the selection year are more represented in teams than their peers born in the second half of the year (Cobley et al. 2009; Till et al. 2010; Delorme et al., 2010,Rashner et al., 2012). This difference in chronological age is referred to as relative age, and its immediate and long-term effects on the performance and selection of young athletes are known as the relative age effect (Cobley et al. 2009; Hancock et al. 2013). The relative age effect represents an unequal distribution of birth dates within the age group of athletes by favoring those born at the beginning or in the first months of the selection year, and discriminating against those born at a later date or at the end of the selection year (Mujika et al. 2009; Helsenet al. , 2012). Comparison of the birthdays of professional soccer players in ten European countries in the 2000-2001 competitive seasons and 2010-2011, showed that there is no change in the presence of the relative age effect in professional soccer over the past 10 years, indicating the robust nature of this problem and its actuality (Helsen et al., 2012). Social factors are considered to have the greatest impact on this phenomenon, which include both the influence of the coach as well as the influence of the parents and the athletes themselves on its appearance and representation (Hancock et al., 2013). Research has shown that athletes born earlier during the selection year are taller and more powerful than peers born later (Carling et al., 2009; Hirose, 2009). It has been previously documented that physical characteristics of players play an important role in successful performance in soccer (Stolen et al., 2005). Soccer skills that require a high level of muscle strength, such as sprint, jump, shot, tackle have been shown to significantly discriminate between different groups of football players according to level of competition (Cometti et al. 2001, Vaeyans et al. 2006). The players born at the beginning of the selection year can be biologically more mature and thus have a higher level of ability related to muscle strength (Stratton et al., 2004) In soccer, the combination of relative age and biological maturity increases the possibility for a young footballer to be selected and recognized as talented (Cobley et al., 2009). On the other hand, there is a number of studies that have not found a relationship between the relative age and the level of physical and physiological characteristics of soccer players (Carling et al., 2009; Deprez et al., 2012; Hirose, 2009; Segers et al., 2008).

Due to the insufficient number of studies and the still insufficiently clear role of relative age in the selection of young football players, this research was conducted to determine the impact of the relative age on the anaerobic characteristics (explosive power, speed and agility) of young soccer players aged 13 and 14.

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METHODS

The research was conducted on a sample of 60 young soccer players born in 2001 and 2002 from a club that competes at the highest state level of the competition. The participants were divided into two age categories, U14 (n = 30; M = 13.7 years) and U13 (n = 30; M = 12.4 years. The selection criteria were as follows: (1) born in 2001 and 2002, (2) active members of the club, (3) train football for at least 2 years, (4) regularly train four times a week (5) have a medical examination confirming that they are healthy.

All participants born in 2002 were classified into two categories according to chronological age. The first category consisted of boys born from January 1st to June 30th2002 (n = 14) and the second category of boys born from July 1st to December 31st 2002. The same division into categories was made in boys born in 2001. The first category includes boys born in the first half of the year (n = 19) and boys born in the second half of the year (n = 11).

Anthropometric measurements included estimation of body height and body weight. The selection of the anaerobic tests was made taking into account the results of research of the importance of particular abilities for success in football. A link between the performance of soccer skills, on the one hand, and running speed, explosive power and agility, on the other, has been confirmed (Stolen et al. 2005, Cometti et al. 2001). A sprint test of 30 meters with a 10 meter passing time was used to assess running speed, a vertical jump was used to evaluate power and an Ajax test was used to assess agility.

The data were processed using the SPPS 20 for Windows and descriptive and comparative analyses were conducted. In the first step, basic descriptive statistical parameters were calculated (arithmetic mean, standard deviation, standard error of arithmetic means for all variables). The statistical significance of the normality of the distribution was tested. In the next step, the statistical significance of the arithmetic mean differences between the two groups of participants was tested. A t-test for independent samples was used for this purpose. This analysis was applied to test for differences in both the boys group born in 2002 (U13) and the boys group born in 2001 (U14). All hypotheses were tested at a significance level of 0.05.

THE RESULTS

Table 1 shows the basic descriptive parameters of anthropometric variables, as well as the parameters of power, running speed and agility. The sample of boys born in 2002 was divided into two groups, boys born in the first and second half of the year.

Table 1. *Descriptive statistics of test results for both groups of players born in the first and second half of the year (U13)*

	date of birth	N	M	SD	SEM
body weight (kg)	first half	14	63.89	4.59	1.53
	second half	16	47.12	8.13	2.03
body height (cm)	first half	14	175.22	3.83	1.28
	second half	16	161.06	10.9	2.72
standing long jump (cm)	first half	14	213.78	14.77	4.92
	second half	16	195.19	21.92	5.48
vertical jump (cm)	first half	14	269.33	9.14	3.04
	second half	16	246.12	17.44	4.36
sprint 10 m	first half	14	2.49	0.20	0.07
	second half	16	2.55	0.10	0.02
sprint 30 m	first half	14	5.20	0.36	0.12
	second half	16	5.45	0.26	0.06
zig-zag running	first half	14	5.47	0.32	0.12
	second half	16	5.53	0.26	0.06
ajax test 5x10 m	first half	14	12.91	0.48	0.16
	second half	16	13.26	0.59	0.15

Legend: N-number of participants; M-arithmetic mean; SD standard deviation; SEM- standard error of arithmetic mean

Table 2 shows the results of testing the statistical significance of differences in the arithmetic means of two groups of boys born in 2002. Boys born in the first half of the year were taller and heavier than boys born in the second half of the year.

The difference between the two categories of boys was statistically significant at a significance level of 0.01. Boys born in the first half of the year, therefore chronologically older players, performed statistically significantly better in power tests (long jump and vertical jump) compared to chronologically younger boys.

The difference between the two categories of boys in the power test (long jump) was statistically significant at the significance level of 0.05, while the difference in the other power test (vertical jump) was statistically significant at the significance level of 0.01. The differences in the running speed and the agility tests were not statistically significant; the chronological age of the subjects did not affect the differences in the results of these tests.

Table 2. *Results of the t-test for independent samples; testing for statistical significance of differences in measurement results between two groups of players born in the first and second half of the year (U13)*

	t	df	p
body weight (kg)	6.587	22.98	**0.000**
body height (cm)	4.706	20.47	**0.000**
standing logn jump (cm)	2.261	23	**0.034**
vertical jump (cm)	3.693	23	**0.001**
sprint 10 m (s)	-1.114	23	0.277
sprint 30 m (s)	-2.04	23	0.053
zig-zag running (s)	-0.508	23	0.616
ajax test 5x10 m (s)	-1.541	23	0.137

Legend: t-t statistic; df degrees of freedom; p-level of significance

Table 3 shows the basic descriptive parameters of anthropometric variables, as well as the parameters of the power, speed and agility in a sample of boys born in 2001.

Table 3. *Descriptive statistics of test results for both groups of players born in the first and second half of the year (U14)*

	date of birth	N	M	SD	SEM
body weight (kg)	first half	19	58.26	6.56	1.50
	second half	11	53.67	6.38	2.60
body height (cm)	first half	19	173.11	9.28	2.13
	second half	11	167.00	7.01	2.86
standing long jump (cm)	first half	19	217.21	20.77	4.77
	second half	11	196.50	16.01	6.53
vertical jump (cm)	first half	19	264.79	13.13	3.01
	second half	11	251.50	9.83	4.01
sprint 10 m (s)	first half	19	2.47	0.10	0.02
	second half	11	2.57	0.06	0.02
sprint 30 m (s)	first half	19	5.17	0.24	0.05
	second half	11	5.43	0.16	0.07
zig-zag running (s)	first half	19	5.58	0.26	0.06
	second half	11	5.67	0.14	0.06
ajax test 5x10 m	first half	19	12.89	0.40	0.09
	second half	11	13.19	0.39	0.16

Legend: N-number of participants; M-arithmetic mean; SD standard deviation; SEM- standard error of arithmetic mean

Table 4 shows the results of testing the statistical significance of differences in arithmetic means of two groups of boys born in 2001. The results showed that there was a statistically significant difference between the two categories of boys in tests of power and running speed. Boys born in the first half of the year had better results in both the long jump test and the vertical jump test and the difference was statistically significant at a significance level of 0.05. Chronologically older boys of this age also had better results in the running speed test, a sprint at 30 meters with a passing time at 10 meters. The difference was also statistically significant at the 0.05 level. The results showed no statistically significant difference in anthropometric variables, body height and body weight. In addition, no significant difference was found between the two categories of boys in the results of agility tests.

Table 4. *Results of the t-test for independent samples; testing for statistical significance of differences in measurement results between two groups of players born in the first and second half of the year (U14)*

	t	df	p
body weight (kg)	1.504	29	0.146
body height (cm)	1.475	29	0.154
standing long jump (cm)	2.229	29	**0.036**
vertical jump (cm)	2.272	29	**0.033**
sprint 10 m (s)	-2.278	29	**0.032**
sprint 30 m (s)	-2.496	29	**0.020**
zig-zag running (s)	-0.765	29	0.452
ajax test 5x10 m (s)	-1.631	29	0.116

Legend: t-t statistic; df degrees of freedom; p-level of significance

DISCUSSION

The aim of this study was to determine the impact of relative age on power, sprint speed and agility in young soccer players in two competitive categories, U13 and U14. Within these categories, participants were divided into categories depending on whether they were born in the first or second half of the year. In the group of young soccer players born in 2002 (U13), it was found that there was a statistically significant difference in tests of power, both horizontal and vertical, as well as body height and weight. Research has shown that biological maturity can influence the selection of young athletes and the incidence of relative age in football (Helsen et al. 2000; Cobley et al. 2009). As in some earlier studies, it was shown that young athletes who are chronologically older within the same selection year often have more developed physical characteristics (Gill et al., 2014; Fragoso et al., 2015). Thus, in this study, statistically significant differences were observed in both examined anthropometric characteristics in U13 group, while in U14 group no differences in body

height and weight were observed. This is probably due to the fact that relatively older and therefore heavier boys are more likely to be selected in the younger age categories and continue playing football in the older age categories (Helsen et al. 2000, Malina et al. 2007, Vaeyens et al., 2005). Similarly, Deprez et al. (2012) in their study found no significant differences in anthropometric characteristics between the 4 quarters of the selection year, which was attributed to the fact that players had already undergone a high level of selection that led to sample homogeneity. Borges et al. (2017) have shown that the anthropometric characteristics of young soccer players change according to the level of biological maturity. The results of this study showed that there is a relationship between the relative age of U13 soccer players and the level of power. Players born in the first half of the year performed better on both power tests than players born in the second half of the year. An earlier research also showed that relatively older soccer players may have better power performance during puberty than their younger peers (Malina et al. 2004, Figueiredo et al. 2009). Explosive power is an ability that correlates with anthropometric player growth and development, and changes in explosive power were attributed to weight gain and development of the neuromuscular and neuroendocrine system (Stratton et al., 2004). This is further compounded by metabolic factors and androgenic hormones that affect anaerobic strength production and muscle hypertrophy, whose concentration begins to increase from 13-14 years in boys (Issurin, 2008). The impact of biological maturity is therefore particularly pronounced when it comes to muscle strength abilities. Deprez et al. (2013) showed that, when controlling for age and biological maturity, there are no differences in the examined parameters of anaerobic performance within the birth quarters. No differences in running speed and agility were found in the group of boys born in 2002 (U13), which is consistent with some earlier studies (Deprez et al., 2012; Malina et al., 2007; Hirose, 2009). The assumption is that younger players can chronologically counteract the effect of relative age on motor skills by entering puberty early or with a higher level of biological maturity.

In a group of young soccer players born in 2001 (U14), it was found that there is a statistically significant difference in power and running speed tests in favor of boys born in the first half of the year. No statistically significant difference in body height and weight was observed. Unlike the younger age group (U13) where there was no difference in sprint speed between chronologically older and younger boys, this difference was statistically significant in the group of U14. The influence of biological maturity on running speed is present in older boys, in whom these differences in growth and strength development are most pronounced (Mendez-Villanueva et al., 2011). In a study conducted by McCunn et al. (2016), the association between biological maturity and running speed was very small in the younger age categories, while a large association was shown for the U14 and U15 age categories, which is consistent with the results obtained in this study.

In this study, no statistically significant difference was found in the results of agility tests between boys born in the first half of the year and boys born in the second half of the year. This was the case in both age categories, both U13 and U14. This is consistent with research that has also not found the impact of relative age on agility in young football players (Lovell et al., 2015).

This research has shown that the relative age of young football players may significantly influence the motor skills of young soccer players, such as power and speed in the U13 and U14 age category. Relatively older U13 players showed a higher level of power than relatively younger players. Players born in the first half of the year performed better on both power tests than boys born in the second half.

With regard to the U14 age, differences between the two categories of soccer players of different relative age were found in power and speed tests. It is very important for coaches to take into account the impact of the relative age and maturity of young football players during the selection process in order to objectively select talented boys into youth selections during adolescence.

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SAŽETAK

Cilj ovog rada je bio da se ispita u kojoj mjeri relativna starost ima uticaj na eksplozivnu snagu, brzinu i agilnost mladih fudbalera uzrasta U13 i U14. Istraživanje je provedeno na uzorku 60 mladih fudbalera rođenih 2001. i 2002. godine. Unutar obe starosne grupe igrači su podijeljeni u dvije kategorije prema relativnoj starosti, odnosno prema tome da li su rođeni u prvoj ili drugoj polovini godine. Izvršena su antropometrijska mjerenja i mjerenja za procjenu eksplozivne snage, brzine i agilnosti pomoću testova: skok u dalj iz mjesta, vertikalni skok, sprint na 30 metara sa prolaznim vremenom na 10 metara, cik-cak trčanje bez lopte i Ajaksov test 5x10m. Pronađene su statistički značajne razlike u tjelesnoj visini i težini, kao i u testovima za procjenu eksplozivne snage u uzorku ispitanika uzrasta U13. U uzrastu U14 pronađene su razlike u testovima za procjenu eksplozivne snage i brzine sprinta, dok nije bilo statistički značajnih razlika u antropometrijskim varijablama. Prema dobijenim rezultatima, može se reći da je relativna starost važan faktor koji dovodi do pojave razlika u rezultatima ispitivanja motoričkih sposobnosti mladih fudbalera uzrasta U13 i U14. Zbog toga se efekat relativne starosti mora uzeti u obzir prilikom procjene sposobnosti i selekcije mladih fudbalera u periodu adolescencije.

Ključne riječi: *relativna starost, biološka zrelost, eksplozivna snaga, brzina, agilost mladi fudbaleri, selekcija i identifikacija talenata*

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AGE AND SEX-RELATED DIFFERENCES IN ANTHROPOMETRIC CHARACTERISTICS AND BODY COMPOSITION IN PRIMARY SCHOOL-AGE CHILDREN

STAROSNE I POLNE RAZLIKE U ANTROPOMETRIJSKIM KARAKTERISTIKAMA I TJELESNOJ KOMPOZICIJI OSNOVNOŠKOLSKE DJECE

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ABSTRACT

This study addressed the assessment of anthropometric characteristics and body composition of primary school children. The study aimed to determine age and sex related differences in children aged 7 and 8 years, which could be used to assess the health status of children and to monitor the trend of their growth and development. The study included 1520 students (814 second-grade students and 706 third-grade students; 772 boys and 748 girls). The participants were measured for body height and weight, body mass index, body fat percentage, fat mass, and fat-free mass. The results indicated that there were significant differences between boys and girls in body height and weight, fat percentage, body mass index, and fat-free mass ($p < .05$), whereas there was no difference in fat mass. Apart from the fat percentage, there are significant differences between seven- and eight-year-old children in all other measured variables. The obtained values of anthropometric characteristics and body composition of children are in accordance with the world trends. The differences between the sexes and the generations of children that have been identified are probably due to genetic predisposition, but also to the conditions in which they grow up.

Key words: health status of children, fat in children

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INTRODUCTION

Obesity among children, adolescents and adults has emerged as one of the most serious public health concerns in the 21st century. According to the World Health Organization (WHO), obesity occurs in one of ten people worldwide (WHO, 2015; van Vliet-Ostaptchouk, Nuotio, Slagter, Doiron, Fischer, Foco, & Joensuu, 2014). Secular trends in increasing body fatness are occurring rapidly and especially sensitive period that can be influenced by this changes are childhood and preadolescents (Ng, Fleming, Robinson, Thomson, Graetz, et al., 2014). Measurement of body composition in childhood, as a key component of individual's health and physical fitness profile, is of considerable importance for creating national health strategies and provide a better environment for healthy growing up. The ability to quantify body composition parameters such as fat mass, pat percentage, free fat mass and body mass index and compare them according age and sex may enable better insight of future health hazards associated with obesity. According to some research sexual dimorphism in body composition is considered to be slight before puberty (Forbes, 1987), but increase of body weight begins at about the age of 8 and this persistence continues until the end of the growing process. (Kędzior, Jakubek-Kipa, Brzuszek, & Mazur, 2017).

Thus, the aim of this study was to compare anthropometrics and body composition parameters in primary school-age children depending on sex and age. In addition, these obtained values of age and sex differences can be used to provide important data on body composition in healthy children from municipality of Banja Luka (region in Bosnia and Herzegovina; ~200,000 inhabitants).

METHODS

The study included second- and third-grade students aged 7 and 8 from Banja Luka (Republic of Srpska, Bosnia and Herzegovina). Stratified random sampling was used in this study. Nine primary schools were identified and randomly selected by the author. Consent to participate in the study was obtained from the parents of the children. A total of 1520 students participated, of which 814 were second-grade students and 706 were third-grade students.

Body weight and height, as the most representative measures of physical growth and development, were measured by standard measurement methods: 1) body height (cm) was measured by a Martin anthropometer; 2) body weight (0.1 kg) was measured by a body composition analyzer (BC-418 "TANITA", Japan). The same apparatus calculated 4 additional parameters: Body Mass Index (BMI), Body Fat Percentage (FatP), Fat Mass (FatM), and Fat-Free Mass (FFM). Bioelectric impedance analyzers can be an accurate device for measuring FatP, FatM and FFM in children (Lim et al. , 2009).

All body parameters were measured by using a multifrequency bioelectrical impedance analyser (TANITA BC-418MA III). Examinees were tested barefoot, in pants and shirts. During the data collection they were standing on the bottom of body analyser and held electrodes in both arms. The surface of the hand electrode was

placed in contact with each of the five fingers. Data input contains body height and age, and for the testing of recreationists' categories were selected. After signal reports the direct current goes throw the body and analysed necessary body parameters: Body Mass Index, Fat Free Mass, Fat Percentage, and Fat Mass. The BIA assessment was performed between 10.00 AM and 4.00 PM. Height was, also, measured barefoot to the nearest 0.1 cm, respectively.

Descriptive statistics were calculated for all variables. A T-test for independent samples was used to determine differences between groups. Also, as an effect size statistic, Partial Eta squared (η^2) was calculated. Statistical significance was determined at the level .05. All analyses were performed using SPSS version 20.0.(IBM, Armonk, NY).

RESULTS

The collected anthropometric and body composition characteristics of the study are reported in Table 1 stratified by sex, and Table 2 stratified by age.

Table 1. *Sex-related difference in body composition in healthy early age school children*

		N (n=1520)	Mean	Std. Dev.	Std. Error Mean	t	df	*p*	Par. Eta Squared
Height	boys	772	131.20	6.67	.24	5.73	1518	.00	.02
	girls	748	129.27	6.43	.23				
Weight	boys	772	30.09	6.86	.24	3.90	1518	.00	.01
	girls	748	28.74	6.61	.24				
BMI	boys	772	17.33	2.86	.10	2.00	1518	.04	.00
	girls	748	17.04	2.82	.10				
FatP	boys	772	21.95	8.47	.30	-5.17	1518	.00	.00
	girls	748	23.78	4.77	.17				
FatM	boys	772	6.85	3.40	.12	-1.46	1518	.14	.00
	girls	748	7.09	3.13	.11				
FFM	boys	772	23.51	8.26	.29	5.64	1518	.00	.02
	girls	748	21.6428	3.80	.13				

Legend: *FatP-fat mass percentage, FatM-fat mass (kg), BMI-body mass index, FFM-fat free mass (kg), Mean – the value of arithmetic means; StdDev. (Standard Deviation) – Average deviation of the obtained results from their arithmetic mean;p* – coefficient of significance $p<.05$. *Partial Eta squared-effect size statistics.*

Table 2. *Age-related differences in Body Composition in healthy Early Age School Children*

		N (n=1520)	Mean	Std. Dev.	Std. Error Mean	t	df	*p*	Par. Eta Squared
Height	seven-year	814	127.378	5.63	.19	-20.55	1518	.00	.21
	eight-year	706	133.57	6.11	.23				
Weight	seven-year	814	27.52	6.02	.21	-12.35	1518	.00	.09
	eight-year	706	31.62	6.92	.26				
BMI	seven-year	814	16.85	2.77	.09	-5.02	1518	.00	.01
	eight-year	706	17.58	2.88	.10				
FatP	seven-year	814	22.74	8.06	.28	-0.65	1518	.51	.00
	eight-year	706	22.97	5.44	.20				
FatM	seven-year	814	6.45	3.02	.10	-6.73	1518	.00	.02
	eight-year	706	7.57	3.45	.12				
FFM	seven-year	813	21.33	7.93	.27	-8.21	1518	.00	.04
	eight-year	706	24.04	3.93	.148				

Legend: FatP-fat mass percentage, FatM-fat mass (kg), BMI-body mass index, FFM-fat free mass (kg), Mean – the value of arithmetic means; StdDev. (Standard Deviation) – Average deviation of the obtained results from their arithmetic mean;p – coefficient of significance p<.05. *Partial Eta squared-effect size statistics.*

Table 1 shows statistically significant differences in both anthropometric (height p= .00; weight p=.00) and body composition characteristics (BMI p=.04; FatP p=.00; FFM p=.00) between boys and girls. According to Means values, the girls are having a more fat percentage (23.78 vs.21.95), more fat mass (7.09 vs. 6.85) and less body mass index (17.04 vs. 17.33) than boys. The boys are taller approximately 2.93cm (132.20 vs. 129.27) and heavier1.35kg (30.09 vs. 28.74) than girls. Table 2 shows statistically significant differences in anthropometric (height p=.00; weight p=.00) and body composition characteristics (FatM p=.00; BMI p=.00; FFM p=.00) between a seven-year-olds and an eight-year-olds. By observing Mean values it can be noticed that eight year-olds have higher values in fat mass (7.57 vs. 6.45), body mass index (17.58 vs. 16.85) and free fat mass (24.04 vs. 21.33) than seven-year-olds. The eight-year-olds are approximately 6.20cm higher (133.57 vs. 127.37) and 3.75 kg heavier (31.62 vs. 27.52) than seven-year-olds.

DISCUSSION

In this study, we aimed to make comparisons between anthropometric and body composition parameters in primary school-age children depending on sex and age. We also assumed that there were no significant differences in anthropometric parameters and body composition between the measured boys and girls and that there were no significant differences in

anthropometric parameters and body composition between the two generations of children. The results showed that, except in Fat mass ($p = .14$), there are significant differences between boys and girls in Height, Weight, Fat Percentage, Body Mass Index, and Fat-Free Mass ($p < .05$). For all variables Partial Eta Squared was $\eta^2 \sim .01$ (*small,*accordingto Pierce, Block, & Aguinis, 2004). Furthermore, except in Fat percentage ($p = .51$), there are significant differences between seven-year and eight-year girls and boys ($p < .01$). Partial Eta Squared for the Height variable was $\eta^2 = .21$ (*large*), and for the variable Weight was $\eta^2 = .09$ (*medium*). All remaining values Partial Eta Squared was $\eta^2 \sim .01$ (*small*).

If we compare the values obtained with Fomon's "reference child" (Fomon et al., 1982) and the values obtained by Ruxton et al. (1999) a clear trend of increasing all measured characteristics in children is evident. Mean values are presented in the table 3.

Table 3. *The trend of changing anthropological characteristics and body composition of children aged 7 and 8*

	Age 7			**Age 8**		
***Variables boys*↓**	Fomon et al., 1982	Ruxton et al., 1999	Vučković et al., 2019	Fomon et al., 1982	Ruxton et al., 1999	Vučković et al., 2019
Height (cm)	121.7	125.0	128.13	127.0	130.2	134.67
Weight (kg)	22.9	25.1	28.05	25.3	28.2	32.40
FatP (%)	12.8	16.5	21.89	13.0	16.9	22.01
FatM (kg)	2.9	4.4	6.31	3.3	4.7	7.45
BMI	15.5	16.0	16.97	15.7	16.5	17.74
FFM (kg)	19.9	20.7	22.26	22.0	23.5	24.93
***Variables girls*↓**						
Height (cm)	120.6	124.0	126.60	126.4	130.0	132.41
Weight (kg)	21.8	24.2	26.98	24.8	27.8	30.80
FatP (%)	16.8	19.0	23.60	17.4	20.0	23.99
FatM (kg)	3.7	4.6	6.58	4.3	5.8	7.69
BMI	15.0	15.8	16.72	15.5	16.5	17.41
FFM (kg)	18.1	19.6	20.40	20.5	22.0	23.09

Hence, due to the large increase in measured characteristics of children over the last 37 years, comparing our results with others only makes sense if we consider recent research. In our study, children from 7 to 8 years grow ~ 6.2 cm and gain ~ 4.1kg. As expected, boys are taller and heavier than girls, which is in concordance with the results of significant studies on a large population of children (Lobstein & Frelut, 2003; Binkin et al., 2010; Özkan et al., 2014; Wijnhoven et al., 2014; Datar & Chung, 2015; Đorđić et al., 2016). According to WHO standard norms (WHO, 2019), the average BMI values of 17.33 kg/m² in boys and 17.04 kg/m² in girls in our study indicated average-normal nutritional status. The boys in our study have a higher BMI than the girls and this is not the rule. In some studies, boys have a higher BMI (Đorđić et al., 2016; Chwałczyńska et al., 2018;), yet in other studies girls do (Halasi et al., 2018; Taylor et al., 1997, Basterfield et al., 2011) and in some cases they are

similar (Maynard et al., 2001; Planinšec & Fošnarič, 2009). For children measured in our study, BMI increases by ~ 0.7 in one year. In Hungarian 6-year longitudinal study (Kovacs et al., 2018) followed the height, weight , and BMI of seven-year-old boys and girls. After 6 years, a new generation of seven-year-olds was measured. New generation of boys and girls are taller, heavier and have a higher BMI. This increase is not statistically significant but is an indication. In this study, boys have a lower percentage of adipose tissue than girls. This is consistent with the results of available research (McCarthy et al., 2006, Halasi et al., 2018;Taylor et al., 1997; Chwałczyńska et al., 2018). Zhang et al. (2015) analysed fatness in Tibetan children. They found that there were no differences between age groups until 11 years, but all fat indices were higher in girls than in boys ($p < 0.05$). Finnish girls of the same age as in our study, have a higher body fat percentage than boys (23.2% vs.18.2, $p < 0.001$, Soininen et al., 2018). When processing the data, we also calculated the relationship between BMI and FatP. Spearman's rank correlations suggesting a significant positive correlation ($r = 0.667$, $p < 0.01$), which is consistent with the studies of Taylor et al. (1997) and Eisenmann et al. (2004). The girls in our study had significantly higher adipose tissue mass than boys. In similar studies (Taylor et al., 1997; Dencker et al., 2007; Chwałczyńska et al., 2018) girls also have higher adipose tissue mass than boys. The study by Dencker et al. (2006) on the 8 to 11-year-olds suggests that girls have a significantly higher fat mass (FatM) (.007 and .0008) and a significantly higher percentage of fat (FatP $p<.001$). Consequently, girls in the prepubertal phase of life seem to have a higher fat mass and a higher percentage of fat than boys. Regarding Fat Free Mass (FFM) in our study, there is more in boys. This is also the case in the studies of Chwałczyńska et al. (2018) and Sen & Mondal (2013). Also, Dencker et al. (2007) found more Fat Free Mass (FFM) in boys ($p <0.001$). However, Wells et al. (2002) found no significant differences between eight-year-old boys and girls in Fat Free Mass. From the age of 3 to 11 FFM significantly increased (~ 10 kg, $p < .001$) in children (Nakao & Komiya, 2003). This is logical as children grow and develop. The Japanese children in that study, aged 7 and 8, recorded an FFM value of 19.10 kg, which is less than the children in our study (22.59kg).

The composition of the human body changes with ontogenetic development. The intensity of changes is determined by genetic factors and it is well influenced by environmental factors (Chwałczyńska et al., 2018). Economic power and social inequalities strongly influence the anthropological characteristics and physical composition of children. According to Dubois et al. (2012), genetics seems to play an increasingly important role in explaining differences in height, weight, and BMI from early childhood to late adolescence, especially in boys. Furthermore, common environmental factors have the strongest impact, especially in the pre-adolescent years, more significantly in girls. These findings underscore the need to target health-related-family and social impacts on children in early childhood, especially in girls.

CONCLUSION

Age and sex-related differences in anthropological characteristics and body composition of urban children aged 7 and 8 in the Republic of Srpska seem to be comparable to those of other European regions. But, to the best of the author's knowledge, there are very few studies that analyse in details the body composition of children aged 7 and 8. The gender differences we identified probably develop from genetic predispositions as well as current environmental conditions. The increase in the value of anthropometric characteristics and body composition of the children we identified in this study is in line with global trends. There are two limitations to this study that should be considered. The participants of the study were children from one region of Bosnia and Herzegovina. It is quite possible to get slightly different results if children from other regions were measured. Secondly, if we had followed multiple generations of children, we would probably have analysed the trend of growth and development of children, or their anthropometric characteristics and body composition we could make more reliable conclusions.

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SAŽETAK

Ova studija se bavila procjenom antropometrijskih karakteristika i tjelesne kompozicije osnovnoškolske djece. Cilj istraživanja bio je da se utvrde starosne i polne razlike kod djece starosti 7 i 8 godina, što bi poslužilo procjeni zdravstvenog statusa djece i praćenja trenda njihovog rasta i razvoja. Studija je obuhvatila 1520 učenika (814 učenika drugih razreda i 706 učenika trećih razreda; 772 dječaka i 748 djevojčica). Ispitanicima su izmjereni tjelesna visina i težina, indeks tjelesne mase, procenat tjelesne masti, masa masnoće i masa bez masnoće. Rezultati su pokazali da postoje značajne razlike između dječaka i djevojčica u tjelesnoj visini i težini, procentu masnoće, indeksu tjelesne mase i masi bez masnoće ($p<.05$), dok razlike nije bilo u masi masnoće. Sem u procentu masnoće, postoje značajne razlike između sedmogodišnje i osmogodišnje djece u svim ostalim mjerenim varijablama. Vrijednosti antropometrijskih karakteristika i tjelesne kompozicije djece koje su dobijene mjerenjem i razlike među djecom u skladu su sa svjetskim trendovima. Za razlike između polova i generacija djece koje su utvrđene vjerovatno su zaslužne genetske predispozicije, ali i uslovi u kojima odrastaju.

Ključne riječi: *zdravstveni status djece, masnoće kod djece*

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APPLICATION OF VORTEX AS AUXILIARY PROP IN JAVELIN THROW TECHNIQUE TRAINING AT KINESIOLOGY STUDENTS

PRIMJENA VORTEXA KAO POMOĆNOG REKVIZITA PRI OBUČAVANJU TEHNIKE BACANJA KOPLJA KOD STUDENATA KINEZIOLOGIJE

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ABSTRACT

Javelin throw is a complex athletic discipline that requires several years of training to master a throw technique. Since teachers are time-limited, problem occuring in the teaching is how to train students to proper javelin throw technique as quickly as possible. Given that it is difficult to master a javelin as prop, research has been conducted to determine efficiency of vortex application as auxiliary prop in javelin throw technique training. The total number of respondents were 30 students of the first year of undergraduate Kinesiology study at University of Mostar in academic year 2016/2017. The initial measurement was made at the beginning of the classes. During the classes general exercises were used as well as vortex application as auxiliary prop in throw technique training. The final measurement and evaluation of javelin throw technique was made by three referees at the end of classes. Statistically significant difference between the initial (31,1m) and final (33,9) measurement was obtained by using the T-test . Results show that students have improved an average score in the final comparing to the initial measurement and based on obtained results it can be concluded that use of vortex has a positive effect on javelin throw training for beginners and it would be beneficial to include the prop in teaching when training students as well as younger children.

Keywords: *javelin throw, vortex, students, throwing technique, performance evaluation methods*

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INTRODUCTION

Throws in kinesiology sense are an elementary forms of movements to manipulate specific object in a space. Athletic throws are a complex movements of acyclic-cyclic nature and include throw of discus, javelin, shot puts and hammer (Pavlović, 2015). Javelin throw is an athletic discipline in which a thrower by approach and specific movements tries to reach the highest speed in the throw moment to achieve the longest possible shot (Zdravković i Matić, 2012). When throwing a javelin, there are four connected structural phases: preparation phase, cross-over phase, maximum effort phase and balancing phase (Bošnjak, Tešanović i Jakovljević, 2015). In javelin throw training, specific props smaller than javelin are increasingly in use. It is hard for students and youngers to control javelin and therefore it is more difficult to learn throwing technique. For this purpose, light-weight balls and recently vortex-rockets are in use (Tešanović, 2009). According to (Atwater, 1979; Menzel 1987) movement pattern used in javelin throw is similar to other movements used when striking or throwing objects. A previous researches showed that throwing balls and vortex makes sense to be used in students training. Puklavec (2010) obtained a high statistically significant correlation between throwing a ball and vortex (r=0,97). Tešanović (2009) in his research obtained high mutual correlation between variables of javelin and vortex throw and it can be assumed that for top results in vortex throw the anthropomotoric capabilities characteristic for javelin thrower are crucial. The most of researches on correlation between motoric characteristics and results in throwing athletic disciplines have confirmed the information on leading impact of explosive power factors (Milanović and Hofman, 1986). Žuvela, Borović and Foretić (2011) indicated that selected set of motoric capabilities (start acceleration and explosion power) have significant effect on score in javelin throw discipline only at students with above average knowledge in javelin throw. Ivanović (2009) conducted a research to determine impact of 12 motoric tests on score in javelin throw discipline. Regression analysis results have confirmed: (a) statistically significant positive linear correlation between predictor variables and criterion variable. The results of research conducted by Alujević, Vukušić and Žuvela (2013) made measure instruments for assessment of adoption level of specific motoric knowledges of javelin throw at kinesiology studenrs and assume that a new test based on principle of accepting (1-criterion is present) and rejection (0-criterion is not present) has a good independence of measurement results from a measurer.

The aim of this paper is to determine efficiency of vortex application as auxiliary prop in javelin throw technique training.

METHODS

The research was conducted on a sample of 30 respondents, students of the first year of undergraduate study of Kinesiology at University of Mostar in the academic year 2016/2017. All students had prior knowledge since they had classes in courses Athletics I and Athletics II. Students were not included in training processes, but they were included in sport activities through classes. Also, they were good health and without any locomotor system injuries.

Description of experimental treatment

The testing was carried out as a part of classes in the course Athletics II. The initial measurement was made at the beginning of a practical classes and

students had three throws. The best throw of each student is taken as their result. After five weeks or 15 hours of exercises, students began the final measurement where they had only one attempt that was measured and later evaluated by three referees. A javelin throw technique is divided in five phases as follows: initial position and javelin grip, the first part of approach, cross-over of javelin, javelin throw and balance. A qualitative approach was used in evaluation of each phase and with grades 0,1 or 2. Referees have evaluated each part via video: grade zero (0) is given to a student who did not meet the criterion, grade one (1) is given if he/she partially met criterion and grade (2) for completely done technique. A completely done technique of javelin throw was evaluated by the sum of all individual grades (scale from one to ten). Given that javelin throw is technically very demanding discipline, in throwing technique training, in addition to general exercises, the emphasis was on application of auxiliary prop – vortex. Immediately after the first methodics classes for javelin, vortex was used, weighing 135 g, lenght 34 cm,and shape requires the same grip as for the javelin and therefore it is a perfect auxiliary device whose lenght allows easy maneuvering and focusing on learning proper movements stages. Use of vortex when training students allows maximum commitment to mastering technical skill and developing sense for a device and precision. The following exercises for students training with vortex were used: 1. Throw from a place with both hands above the head; 2. Throw from a place with one hand above the head; 3. Throw from a place with one hand above the head with step forward; 4. Throw from a place with one hand above the head over leading hip; 5. Throw from a place after withdrawal; 6. Throw from a place by hip turned in throwing direction; 7. Throw from a place by hip turned in throwing direction with raised front leg; 8. Throw from a place – target on the wall; 9. Throw from a place – higher target on the wall; 10. Throw from a place by kneeling on the mat.

STATISTICAL EVALUATION

To determine a metric characteristics of the test, the following metric characteristics are calculated:

- In order to measure objectivity of the particles the following was calculated; matrix of intercorrelation of particles for each test, Inter item correlation (II r) i Cronbachalpha (α)
- In order to determined homogenity of referees the average correlation between test particles was calculated
- In order to analyse sensitivity of variables to determine sensitivity of each variable the following parameters were calculated: mean (AS); standard deviation (SD); minimum and maximum score (MIN i MAX); asymmetry measures (SKE) i kurtosis (KURT); normality of distribution (KS-test).

Descriptive statistics, K-S test and T-test for dependent samples were calculated to calculate differences between the initial and final measurement of javelin throw.

RESULTS AND DISCUSSION

In order to analyse objectivity of referees the following were calculated: intercorrelation assessments of referees, average inter-item correlation and Cronbachalpha coefficient and based on obtained results it can be concluded that thete is a satisfactory objectivity.

Table 1. *Variable objectivity measures for assessment of knowledge in specific stages of javelin throw (S1-S3 – intercorrelation of referees; II r – inter-item correlation; α – Cronbachalpha coefficient)*

Variables	S1	S2	S3	II r	α
PPIDK	1,000	0,749	0,599	0, 697	0,870
	0,742	1,000	0,737		
	0,599	0,737	1,000		
ZALET1	1,000	0,709	0,683	0,654	0,847
	0,709	1,000	0,558		
	0,683	0,558	1,000		
PK	1,000	0,793	0,685	0,752	0,898
	0,793	1,000	0,769		
	0,685	0,769	1,000		
IK	1,000	0,737	0,613	0,750	0,892
	0,737	1,000	0,853		
	0,613	0,853	1,000		
OR	1,000	0,780	0,555	0,659	0,843
	0,780	1,000	0,613		
	0,550	0,613	1,000		

(PPIDK –initial position and grip, ZALET1 – the first part of approach, PK – cross-over of javelin, IK – javelin throw, OR – balance)

In *Table 1* it can be seen that results are on acceptable level, i.e. they show statistically significant correlation between referees in all test for assessment of javelin throw knowledge at kinesiology students. The values of inter-item correlation are in the range between 0,659 for knowledge assessment in the balance phase to 0,752 for knowledge assessment in javelin withdrawal sphase. In accordance with values of inter-item correlation, values of Cronbachalpha coefficient are in the range of 0,843 to 0,898 what is considered as high value of correlation. Božanić (2011) states that according to Dizdar (2006) objectivity is the most important metric characteristic since test can be used only in the case when different measurers obtain the same or similar results when using the same test for the same respondents. In this research, it is about qualitative assessment of referees not quantitative measurement, and larger discrepancy in grades is acceptable.

Table 2. *Average correlation between test particles to determine referees homogenity*

Variables	ZBROJ S1	ZBROJ S2	ZBROJ S3
ZBROJ S1	1,00	0,86	0,79
ZBROJ S2	*0,86*	*1,00*	*0,87*
ZBROJ S3	*0,79*	*0,87*	*1,00*

(ZBROJ S1-S3 – total grades of each referee)

The results of average correlation between particles (*Table 2*) is within the range of 0,79 and 0,86 that indicates that there is statistically significant correlation between all particles and measure instruments are homogeneous. This can be attributed to the fact that referees are familiar with an „ideal“ performance and evaluation criteria of each javelin throw phase.

Table 3. *Results of variable sensitivity to assess level of javelin throw knowledge (AS – mean; MIN – minimum score; MAX – maximum score; SD – standard deviation; SKE – asymmetry measure; KURT – kurtosis; K-S – normality distribution test)*

Variables	AS	MIN	MAX	SD	SKE	KURT	K-S
S1	7,70	5,00	10,0	1,44	-0,25	-0,33	0,215
S2	7,73	5,00	10,0	1,46	-0,14	-0,76	0,172
S3	7,80	5,00	10,00	4,45	-0,28	-0,86	0,196

(S1-S3 – Referees grades 1-3)

In *Table 3* it can be seen that no distribution deviates significantlly from the normal, that is verified by K-S test that defines good sensitivity.

Tablica 4. *Descriptive parameters of javelin throw at initial and final measurement (N – number of respondents; AS – arthimetic mean; MED – mean value of scores; MOD – dominant value; MIN – minimum score; MAX – maximum score; SD – standard deviation; CV – variability coefficient; SKE – asymmetry measure; KURT – kurtosis; K-S – normality distribution test)*

Variables	N	AS	MED	MOD	MIN	MAX	SD	CV	SKE	KURT	maxD
BK I	30	31,1	30,7	27,4	23,2	43,4	4,3	13,7	0,6	0,9	0,09
BK II	30	33,9	34,1	38,4	24,6	47,9	4,7	14,6	0,5	1,3	0,07

(BK I – initial scores of javelin throws; BK II – final scores of javelin throws)

It is evident from the table of descriptive data (*Table 4*) that both variables have normal distribution. The average score of javelin throw is 31,1m, while average score of the final measurement is longer for 2,8m and it amounts 33,9m. The range of scores is within 23,2 and 43,4m in the inital and 24,6 to 47,9 in the final measurement. The reason for this large range is in impact of other sport activities on scores in javelin throw. Student who achieved a high result was engaged in handball, where hand movements (handball throwing) are similar to javelin throw movements. The similar results were obtained by Žuvela, Borović and Foretić (2011) who determined correlation of motoric capabilities and javelin throw scores at kinesiology students. The average javelin throw score in their research was 33,53m, while the lowest score was 22,70m, and the best was 43,20. Significantlly lower scores were obtained by Moguš, Jukić and Šušnjerga (2017) who also tested kinesiology students. The results of javelin throw were within the range of 19,00m to 29,95m.

Table 5. *T-test for dependent samples to determine difference between the initiaal and final state of javelin throw at kinesiology students (AS – mean; SD – standard deviation; p - significance level)*

Varijable	AS	SD	p
BK I	31,180	4,286	0,000
BK II	33,926	4,744	

(BK I – initial scores of javelin throws; BK II – final scores of javelin throws)

Table 5 shows the T-test scores for dependent samples that is used to test differences between the initial and final measurement scores of javelin throw. Results have shown statistically significant differences between the initial and final measurement at the significance level of $p<0,05$. Many authors agree with the fact that high level of motoric learning can be achieved only by a long-term practice (Žuvela et al, 2011). Čoh, Jovanović-Golubović and Bratić (2004) state that is it is necessary to do between 40.000 and 50.000 repetitions to achieve stability and automation of one single moving structure in sport that corresponds to a long period of time. Despite this, our research has shown statistically significant differences between the initial and final measurement, i.e. improvements in achieved scores of javelin throws, as well as good homogenity, objectivity and sensitivity of the test that can be attributed to insufficient knowledge of the throwing technique on the beginning of the classes in Athletics II. Also, we can assume that level of adoption of javelin throw is caused by using general and specific exercises (vortex-rocket throws) through methodics of javelin throw training. Based on existing researches (Tešanović, 2009) and our research, it can be concluded that vortex as throwing prop should be included in classes when training students.

CONCLUSION

A javelin throw is very complex and many existing researches showed that technically proper and long hits are achieved only by students with above-average knowledge of javelin throw. During classes of the course Athletics II, students went through the process of learning and adopting motoric knowledges, and given that for beginners it is difficult to control javelin as throwing prop due to its shape. In this research we have used a vortex-rocket as a specific prop in training. The vortex-rocket is spongy-shaped, weighing 135g and that is much easier to control for beginners than the javelin. The results of the final measurement and referees grades showed that students have improved javelin throw technique as well as their results, that can partially be attributed to the use of vortex-rocket in training process. A disadvantage of the ressearch is the lack of control group that would do classes only by performing general training exercises of javelin throw, thus providing more detailed information how much the use od vortex has helped to improvement of technique and throwing scores. No matter to this disadvantage, we consider that use of specific props like vortex and light-weight balls throwing should be an integral part of javelin throw training at students, as well as younge adults since they are more practical and easier to control for beginners.

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SAŽETAK

Bacanje koplja je složena atletska disciplina koja zahtijeva nekoliko godina treniranja kako bi se ovladalo tehnikom bacanja. Budući da su nastavnici ograničeni vremenom, problem koji se javlja u nastavi jest kako u što kraćem vremenu obučiti studente pravilnoj tehnici bacanja koplja. S obzirom da je kopljem kao rekvizitom teško ovladati, povedeno je istraživanje koje je imalo za cilj utvrditi efikasnost primjene vortexa kao pomoćnog rekvizita pri obučavanju tehnike bacanja koplja. Ukupan broj ispitanika bio je 30 studenata prve godine preddiplomskog studija Kineziologije Sveučilišta u Mostaru u akademskoj 2016/2017 godini. Na početku nastave odrađeno je inicijalno mjerenje, tijekom nastave koristile su se opće vježbe, kao i primjena vortexa kao pomoćnog rekvizita u obuci tehnike bacanja, a na kraju nastave je odrađeno finalno mjerenje i ocjenjivanje tehnike bacanja koplja od strane 3 suca. Primjenom T-testa dobila se statistički značajna razlika između inicijalnog (31,1m)i finalnog (33,9m) mjerenja.Rezultati pokazuju da su studenti poboljšali prosječan rezultat u finalnom u odnosu na inicijalno mjerenje te se na osnovu dobivenih rezultata može se pretpostaviti da korištenje vortexaima pozitivno djelovanje na obuku bacanja koplja kod početnika i da bi bilo poželjno taj rekvizit uključiti u nastavu prilikom obuke studenata, ali i mlađih uzrasta.

Ključne riječi: *bacanje koplja, vortex, studenti, tehnika bacanja, metode za procjenu izvođenja*

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ISOMETRIC MUSCLE FORCE AS A PREDICTOR OF A MAXIMAL MUSCLE EFFORT IN THE LEG PRESS TEST

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IZOMETRIJSKA MIŠIĆNA SILA KAO PREDIKTOR JEDNOG MAKSIMALNOG NAPREZANJA U TESTU NOŽNI POTISAK

ABSTRACT

This research aimed to determine whether the manifestation of maximum isometric muscle force at a certain joint angle (80°, 110°, and 140°) can act as a predictor of 1-RM in a leg press movement task. The research was carried out in a group of twenty-four (N=24) male students, within two separated sessions, with seven days of rest between each. The anthropometric measurements and muscle force assessment that is 1-RM, was executed through the training-to-failure method on a leg press machine (leg press, V-Gym Croatia) in the first session. Maximum isometric force (Fmax) of leg muscles was measured using maximum consecutive contractions test, in the laboratory conditions, on leg press machine with the help of dynamometer probe and Globus Ergo Tesys System 1000 software. Having analyzed the results obtained on the linear regression basis, the authors have, with 84,5% precision, inferred that it is possible to assess 1-RM in leg press exercise based on maximum isometric force exerted at the angle of the knee joint of 140°. The results attained may be applied in practice when assessing 1-RM, based on maximum isometric force measurement for a given movement task.

Keywords: *muscle force, prediction, 1RM, leg press*

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INTRODUCTION

Muscle force is defined as the ability of a muscle to act with a certain force, at any speed of muscular contraction due to the voluntary muscular effort, and thus describes the mechanical characteristics of the movement.

Striving to obtain efficient assessment and prediction of the current level of certain mechanical characteristics of muscles, the muscle force testing has found a wide application, primarily in sports practice. One of the fundamental aims of muscle force testing in sport is to evaluatethe maximum voluntary muscle force.

Maximum voluntary muscle force, that is muscle strength, representsthe maximum force that a muscle or group of muscles can generate when overpowering large external loads at low rates of muscular contraction or in isometric conditions (Zaciorskyi& Kreamer, 2009).

Isometric conditions represent a manifestation of voluntary muscle (isometric) force, with a constant angle in the joint of the corresponding extremity. It is known that maximum muscle force performed in isometric conditions does not significantly differ from maximum muscle force inslow movements (Smidtbleicher 1992, Zaciorsky i Kreamer, 2009).

The results of the research (Parai et. al 2106) show that there are no vital differences between the equation for the assessment of maximum muscle force in isometric conditions and 1-RM. Furthermore, (Juneja et. al 2010, Bazyler et. al 2015,) claim that the use of the maximum muscle force measurement tests is justified and that it can play an important role in assessing dynamic performance predictions. However, it is not quite known whether the exertion of maximum isometric force at a corresponding extremity joint can act as a predictor for the manifestation of maximum muscle force in slow movements, that is (1RM) in certain moving tasks.

1-RM is a gold standard for the assessment of muscle force in slow movements, and it represents one maximummuscular effort.

Therefore, this research aim is to determine whether the maximum isometric force exerted at a certain joint angle (80°, 110°, and 140°) can act as a predictor of 1-RM in leg press. The authors suggest that the maximum isometric force exerted at an angle of 140° in the knee joint, in leg press, will be a solid predictor of 1-RM. The maximum isometric force was assessed using the isometric dynamometry method.

Having measured the maximum muscle force, a number of researchers have obtained reliability coefficients in the range of 0,85 to 0,99 (Wilson i Murphy, (1996), Vilijanen et al. (1991), Agre et al. (1988), Bemben i Murphy, (2001), Papadopulous et. al (2008&2012), Ivanović i Dopsaj, (20139, Drake et al. (2017)). 1-RM in leg press exercise was estimated applying an RM test for which, Sale (1991) claims, the reliability coefficient ranges from 0,92 to 0,98 (ICC=0,92-0,98).

The results obtained from this research can be applied in practice when assessing 1-RM based on maximum isometric force measurement for a given moving task.

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METHODS

Twenty-four male freshman students (N=24), from the Faculty of Physical Education and Sport at the University of Banja Luka, took part in the study. All of the respondentsare male, of a regular health condition, physically active, and had no physical activity 72 hours prior to the test. They were, also, technically trained for the usage of the leg press machine, that way avoiding the occurrence of possible mistakes during the process of the examination. All of the tests were taken at the Sports Institute within the Faculty of Physical Education and Sport at the University of Banja Luka.

All measurements were carried out in two separated sessions with 7 days of rest between them. Familiarization with the experimental protocol, anthropometric measurements and the assessment of 1-RM in leg press exercise were done in the first session. The measurement of the maximum isometric force of leg muscles exerted in three different knee joint angles in leg press movement was executed in the second session.

After the familiarization with the experimental protocol, all respondents approached anthropometric measurements for which anthropometer and body analyzer (TANITA BC – 418MA, Tokio, Japan) were used. The measurement of anthropometric variables was accomplished according to the International Biological Program (IBP), and in this paper, these have been used: body height, body mass, muscle tissue percentage, fat tissue percentage, MFR-index (the ratio between muscle and fat tissue in the body).

The assessment of muscle force, that is 1-RM, was carried out usingthe training-to-failure method on a leg press machine (leg press, V-Gym Croatia). The respondents were asked to lift a load of a given weight the maximum number of times, with the number of repetitions not exceeding 10. The approximate muscle force value was obtained based on the regression equation 1RM = weight / (1.0278 - (0.0278 * number of repetitions)) according to Brzycki (1993). After a ten-minute warm-up, all the respondents did 2 sets with 5 repetitions of additional warm-up, in the leg press exercise, with 100 and 120 kg. It should be mentioned that the identical warm-ups were performed in each of the sessions. In the third set, the weight was progressively increased by 10% for the measurer to predict the optimal weight for the test. Ifthe respondent, due to poor estimation of the meter, succeeded in lifting the given weight more than 10 times in the fourth series, the task would be interrupted only to be continued after a ten-minute break in the fifth series where additional load would be added.

The maximum isometric force of leg muscles was measured with maximum consecutive contractions test in laboratory surroundings on a leg press machine with the help of dynamometer and Globus Ergo Tesys System 1000 software. The respondents performed two maximally voluntary contractions 3-5 seconds long with a one-minute break between the repetitions. Three angles of the knee joint of 80°, 110°, and 140° were measured using the Leica Vetronix - SG12F goniometer. The respondents were asked to perform every repetition from the same initial position. They were, also, asked to place their feet in the width of the hips and to perform the maximum possible muscular effort. The dynamometer was fixed to the

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ends of the machine used, with the fixers specifically designed for this test. The maximum force value (Fmax) was obtained from the derivation of the signalusing the Globus Ergo Tesys System 1000 software, registered by stretching the probe of the dynamometer.

The basic descriptive parameters were measured for all the variables, while stepwise multiple regressionwas used to obtain the regression model as a predictor of 1-RM, with statistical significance set at $p<0.05$. The SPSS *(IBM SPSS Statistics 20. Chicago, IL, USA)*application program was used for mathematical processing of the original data, as well as their graphic illustration.

RESULTS AND DISCUSSION

The basic descriptive indicators of anthropometric and motor variables are presented in Table 1. The highest value of maximum isometric force in the leg press task was achieved at the angle of the knee joint of 140°, and it was 4082 N (3292 ± 444,24), then at the angle of 110°, 3848 N (2842,58 ± 451,86). The lowest values of maximum isometric force were noted at the angle of the knee joint of 80°, and they were 2678 N (2145,83 ± 266,82).

Table 1.*The basic descriptive indicators of anthropometric and motor characteristics*

Variables	N	Min	Max	AM	SD	CV
Body height (cm)	24	168,00	190,30	179,63	5,96	0,03
Body mass (kg)	24	57,10	95,00	73,89	8,85	0,11
Fat tissue (%)	24	5,40	21,40	13,28	3,74	0,28
Muscle tissue (%)	24	45,30	52,40	49,69	1,67	0,03
MFR index (%)	24	2,22	9,25	***4,14***	1,63	0,39
Leg press80°	24	1720	2678	2145,83	266,82	0,12
Les press110°	24	2089	3848	2842,58	451,86	0,15
Leg press140°	24	2492	4082	3292	444,24	0,13
Leg press1RM	24	180	340	240	44,74	0,20

Legend: N-the number of the respondents, **Min**-minimum span, **Max**-maximum span, **AM**-arithmetic mean, SD-standard deviation, CV-coefficient of variation

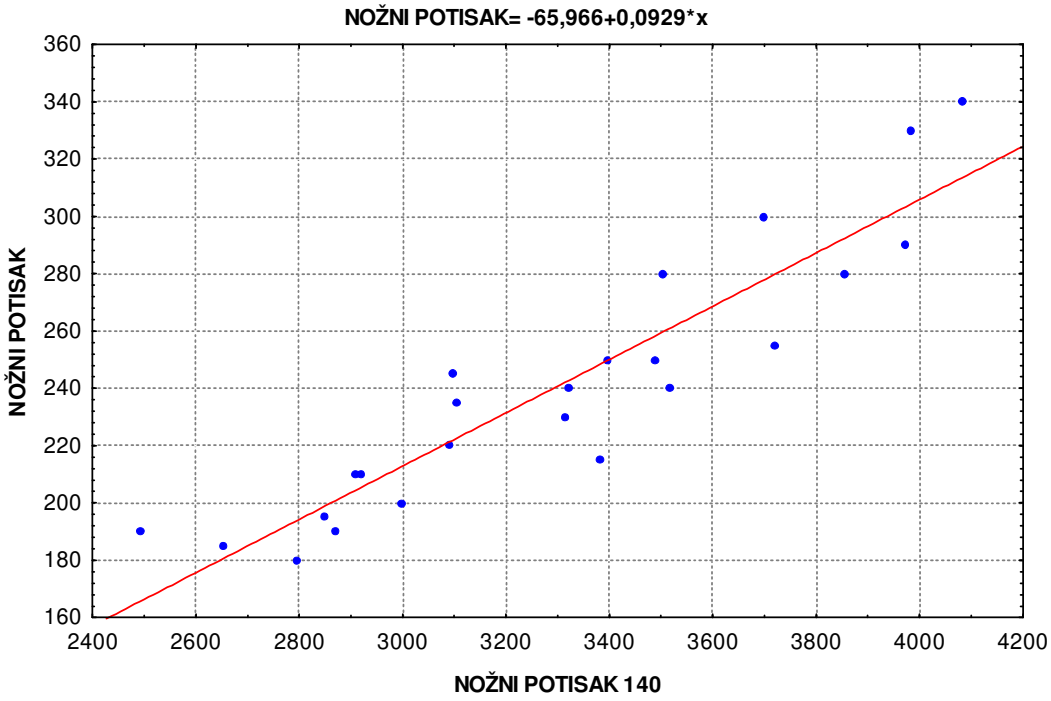
The assessed value of 1-RM for the moving pattern – leg press, was from 180 to 340 kg (240 ± 44,74). Based on the result of multiple regression from Table 2 and Image 1, one regression model has been secluded which takes into account only the influence of the subtest "Leg press 140°" and demonstrates that, with the precision of 84,5%, it can predict 1-RM based on the maximum force at a given angle.

Table 2. *The regression model for the prediction of 1-RM based on the maximum isometric force applied in the leg press moving task at the angle of the knee joint of 140°*

MODEL 1	**Leg press=a+b*leg press140°**							
Parameters Equations	Parameter values	Standard error	T(20)	P-level	R	R²	Korig. R²	**st**
A	**-65,966**	27,482	-2,400	0,025				
B	**0,093**	**0,008**	**11,230**	**0,000**	0,923	0,851	0,845	**17,6**

Legend: **MODEL 1** predictor: Leg press 140°, Criterion: Leg press

Image 1. *The prediction of 1-RM based on the isometric force exerted in the leg press moving task at the angle of the knee joint of 140°*



Twenty-four students voluntarily took part in this study. Based on the average muscle-fat component (MFR) of 4,14±1,63 in this group of subjects, it can be concluded that these are the respondents belonging to the muscular-sports morphological type (Ugarković, 1996).

The obtained differences in the exerted muscle force (Table 1), show an increasing trend in the generation of muscular force, going from smaller joint angles to lager ones. The results show that the highest values of isometric force in the leg press moving task are achieved at the angle of the knee joint of 140°. The results of the "Leg press 140°" variable 4082 N (3292 ± 444,24) are significantly higher than at the angles of 110° and 80°. Such results can be explained

by the fact that this is an articulated angle at which mechanical preconditions are ideal for exhibiting all parameters related to muscle force. Sale (1991) proposes that isometric measurements be made in the position in which the force range is the greatest for a given range of motion.

What is interesting, and may further justify the generation of greater force at the angle of 140° in the leg press moving task, is the fact that, according to Spairani et al. (2012), the VM (vastus medialis) is more active at larger joint angles, that is, the muscle itself has a grip closer to the knee joint with the fibers in a parallel position to the knee extension. When performing the leg press test, the angle at the hip joint changes with the change at the angle of the knee joint, which additionaly results in hamstrings generating muscle force at a higher or lower level.

Analyzing the results, obtained on the basis of linear regression, we can deduce, with 84,5% precision, that we are able to estimate 1-RM in the leg press exercise applying the equation (Y= -65,966 +0,0929 * X), considering that the maximum isometric force is to be measured at the angle of the knee joint of 140°. The standard measurement error was 17,6 kg, or 7,3%, which is acceptable considering that the averge result is 1 RM-a 240 ± 44,74 kg.

The obtained results analysis has shown that in order for the isometric force variables to be used as predictors for terrain tests it is necessary to perform the tests at an exactly defined body position, keeping in mind the angle at which the test is being carried out. It seems that the previous researchers' claims, that the muscle force exerted at slow movements don't significantly differ from maximum muscle force exerted in isometric conditions, can be reaffirmed (Smidtbleicher 1992, Zaciorski 2009).

RESULTS

The isometric force value exerted in leg press moving task at the angle of the knee joint of 140° can be considered to be a good predictor of 1-RM, that is one maximum muscular effort in the aforementioned task in dynamic conditions.

The results obtained in this research show that from the methodological aspect this kind of a study approach of the research of myogenic properties is acceptable and that its principles can be used in further research. This type of muscle force measurement can be applied widely, primarily for sports and rehabilitation purposes, in cases where the measurement of muscle force in dynamic conditions is not possible. Further research must be directed to the analysis of the isometric force, as a predictor, obtained at multiple joint angles at a given extremity, which would certainly reduce the standard error of measurement. Furthermore, in addition to Fmax, the force increment (RFD) should be examined for a given task as one of the indicators of the magnitude of myogenic properties. Finally, it should be mentioned that the regularities stemming from this research relate to the sample od the examinees used in it.

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SAŽETAK

Cilj ovog istraživanja je bio da se utvrdi da li ispoljavanje maksimalne izometrijske mišićne sile pri određenom uglu u zglobu (80°, 110° i 140°) može služiti kao prediktor 1 RM-a kod kretnog zadatka nožni potisak(leg press).Istraživanje je sprovedeno na grupi od dvadeset i četiri studenta (N=24), muškog pola u okviru 2 odvojene sesije sa po 7 dana odmora između svake. Antropometrijska mjerenja i procjena mišićne sile, odnosno 1 RM-a izvršeno je metodom repetitivnih maksimuma do otkaza na trenažeru za nožni potisak (leg press, V-Gym Hrvatska) u okviru prve sesije. Maksimalna izometrijska sila (Fmax) muskulature nogu mjerena je testom uzastopnih maksimalnih kontrakcija u laboratorijskim uslovima na trenažeru nožni potisak uz pomoćsonde dinamometra i softwerskog sistema Globus Ergo Tesys System 1000. Analizom rezultata dobijenih na osnovu linearne regresije, autori zaključuju da sa preciznošću od 84,5% možemo izvršiti procjenu 1RM-a u vježbi nožni potisak na osnovu maksimalne izometrijske sila ispoljene pri uglu u zglobu koljena od 140°**.** Rezutati dobijeni ovim isztraživanjem mogu poslužiti aplikativno u praksi prilikom procjene 1 RM-a na osnovu mjerenja maksimalne izometrijske sile za dati kretni zadatak.

Ključne riječi: *Mišićna sila, predikcija, 1 RM, nožni potisak*

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Journal intention

SportLogia journal covers the areas of sports and physical education. It is issued twice a year and publishes original scientific papers, reviewed scientific papers, scientific gathering presentations, short scientific articles and professional articles from the area of sports, physical education, recreation, kinesiology anthropology, training methods, sport biology and exercise, sport medicine, biomechanics, sport history and sport management as well as contributions from other sciences (medicine, sociology, psychology, philosophy, exact sciences and mathematics) applied in sports.

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If the author has corrected the text in accordance with the instructions from the editor, the manuscript is sent for review. In that case, the author will be given a form called *Copyrights Declaration*, which needs to be filled in and sent back to the editor. The signature of the author verifies the authenticity of the text, authorship and acceptance of the review procedure.

All articles must be reviewed. There will be two reviewers from the relevant scientific area for each article, and both reviews will be anonymous. The author's name will be unknown to the reviewers (double blind review). If a reviewer finds the article noncompliant with the criteria of the journal, the editorial will not accept the article. The review process lasts 8 to 12 weeks. If, on the other hand, the reviewers find the article acceptable, it will be put in one of the following categories:

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