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Potential Benefits of Introducing Canoe Polo in the Sport System of Western Balkan Countries

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POTENCIJALNI BENEFITI UVOĐENJA KANU POLOA U SISTEM SPORTA DRŽAVA ZAPADNOG BALKANA

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ABSTRACT

The International Canoe Federation includes 10 forms of kayaking and canoeing and recognizes 4 additional disciplines. One of the most popular is canoe polo. Canoe polo is a team sport that belongs to the family of sports games. Two teams of five players each fight to score more goals, with a water polo ball, in a pool of specific dimensions. Canoe polo developed in parallel in three similar variants of the rules, as an alternative to paddling during windy and cold winter days. Canoe polo contains the largest number of different techniques in relation to all paddling sports, while ball handling is done with a mixture of water polo, handball, basketball, and volleyball techniques. Simultaneous handling of the ball, with an overview of the game and interfering with the opponent is a very demanding coordination activity that does not exist in paddling in nature with different obstacles, both in terms of content and dynamics. Today, canoe polo is played in about 40 countries. Wild and flat water kayak and canoe disciplines have existed in the countries of the Western Balkans outside the European Union for many years, while canoe polo activities, clubs and competitions do not exist at all. The introduction of canoe polo in the sports systems of the West Balkan countries outside of European Union can be used as a means to popularize canoeing, as well as to raise the quality of canoeists by applying situational and super-situational training methods. Very demanding activities during more diverting trainings, with a greater opportunity to compete, as well as with a longer and more meaningful competition calendar, can significantly improve the skills needed for kayaking and canoeing in all its manifestations. In addition, the economic effect of development through sports facilities, infrastructure and boats with protective equipment should not be neglected, which at some point may become the basis for the organization of domestic and international competitions.

Key words: *sports strategy, transfer, means, wildwaters.*

INTRODUCTION

Kayaking and canoeing belong to the group of paddling sports, ie sports whose competitions are held on water. The term kayak or canoe means all boats in which one sits (or kneels) with the face facing the direction of movement when paddling, while the paddles are not attached to the boat, but are held freely in the hands (Mitrović, 2003). Although this activity is used today as a sports and recreational activity, it used to have completely different functions in hunting and fishing, transport of people and goods, war and research (Weber, 1950).

With the improvement of living and working conditions, the modernization of industry, man was less and less engaged in hard physical work and devoted more and more time to leisure, tourism, and later sports. Thus began the first kayak and canoe competitions. There are a large number of kayaking and canoeing sports and disciplines that have many similarities and differences. The ten sports organized by the International Canoe Federation (ICF) are: Canoe Sprint, Wildwater Canoeing, Canoe Slalom and extreme, Paracanoe, Canoe Marathon, Canoe Polo, Dragon Boat, Canoe Freestyle, Canoe Ocean Racing, Standup Paddling with sports recognized by the ICF, namely: Canoe Sailing, Rafting, Waveski Surfing and Vaa (https://www.canoeicf.com/).

For a long period of time in the Balkans, the term kayak prevailed in the name of the manifestations of kayaking and canoeing, until the change by the ICF, which took place several decades ago. There are still terminological misunderstandings about kayaking and canoeing in these areas, which have not been resolved satisfactorily. Today, the ICF retains the name of canoe for all disciplines, although in most cases it is paddled in both kayaks and canoes, while in some cases only kayaks are paddled (Canoe Polo, Ocean Racing, Waveski surfing) and are called canoe disciplines. The explanation is in an English custom dating back to the late 19th century when it was usual to call a canoe any vessel in which the paddler sits low and looks in the direction of the boat, as opposed to the then widespread rowing in the sweep and sculling, where the rower moves backwards (https: //www.canoeicf.com/disciplines/canoe-polo/history).

One of the very interesting manifestations of this sport is canoe polo. Canoe polo is a team sport that belongs to the family of sports games. Two teams of five players each fight to score more goals, with a water polo ball, in a pool of specific dimensions (Basley, 2008). Today, canoe polo is played in about 40 countries, while in the Western Balkans, canoe polo activities, clubs and competitions do not exist at all (http://www.canoepoloarchives.org/polo-playing-countries.html).

The problem of this research is the fact that the countries of the Western Balkans outside the European Union do not record the once large mass membership as well as great results in wildwater kayak and canoe and slalom, while a significant number of kayakers and canoeists on flat waters engage in training and competitive activities only seasonally in the time of spring, summer and autumn, while the once important centers of water sports throughout the Western Balkans outside the European Union are falling

apart, remaining true to the previous time and the tradition of failed investments. The introduction of canoe polo in the sports system of the Western Balkan countries outside of European Union can be used as a means of popularizing kayaking and canoeing, strengthening national canoe federations, increasing the number of kayakers and canoeist who train all season, as a means of raising the quality of kayakers and canoeist on flat and wild waters with applying situational and the super-situational method of exercise, as well as a means of economic profit by the potential organization of national and international canoe competitions, which is the subject of this paper.

The Western Balkans outside of European Union here includes the countries of Serbia, Bosnia and Herzegovina, Montenegro, Northern Macedonia and Albania.

METHODS

The paper used the method of theoretical analysis of the content of scientific and professional literature and the causal method with systematization based on the professional experience of the authors in the field of physical education, sports and recreation, with an emphasis on paddling sports, with the application of logical inductive and deductive reasoning.

Canoe Polo

Canoe polo is a team sport that belongs to the family of sports games. Unlike other kayak and canoe sports in which the goal is to cross a certain distance in the shortest possible time, in canoe polo there are two teams of five players each who try to score as many goals as possible with a water polo ball, ie receive as few goals as possible. The match lasts ten minutes in two halves. In this game, players must know how to paddle and at the same time manipulate the ball with paddle and hands, it often happens that players capsize, after which they return to the surface of the water as fast as possible to continue the game with eskimo roll (turning the boat to its starting position after capsizing) or with the help of a rival or teammate.

Canoe polo can be played on all water surfaces that do not move, even in swimming pools, which provides the opportunity to practice this sport throughout the year. Despite all its interesting and dynamic caracteristics, a relatively small number of people and countries still practice canoe polo is played exclusively in kayaks, there are no canoe disciplines (ICF, 2013).

Brief History of Canoe Polo

The first records of people on vessels playing with a ball on the water were recorded in British journals and date from the second half of the nineteenth century. In 1875, the English magazine Punch or the London Charivarl first described players standing in boats paddling with long wooden paddles with two blades, then in 1880, in London Scottish players sitting on horse-shaped wooden barrels (with head and tail of a horse) were painted and since 1884 t here have

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been paintings in which kayakers sit in „Rob-Roys“ boats and play something that most resembled today's canoe polo (British Canoe Union, 2006). Then the game was not as much contact as today and the goals were at water level (they were not raised), other, accompanying equipment - helmets, vests, protective tires on the bow and stern of the boat did not exist, and contacts could lead to more serious player injury (Beasley, 2008).

In 1926, the German kayak-canoe federation included canoe polo (with slightly different rules of the game than today) in its federation as a new, attractive sport in order to develop team spirit and cooperation between paddlers through team play, to contribute to the federation's finances and to enrich the application of paddling skills on another way (Beasley, 2008).

France follows Germany after three years with the first forms of canoe polo, with the aim of making changes in paddling training and testing the skills of kayakers. The French version of the rules also changed during later periods (Beasley, 2008).

Canoe polo was played in Australia from 1952 to 1970, with some differences in rules. They mainly played canoe polo in two-seater kayaks, so that the player sitting in front caught, threw, shot and maneuvered with the ball with his hands, and the player sitting in the back controlled the movement and position of the boat (http://www.canoe.org.au/). In Britain, this sport began to be played in 1950, but without clear regulations and direction of development (British Canoe Union, 2006). Independently of this sport, since 1966, kayaks have been built en masse to train beginners in swimming pools. The school pools of that time were smaller (10m x 25m), so it was necessary to make a kayak of smaller dimensions that would be functional in such a space. The first kayak of smaller dimensions was made of wood with a rounded bow and stern, thus providing protection for pools, kayaks and beginners in the event of a collision (Beasley, 2008). Enthusiasm for the spread of canoe polo culminated in the presentation of this sport at the International Boat Show at the Crystal Palace in London in 1970. Then the first rules for the game were accepted. In 1986, the ICF favored the Anglo-French-Australian version of the sport with raised goals and pitch dimensions, while allowing ball and paddle contact corresponding to the German, Italian and Dutch versions of the rules (ICF, 2013).

The first demonstration of this game was organized in 1987 in Duisburg (Germany) as part of the World Kayak and Canoe Championships on flat waters (Beasley, 2008).

Canoe Polo Sports Equipment

To play canoe polo you need to have the appropriate equipment – kayak, paddle, spyraydeck, protective helmet, personal floatation device (PFD) and water polo ball. Only the ball is of standard dimensions, everything else varies (Mattos, Evans, 2016).

There is a specially adapted kayak boat for this sport, which is designed so that the paddler with it can quickly change direction, be stable enough, throw and catch the ball from it, shoot at goal and defend against opponents. Besides mentioned boat mast provide non-existence of injuries and equipment demage (Beasley, 2008). The kayak is of low volume, which gives the player the opportunity to easily stern and quickly change the direction of movement even if he does not have a stern. In recent years, with the progress in the production and construction of boats, carbon-kevlar and only carbon have been used.

In canoe polo, as well as in wild waters, neoprene spray deck are most often used, which are firmly attached with an elastic strap to the boat (Rajković, Rajković, 2016). In the event of lining or capesizing, the player can return to the surface of the boat with the eskimoroll without water entering the boat, thanks to the spray deck (Mattos and Evans, 2016).

Players use a kayak paddle to play canoe polo (https://canoepolo.shop/en/en-Canoepolo-Paddles). Similar with paddling kayaks on flat and wild waters, care must be taken in determining the optimal length of the paddle, the size and shape of the blades, as well as the angle between the blades. The length of the paddle does not depend only on the morphological, motor and functional abilities of the player, as is the case in other paddling sports (Gullion, 1987). The position in the team also has a great influence. Goalkeepers more often choose longer paddles, sprinters shorter, which contributes to improving their abilities in those positions.

When it comes to the shape of the paddle blades, the position in the team also has the biggest impact, so goalkeepers and players who move less often choose symmetrical paddles (Beasley, 2008). The choice of blade size, ie their volume, in all kayak disciplines is influenced by individual strength abilities that are most correlated with age and gender (Rounds, Dicket, Brown, Sabas. 2005), while in canoe polo the maximum allowable area is determined to prevent abuse by the goalkeeper.

The role of the helmet is to protect the player's head and face from possible injuries during the match. Without it, players cannot play in the game. A face protection is attached to the helmet, which is actually a steel mesh (Mattos, Evans, 2016).

The protection for the paddlers body is a protective – PFD, as in the case of kayaks and canoes on wild waters, it must meet certain conditions in accordance with the rules of the ICF. The role of this vest is to protect the player from possible traumatic injuries, while the secondary role in the canoe polo is to keep it on the surface of the water in case it capsizing remains unconscious and e.t.c. (ICF, 2013).

Canoe Polo Technique

A high level of mastery of the technique in canoe polo implies effective and efficient use of muscles to control the boat and the ball (Cochrane, 2010). The difference in relation to all other canoe sports is that in addition to the requirements for dominant balance, explosive power (when starting and changing the direction of the boat) and endurance in strength, there are certain accentuated requirements for coordination (predominantly precision) in handling, gripping,

passing and kicking the ball. The dominant musculature in the stroke (leg extensors, back muscles, torso rotators) is driven by large motor units (one neuron, powers a large number of muscle fibers), so it takes more time to learn kayak and canoe techniques to build precise paddle movements. (Mitrović, Rajković, 2020).

In canoe polo kayakers use a large number of different techniques: plat, forward stroke, braking, back stroke, sweep stroke, revers sweep, draw stroke, pry stroke… (Harrison, 1998; Ford, 1995; Rounds, Dicket, Brown, Sabas, 2005). In addition, a small boat and the requirements of the game enable and dictate changes of direction by changing the center of gravity of the body and immersing the left or right side of the bow or stern in the water.

Additional elements of the technique are contact situations of two boats when one can be placed above or below the other, with frequent collisions below 90° and less often direct collisions.

One of the components of the game is the capesizeing with the eskimoroll (a paddle and body maneuver that returns the kayaker from the capsized boat position to the starting position on the water) which enables a quick return of the overturned player to the game.

It is also necessary to practice the maneuver of removing the spraydeck and going to the surface (in case of failed eskimoroll, for which 5 seconds is enough) (Monk, Knap, 1976). Harzards of capesizeing are partially eliminated by group exsercise, especialy on „risky" water surfaces (Dillon, Oyen, 2009). Eskimo roll with all its variants with and without paddles is certainly one of the crucial skills (Harrison, 1998) that kayak players have to learn. The specificity of this kayak skill in relation to all the others is that the kayaker does not rely on the sense of sight through which a person receives most (80%) information (Keros, Pećina, Ivančić-Košuta, 1999), so the maneuver is based on the other senses. An additional difficulty is the possible situation of capesizeing and eskimoroll with the ball, where it is necessary to think about the position of the opponent and teammates.

Maneuvering the ball in addition to controlling the kayak is one of the key abilities for a quality game of canoe polo. Handling the ball in canoe polo has the most similarities to handling the ball in water polo and includes the following elements: lifting-catching the ball from the water surface, throwing, throwing and shooting at the goal, catching throwed balls, cutting path of the ball, with different ways of defending the goal. By passing or throwing, the player passes the ball to a teammate, throws it into an empty space or throws it into the game after the out, and when shooting, directs it to the opponent's goal. As in most other sports games, these balls can be sent in an arc path as a lob or a straight line, such as throwing in handball, in addition, can be performed with one or both hands. Elements of the basketball technique are also used less often, and more often when throwing in or lob passing. The highest level of feeling for the ball and water is the application of volleyball handling techniques when two or one hand or even a paddle makes short contact with the ball and it quickly steers in the desired direction (Beasley, 2008).

There are a large number of different variants of basic shots and passes that are applicable and suitable in different situations in the game. Shots with a change of angle in the

wrist are often used to deceive the goalkeeper. With them, all body segments successively move with their flow, only the final change of the angle in the wrist partially changes the direction of movement of the ball, which makes the job of the goalkeeper more difficult. Changing the height, changing the angle at the elbow joint when dropping the ball and balls that get a spin (rotation around its axis) when dropping from the palm can also cause difficulties for the opponent's defense (Beasley, 2008).

Following the example of other sports games, feints – false movements are also used in canoe polo. With them, body language gives a signal to the opponent to move in defense in the wrong direction, after which the attacker changes his movement and tries to realize his idea without disturbing the opponent. There are also so-called „false" throwing and shooting movements in which players swing their hand as if to kick, but the ball remains in their hand, to which the defense reacts, after which the player sends the ball in the other direction or starts to penetrate. Also, players can deceive the opponent's defense with a „false" look, by focusing the gaze on one point as if directing the ball to which the defense responds adequately, but the player directs the ball to a point from peripheral vision or to a player whose position he previously noticed (Beasley, 2008).

Catching is learned along with throwing the ball, and is one of the key skills in playing the canoe polo. Player can catch the ball with one hand, with both hands or control it with an paddle.

The path of the ball can be „cut", caught and stopped with the help of a water surface, by matching the ball with a hand or a paddle from above. Dribbling in the canoe polo or guiding the ball is performed by constant throwing, so that the player lifts the ball out of the water, throws it in front of him and brings it to him to take it again, paddling while the ball is on the spraydek is not allowed.

To control the ball, players also use a paddle as an extension of their hands to block the pass between opponents, block a shot on goal, draw the ball within arm's reach, lift the ball from the water or throw it to a teammate.

The paddle is useful in such situations because the range with which players can influence the movement of the ball is greater, but the coordination abilities are weaker compared to manipulating the hands with the ball (Beasley, 2008).

The ball is often taken away from the opposing players by the defense by blocking the throw between the attackers and suddenly cutting off the path of the ball, suddenly, reflexively raising or placing the paddle as far into the field as possible. The success of these abilities depends on the ability to anticipate in which direction the ball will be directed, on the speed of reflex reactions and on the coordination abilities of the eyes (senses of sight) and hands (Cochrane, 2010).

Ball control can also be performed with an paddle. When leading the ball with the paddle, the advantage is that the paddle is in the hands and players who dribble well in this way, can move without losing rhythm and major delays. Players also use a paddle to catch the ball after a pass, which is less safe than catching the ball with their hands, but provides the ability to dribble faster and control the boat better (Beasley, 2008). In addition to all the above, kayakers should move on the water surface in a coordinated

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manner so that individual efforts make a synergistic effect of the team.

Thus, transitions from attack to defense and vice versa are very common, with frequent sprints, changes of direction, with specific roles and individual, group and team tactics, where positions and movements of each position in the team are defined individually (Cochrane, 2010).

Kayaking and Canoeing in the Western Balkans Countries Out of the European Union

The countries of the Western Balkans out of the European Union have not developed kayaking and canoeing to their full potential. Through the efforts of the „Narodna Tehnika" movement, kayaking strengthened the system of economy and sports of Yugoslavia after the Second World War, where it trained a large number of young people who only got the opportunity to train this sport after acquiring basic work skills. Kayaking reached its peak in the Balkans in the 1960s and 1970s, where later development was based on professionalism and a focus on top results. The unprincipled deviation from mass sports is certainly, among other factors, responsible for the slowdown in the momentum of development and the current state of stagnation and in some cases extinction of this sport in the Western Balkans outside European Union.

Canoe polo activities do not exist in this area (http://www.canoepoloarchives.org/polo-playing-countries.html). Based on that, it is possible to ask the question whether Balkan should allow a delay 100 years for developped European Countries here as well in other activities or well the backlog be kept in double digits (currently 96 years behind in introducing competition systems)?

Serbia has a relatively well-developed kayak and a significantly less developed canoe on flat waters with large oscillations in membership and results at the international level, while a small number of athletes practice kayaking and canoeing on wild waters with poorer results in international competitions.

Bosnia and Herzegovina is characterized by significantly more developed rafting than kayaking and canoeing. The potential for development is great, given the large number of possible courses for training and competition on flat and wild waters. After the desintegration of Yugoslavia, Bosnia and Herzegovina never reached the number of members it had thirty years ago, while today there are significant individual results with numerous organized international competitions (World and European Championships and World Cups).

Montenegro has been developing kayaks only recently. In addition to the significant area of the sea coast, several lakes and significant fast rivers, there are only a few clubs with a very small number of athletes.

Northern Macedonia in both flat and wild waters used to be very popular with a small number of clubs, but today it operates with a dozen, mostly wild water clubs, with significant results of several individuals, with the continuation of the organization of competitions at the international level.

No data are available for Albania, but their absence from international competitions is noticeable. The long-term unfavorable economic situation in the region, past wars and conflicts are certainly affecting the state of kayaking in the Western Balkans. However, it should be noted that the lack of a strategic approach to development also allows the situation to maintain the "status quo". One of the features of the mentioned possible strategy can be the introduction of canoe polo in the sports systems of the mentioned

countries. There are also ICF development programs where it is possible to apply for boats and some protective equipment (https://www.canoeicf.com/development/equipment-donations). There are several untapped resources to re-launch the sport in the region, such as co-ordinated co-operation between the Western Balkans countires, in terms of a joint development strategy, sharing infrastructure costs, staff development, sharing specific sports facilities and equipment and organising mutual training.

Potential Benefits of Introducing Canoe Polo in the Sports System of the Western Balkan Countries Out of the European Union

Although the ICF covers 9 or more special but very related sports, very few countries in the world are developing in parallel in all its manifestations. Countries that develop their strategy in this direction have a large noumber of athletes, while their competitors show high levels of knowledge and skills that they display on a wide scale. A significant number of countries long ago have included kayaking and canoeing (Canada, Hungary, Germany, Australia, the Czech Republic, Slovakia, Russia, Belarus…), and especially canoe polo in the school sports system. This was not done in the way it was done, for example, in Serbia, where school sports are considered only a system of inter-school competitions from the municipal to the federal level. In mentioned countries sports schools are specially developed, where young people complete training courses, while they are included in the system of long-term regular trainings, where only then competitions from junior school to university level follow.

Unfortunately, the sports systems in the Western Balkans countries out of the European Union have experienced a significant changes, so for example, University sports have a very weak real connection with the sports system. Problematic funding and lack of regular physical exercise for students is neglected at the expense of recruiting already active athletes who study and who without systemic changes can sometimes win a medal at international competitions. Thus delaying significant changes in their countries because instead of winning medails trough functioning of some established system, the opposite is happening, and that is that the results are happening despite the existing system. In reality, occasional success is brought about by the work of an individual and a small group of experts around that individual.

Canoe polo as a sport that contains the characteristics of several branches of sport (Sheykhlouvand, Gharaat, Bishop, Khalili, Karami, & Fereshtian, 2015) and some seemingly incompatible skills is an excellent tool for developing the abilities and skills of young people, who should become the mainstay of development their country in the very near future.

Kayaking and canoeing on wild waters with its disciplines of classic and sprint downhill, as well as slalom and extreme slalom are very demanding forms of movement where the necessary strength, speed and endurance are dominated by skills and abilities of balance in

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dynamic conditions, „reading water" recognizing the shape of a skills watercourses with the choice of direction with knowledge of its causes and consequences (Ford, 1995; Absolon, 2018), as well as coordination in terms of overcoming various natural and artificial obstacles (Harrison, 1998). Direct and rapid progress of kayakers and canoeists on wild but also flat waters
can be achieved by using canoe polo as a means of training through a situational and super-situational approach. Complex and dynamic everyday situations in canoe polo training with more parallel actions happening at the same time, can significantly improve the performance of competitors in their home sport.

In the whole process, training is more important than the competition itself, because it is known the athletes spend more than 90% of their time on training, while a very small part of the time they compete.

The changes that occur in training are often ignored in terms of breaking barriers in duration, intensity and scope of effort, overcoming various situations outside the comfort zone and acquiring skills that represent more significant achievements than placement and comparison of several athletes.

At the same time, the influence of canoe polo can be reflected in a smaller outflow of newly trained beginners, because there is a further possibility of their training with additional space for a competitive career. At the same time, already active athletes can enrich their competition calendar by competing in several
branches of canoeing, thus increasing the scope and intensity of their training while continuing to expand by expanding the field of skills and abilities, as opposed to their stagnation and intensive conditioning and narrow specialization.

Indirectly, with a larger number of members, national kayak federations can strengthen with more developed sports.

National kayak federations are currently the biggest limiting factor and obstacle to their own development in the Western Balkans out of the European Union, due to inefficiency and lack or non-implementation of strategy, and then clumsy and wrong attempts, as well as dominating the development of administration with great success in choking their own sport.

Using kayaks in training and coaching (Rajković, Mitrović, Milivojević, 2013) canoe polo, especially in winter, would increase the number of specific trainings on the water of active competitors who usually do not meet the number of kilometers traveled or time spent on water that enable international results.

It will take some time for the new system to produce economic effects as well. Thus, after investing in specific equipment, renting a swimming pools or arranging free water surfaces, one can expect a profit from the organization of canoe competitions at the level of primary and secondary schools, universities, clubs, as well as national competitions of different ages and categories.

An equipped canoe polo center could be sustainable only on the basis of international competitions organized for European universities, club European and world level as well as for European and world championships of national teams of both genders and more age categories.

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CONCLUSIONS

Some (or many) sports, especially in situations of reaching plateaus in learning and progress, can also serve as a means of advancing athletes in another similar or diametrically different parent sport, and not just as an ultimate goal in terms of results. Sometimes a longer and longer lasting journey leads to the goal earlier, so a trip to a new sport can serve as a springboard for results in the home sport, where you can literally draw a parallel with the famous sayings „one step back two steps forward" and „hurry slowly"…

In this way, canoe polo can be used by whitewater kayakers to significantly improve their skills and abilities. Simultaneous handling of the ball, with an overview of the game and interfering with the opponent is a very demanding coordination activity that overcomes paddling in nature with various obstacles, both in terms of content and dynamics. At the same time, kayakers solve a large number of tasks at the same time, which mostly improves their stability and sense of water.

The combination of water polo, handball, basketball and volleyball technical elements implies high automation in maintaining balance, as well as the situational manifestation of different types of strokes.

Efforts aimed at the presentation and popularization of canoe polo could be used to massification the canoeing, as well as to raise the quality of results by applying situational and super-situational training methods.

Very demanding activities in different trainings, with a greater opportunity to compete, as well as with a longer and more meaningful competition calendar, can significantly improve the skills needed for kayaking and canoeing in all its forms. In addition, the economic effect of development through sports facilities, infrastructure and boats with protective equipment should not be neglected, which at some point may become the basis for the organization of domestic and international competitions.

In addition to the above, there are numerous examples of unused and insufficiently explored possible transfers between paddling disciplines in both directions, such as kayaking and canoeing, flat and wild kayak, rafting and kayaking, academic rowing and kayaking and canoeing with specific benefits or emphasis on certain technical, tactical or fitness entiretyes.

In that sense, it is disappointing that there are no universal rowing and paddling clubs in the Balkans where all rowing and paddling sports are taught in parallel, while similar examples exist in the world. This statement becomes especially interesting when considering the order in the adoption of certain technical units in training, where it is possible to completely avoid delays and plateaus in progress, where each paddling discipline (more broadly, some other sports) has its significant and irreplaceable place.

The assumption is that in this area lies a great untapped resource for improving results in all rowing and paddling sports.

For quantitative and qualitative leaps in their work, it is sometimes necessary for coaches and sports managers to step out of their professional phenomenological comfort zone and seek solutions somewhat wider than usual, which again implies a multidisciplinary approach with constant self-improvement.

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SAŽETAK

Internacionalna Kanu Federacija obuhvata 10 pojavnih oblika kajaka i kanua i prepoznaje 4 dodatne discipline. Jedan od veoma popularnih je kajak polo. Kajak polo je timski sport koji pripada porodici sportskih igara. Dva tima sa po pet igrača se međusobno bore da postignu veći broj golova sa vaterpolo loptom, u bazenu specifičnih dimenzija. Kajak polo se razvijao paralelno u tri slične varijante pravila i to kao alternativa veslanja za vreme vetrovitih i hladnih zimskih dana. Kajak polo sadrži najveći broj različitih tehnika u odnosu na sve veslačke sportove, dok se baratanje loptom vrši mešavinom vaterpolo, rukometnih, košarkaških i odbojkaških tehnika. Simultano rukovanje loptom, uz pregled igre i ometanje protivnika je veoma zahtevna koordinaciona aktivnost koja ne postoji pri veslanju u prirodi sa različitim preprekama, kako po sadržaju tako i po dinamici. Danas se kajak polo igra u oko 40 država. Divljevodaške i mirnovodaške kajak i kanu discipline u državama zapadnog Balkana van Evropske Unije postoje dugi niz godina, dok kajak polo aktivnosti, klubovi i takmičenja uopšte ne postoje. Uvođenje kajak poloa u sistem sporta zapadno balkanskih država van Evropske Unije može biti iskorišćeno kao sredstvo za omasovljenje kajakaškog sporta, kao i za podizanje kvaliteta kajakaša primenom situacionog i nadsituacionog metoda vežbanja. Veoma zahtevne aktivnosti na različitijim treninzima, sa većom mogućnošću za takmičenje, kao i sa dužim i sadržajnijim takmičarskim kalendarom, mogu značajno unaprediti veštine potrebne za veslanje u kajaku i kanuu u svim njegovim pojavnim oblicima. Pored toga ne treba zanemariti ni ekonomski efekat razvoja kroz sportske objekte, infrastrukturu i čamce sa zaštitnom opremom, koji u jednom trenutku mogu postati osnov za organizaciju domaćih i međunarodnih takmičenja.

Ključne reči: *strategija sporta, transfer, sredstvo, divlje vode.*

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Wellness Programs as an Integral Part of the Tourist Offer on Cruise Ships

[short scientific article]

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WELLNESS PROGRAMI KAO SASTAVNI DEO TURISTIČKE PONUDE NA KRUZERIMA

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ABSTRACT

Cruise is a special type of tourist offer that includes a large market. Interests of guests - the structure of service users and their financial capabilities determine the content offered - entertainment, adventure, wellness or recreation, etc. One of the primary activities during long voyages are wellness procedures that are performed in order to preserve and improve the health of passengers. These procedures involve a multidisciplinary approach from several areas, of which tourism, medicine and physical culture stand out. The provision of services requires specific knowledge and skills, which have only recently taken their place in the nomenclature of job titles, as well as a special direction of education. Successful effects require a proper hierarchy of treatment during procedures, but also a system of periodic evaluation. The paper presents a questionnaire with the results that was conducted on 102 guests on a cruise from Strasbourg to *Köln*, where passengers confirm the high quality and suitability of the program for users. The results especially emphasize the importance of the Wellness program for the quality and content of the trip itself. Training of personnel for these programs is possible and desirable in continental countries, whose graduates can find employment on one of the many cruises at sea, but also on larger passenger ships on continental navigation in the systems of rivers and canals of Europe.

KEY WORDS: health, SPA programs, navigation

INTRODUCTION

One of the modern trends in nautical and cruise tourism is the offer of various facilities on board (Pašković, 2020). Cruising is a special type of tourist offer that includes a large market with an estimated value of 29.4 billion dollars a year, with 314 sea cruisers in 2018, covering a capacity of 537,000 passengers, a total of 19 million passengers a year in 2011 (https: / /cruisemarketwatch.com/capacity/). In addition to maritime tourism, the development of continental cruising, which is growing worldwide, should not be neglected (Vuksanović, Pivac, Dragin, 2013; Pašković, 2020). Among the primary activities on such trips are Wellness procedures in order to preserve and improve health. Wellness services require a complex approach and application of various methods and activities related to fitness, cosmetic care, healthy eating, relaxation, meditation, physical and mental activity as well as other procedures in order to strengthen and preserve health.

Wellness and SPA procedures have a positive effect on the health, working ability, self-confidence and aesthetics of the human body. In this regard, a modern concept has been created that aims to improve the quality of life, which is known in professional circles as Wellness and SPA philosophy of life. Wellness is a process, not a static state (Travis, 1981). Four basic principles of Wellness have been defined (Adams, 2003):

- Wellness is multidimensional;
- Wellness research and practice should be oriented towards identifying a Wellness sample rather than the cause of the disease;
- Wellness is about balance;
- Wellness is relative, subjective or perceptual.

The connection between health and nautical and cruise tourism can be seen through the prism of the application of various health prevention programs that are implemented on large ships – cruisers. The purpose of cruisers - passenger ships is to travel from port to port while enjoying the sea, ocean or river (Станковић, 2000) in a luxurious environment. Interests of guests - the structure of service users and their financial capabilities determine the content offered – entertainment, adventure, wellness or recreation, etc.

"The wellness program is a set of all relationships and phenomena that arise from the travel and stay of people whose main motive is to preserve and improve their health.

They require a thorough package of services that includes professional knowledge, fitness, cosmetic care, healthy eating or dieting, relaxation or meditation, physical or mental

Jotov, N., Miletić, V., Rajković, Ż., Vidaković, M., & Mitrović, D. (2022). Wellness programs as an integral part of the tourist offer on cruise ships. *Sportlogia, 18* (1), 14-24. https://doi.org/10.5550/sgia.221801.en.jrm

activity, and education" (Mueller and Kaufman, 2001). Cruising large ships requires the provision of a variety of services, and among the priorities are *Wellness* and *SPA* programs.

In addition to the economic component, the modern tourist offer must also have a content component (Mitić, 2001; Гърков, 2019), which provides the guest with a healthy and useful rest and psychophysical refreshment and relaxation.

There are modern *Wellness* and *SPA* centers on cruise ships. Wellness centers are places where health-preventive procedures are harmonized with pleasant feelings (Dimitova, 2012). In *SPA* centers on cruisers, various health procedures and programs based on natural therapeutic and recreational resources are applied through the application of eastern (breathing gymnastics, meditation, yoga) and aqua methods, as well as various anti-stress and relaxation programs. In addition, there are various programs for body care and beauty. *SPA* zone contains a minimum: swimming pool, fitness, fresh bar, and the body care and beauty zone has a minimum of two cabinets with Jacuzzi procedures, Turkish bath, steam bath, sauna for relaxation. There are modern wellness centers on many modern cruise ships.

They recommend a variety of recreational, cosmetic and other procedures, anti-stress programs based on the action of natural therapeutic and holistic procedures in order to achieve emotional, physical, spiritual, intellectual and social well-being.

Recently, various wellness programs of selective purpose have been increasingly applied and modeled on cruisers, which are aimed at:

- prevention and alleviation of acute fatigue, so-called anti-fatigue programs;
- prevention of obesity, reduction of fat deposits;
- prevention, alleviation and elimination of tension and pain of the locomotor system;
- optimization of the cardiovascular system;
- relieving nervous and emotional tension;
- anti-stress, relaxation programs.

Many authors in their research state that users of *Wellness* services on cruise ships are active at home and have an appropriate *Wellness* culture.

The following wellness dimensions are defined in the literature (Smith, Kelly, 2006) (Table 1).

Table 1. *Welness dimensions*

Motivation of tourists	Typical locations / activities	References
Medical / cosmetic	Hospitals and clinics	Cornell
Physical / physical	Spas, massages, yoga	Lea; Lehto, Brown, Chen and Morrison; Puczko and Bachvarov
Escapism and relaxation	Beaches, spas, mountains	Pechlaner and Fischer; Puczko and Bachvarov
Hedonistic / Experimental	Festival Spaces	Lea; Pernecky and Johnston
Existential and psychological	Holistic centers, with a focus on self-development and philosophical satisfaction	Smith and Kelly; Steiner and Reisenger
Spiritual	Spiritual Pilgrimage, Yoga, Resorts	Devereaux and Carnegie; Pernecky and Johnston; Lehto, Brown, Chen and Morrison
Related to the community	Volunteering, humanitarian work, hospital centers	Devereaux and Carnegie; Smith and Kelly

The problem of this research is related to the modeling of the algorithm of *Wellness* and *SPA* programs on cruise ships with the presentation of the model of examining the attitudes of users of *Wellness* services on cruise ships.

The tasks of the research include the analysis of written sources and consideration of the possibilities of applying *SPA* and *Wellness* programs on cruisers, proposing an appropriate algorithm model for *Wellness* and *SPA* programs and defining a questionnaire to examine the attitudes of *SPA* and *Wellness* program users on cruisers.

Jotov, N., Miletić, V., Rajković, Ž., Vidaković, M., & Mitrović, D. (2022). Wellness programs as an integral part of the tourist offer on cruise ships. *Sportlogia, 18* (1), 14-24. https://doi.org/10.5550/sgia.221801.en.jrm

METHODS

The applied methods include the procedures of modeling and analysis of the *wellness* and *SPA* programs. For this purpose, scientific and professional literature was studied using the methods of theoretical analysis, modeling and statistical data processing.

This research examined the attitudes of clients regarding *Wellness* services on a cruise ship from *Strasbourg* to *Köln* through a seven-day cruise. The research was applied on a sample of 102 guests. The sample of respondents was formed by random selection. During the application, the questionnaire met all the prescribed criteria.

As stated, one of the represented methods in this paper is the *Wellness* Program Modeling Method. The following criteria were used during modeling the algorithms for the *Wellness* and *SPA* programs:

- diagnosing the initial - current state;
- time available to the client;
- sample of clients and health condition;
- financial capabilities of clients.

RESULTS OF RESEARCH WITH DISCUSION

In order to propose an appropriate model of the algorithm of the *Wellness* and *SPA* programs, the *Wellness* literature, goal, purpose, ie orientation of the *Wellness* and *SPA* model was primarily studied. The following factors were taken into account when modeling the wellness program algorithm:

- objective and subjective needs of users of the Wellness program on the cruise as well as diagnosing the condition of clients;
- relevant biomedical knowledge and laws.

In practice, the modeling of the algorithms of the *Wellness* and *SPA* programs can be performed as follows:

- SPA Day - in the form of so-called Weekend packages - usually for two;
- package for three people during the week (Monday-Wednesday, Friday-Tuesday, Thursday-Saturday);
- weekly package (Sunday to Friday);
- ten-day package.

Jotov, N., Miletić, V., Rajković, Ż., Vidaković, M., & Mitrović, D. (2022). Wellness programs as an integral part of the tourist offer on cruise ships. *Sportlogia, 18* (1), 14-24. https://doi.org/10.5550/sgia.221801.en.jrm

The structure of the *Wellness* and *SPA* packages is modeled based on the age of the client and his health condition. The decisive role in the application of appropriate procedures and Wellness packages is played by the *Wellness* Trainer – an expert who knows best the impact and effects of individual procedures and program packages on the health status of users. Based on the above, several *Wellness* programs are proposed that should meet the following requirements:

- that the content of procedures and activities is indicated by its nature, i.e. that the procedures have the so-called compensatory-corrective and relaxation role;
- hat procedures have a positive emotionality and health preventive role;
- to optimize the cardiovascular system during the applied procedure, accelerate the process of fat elimination, activate the muscular system, activate metabolic processes, eliminate toxins, improve skin elasticity, etc.

Table 2. *Several models of SPA and Wellness programs*

Five-Day Anti-Cellulite Program Model	
1. day	• aqua fitness; • exfoliation with marine peeling products (removal of dead cells from the skin surface); • CELUTRON MULTI treatment (diathermic treatment); • anti-cellulite mask; • anti-cellulite massage.
2. day	• aqua fitness; • CELUTRON MULTI; • sauna; • anti-cellulite massage;
3. day	• aqua fitness; • CELUTRON MULTI; • anti-cellulite massage.
4. day	• aqua fitness; • CELUTRON MULTI; • sauna; • anti-cellulite massage.
5. day	• aqua fitness; • CELUTRON MULTI; • exfoliation; • anti-cellulite massage.

Jotov, N., Miletić, V., Rajković, Ż., Vidaković, M., & Mitrović, D. (2022). Wellness programs as an integral part of the tourist offer on cruise ships. *Sportlogia, 18* (1), 14-24. https://doi.org/10.5550/sgia.221801.en.jrm

A two-day model of a weight loss program	
1. day	• diagnosing the condition of clients and modeling appropriate procedures in accordance with the health condition of clients of the program; • modeling a weight loss program; • CELUTRON MULTI; • Turkish bath; • exfoliation of seafood; • anti-cellulite massage.
2. day	• CELUTRON MULTI; • Sauna • relaxation massage;

"Relax" program model	
1. day	• diagnostics of clients' condition; • Yoga exercises.
2. day	• methods of adopting relaxation techniques; • vitamin drinks; • breathing technique training.
3. day	• partial massage; • relaxing aromatic baths in the bathtub; • breathing technique training; • relaxing music for psychorelaxation.

In order to examine the attitudes of the users of the *Wellness* program on cruise ships, a scale of attitudes was constructed, which empirically examined the degree of agreement of the users of *Wellness* services with items that represent the value of the Wellness program.

The examination of attitudes was performed on the *Likert scale*, where the degree of agreement with the offered items was measured on a continuum from 1 to 5. The highest degree of agreement was marked with the number 1, and the lowest with 5.

Jotov, N., Miletić, V., Rajković, Ž., Vidaković, M., & Mitrović, D. (2022). Wellness programs as an integral part of the tourist offer on cruise ships. *Sportlogia, 18* (1), 14-24. https://doi.org/10.5550/sgia.221801.en.jrm

Table 3. *Attitudes of users of Wellness services about the values of Wellness programs offered on a cruise ship*

Serial number	Item	1	2	3	4	5
		I totally agree	I mostly agree	I'm not sure	Mostly I disagree	I do not agree at all
1	If someone asked me I would suggest him to visit this Wellness Center on a cruise ship	94 92,16%	6 5,88%	2 1,96%		
2	Wellness programs offered in the Wellness Center on a cruise ship contribute to improving the image of services on a cruise ship	100 98,04%	2 1,96%			
3	The packages of Wellness and SPA programs offered on the cruiser are of a complex nature and optimally affect my psychosomatic status	92 90,20%	8 7,84%	2 1,96%		
4	The goal and purpose of the Wellness and SPA programs meet my needs	95 93,14%	5 4,90%	2 1,96%		
5	This Wellness Center applies modern scientific knowledge and practical experiences and innovative procedures	102 100%				
6	Wellness services and SPA rituals have a positive effect on the emotional mood of clients	100 98,04%	2 1,96%			
7	The applied aqua-fitness program within the program package according to the nature of the content and activities is harmonized with the level of my abilities	94 92,16%	5 4,90%	3 2,94%		
8	The level of health largely depends on the practice of wellness procedures	102 100%				
9	Some programs that are applied in the Wellness Center on a cruise ship can cause negative health effects		51 50,00%	32 31,37%	19 18,63%	
10	People who work on a cruise in the Wellness Center have the necessary professional qualities	100 98,04%	2 1,96%			

From Table 3, it can be concluded that the users of the Wellness program have a positive attitudes towards the Wellness facilities offered on the cruiser that travels for seven days on the route *Strasbourg – Köln*.

The results show that the users of *Wellness* services are satisfied with the offered model of the program provided on the cruiser. Also, the attitudes of tourists indicate that the wellness programs offered on the cruise contribute to improving the image of services. On the occasion of the *Wellness* packages and *SPA* programs offered by cruisers, the guests declare that they have an optimal effect on their psychosomatic status. Guests confirm the satisfaction of their needs through *Wellness* and *SPA* programs. The users of the *Wellness* Center confirm the application of modern scientific knowledge and practical experiences with innovative procedures. Guests confirm the positive effect of *Wellness* services and *SPA* rituals on their emotional mood. Clients also confirm the compliance of the character of the content and activities of aqua-fitness with the level of their abilities. Clients confirm that the applied *Wellness* and *SPA* procedures effectively affect their health status. The results of the survey show that clients are aware of the possible negative health effects of the programs used. Clients also confirm the expertise of the staff engaged in *Wellness* programs.

The results of the survey, although related to a specific seven-day trip on a tour from Strasbourg to Cologne, have a high degree of generalization, given the similarity of the clientele and the very concepts of content on cruise ships. Similar questionnaires can be used for market research or evaluation of already existing contents both on sea cruisers and on larger tourist ships in continental navigation, but also on other forms of tourism where wellness programs are applied (rural, nautical, congress).

CONCLUSION

The starting points for modeling the algorithm of *Wellness* and *SPA* programs that are applied in the form of a complex program on cruisers are based on:

- diagnosing the current condition of the users of the *Wellness* program – psychosomatic condition at the initial diagnosis;
- determining the desired and possible effects of the applied procedures;
- modeling of the appropriate procedure – program;
- monitoring and controlling the reactions of the client's organism during the implementation of procedures – programs;
- valorization effect procedure.

Based on all the above, it can be concluded that the modeling of the algorithm of *Wellness* and *SPA* programs is a prerequisite for *Wellness* programming in order to effectively manage the *Wellness* and *SPA* process.

Jotov, N., Miletić, V., Rajković, Ż., Vidaković, M., & Mitrović, D. (2022). Wellness programs as an integral part of the tourist offer on cruise ships. *Sportlogia, 18* (1), 14-24. https://doi.org/10.5550/sgia.221801.en.jrm

Wellness facilities on cruise ships have a significant role as a concept of a new approach to maintaining and improving human health for tourists who have a specific role and are "active seekers of health".

In addition to cruisers, wellness facilities have their value in all other forms of tourism (rural, ecotourism, congress, sports).

In addition to maritime countries that have great potential for developing this type of nautical tourism, continental countries can through a strategic approach (Evans, Campbell, Stonehouse, 2003) have a large share in the development of this type of activity through training of specific staff covering a wide multidisciplinary field which consist of tourism, health and physical culture. Consequently, synergies between appropriate, higher education institutions are needed.

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SAŽETAK

Krstarenje kruzerima predstavlja posebnu vrstu turističke ponude koja obuhvata veliko tržište. Interesi gostiju – struktura korisnika usluga i njihove finansijske mogućnosti određuju sadržaje koji se nude – zabava, avantura, wellness ili rekreacija itd. Jedna od primarnih aktivnosti tokom dugih plovidbi su Wellness procedure koje se obavljaju u cilju očuvanja i poboljšanja zdravlja putnika. Navedene procedure zahvataju miltidisciplinarni pristup iz nekoliko pravaca od kojih se ističu turizmologija, medicina i fizička kultura. Za pružanje usluga neophodne su specifična znanja i veštine, koje tek od skora imaju svoje mesto u nomenklaturi zvanja, kao i poseban pravac školovanja. Za uspešne efekte neophodna je pravilna hijerarhija postupaka tokom procedura, ali i sistem periodične evaluacije. U radu je predstavljen upitnik sa rezultatima koji je sproveden na 102 gosta na krstarenju od Strazbura do Kelna, gde putnici potvrđuju visok kvalitet i prilagođenost programa korisnicima. Rezultati posebno ističu značaj Wellness programa za kvalitet i sadržajnost samog putovanja. Obučavanje kadrova za navedene programe moguće je i poželjno i u kontinentalnim zemljama, čiji diplomirani učenici mogu naći svoje zaposlenje na nekom od mnogobrojnih kruzera na moru ali i na većim putničkim brodovima na kontinentalnoj plovidbi u sistemima reka i kanala Evrope.

Ključne reči: *zdravlje, SPA programi, plovidba*

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The Relationship of Body Mass Index and Motor Abilities of Eight Grade Students

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POVEZANOST INDEKSA TJELESNE MASE I MOTORIČKIH SPOSOBNOSTI UČENIKA OSMIH RAZREDA OSNOVNE ŠKOLE

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ABSTRACT

The aim of this research was to examine the connection of body mass index of eighth grade students and their results in motor abilities test, with the purpose of gaining insight in which tests is that connection more or less expressed, or there isn't any. The sample of subjects consisted of 66 male and 64 female students from four elementary schools from the Varaždin city area, who attended eighth grade in the school year of 2018/2019 For data analysis, the results of the final testing of motor abilities were used. The sample of variables consisted of six motor tests and two anthropometrical measures, student's age and their body mass index. For all 10 variables the basic descriptive parameters were calculated (arithmetic mean, standard deviation, minimum and maximum), both for female and male students. Further data processing was done by linear regression analysis – 6 x regression analysis for each motor ability. The results of the regression analysis in male students showed statistically significant connection of body mass index and four variables (standing long jump, shuttle run with carrying objects, sit and reach and pull-up hold), while in female students the connection was significant only in two variables (standing long jump and pull-up hold). Overweight and obesity of children and adolescents is a growing phenomenon all over the world. Motor abilities are an important indicator of physical activity and one of the possible indicators of the level of fitness. Overweight and obesity, as well as underweight, negatively influence the condition and development of motor abilities, and the role of Physical education classes are of great importance in prevention and promotion of healthy living habits of students.

Key words: *exercise, body weight, activity*

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INTRODUCTION

In Croatian elementary and high schools students are systematically monitored in anthropological characteristics twice a year through initial and final testings. According to Findak and Prskalo (2004), anthropological characteristics are defined as „organized systems of all traits, abilities and motor information and their mutual relations, which include anthropometric features, motor, functional and cognitive abilities, conative features and social status." There are many definitions of motor abilities, which are the subject of this research. Prskalo (2004) defines them as „latent motor structures responsible for practically infinite number of manifested motor reactions, and they can be evaluated and described. Jurko et al (2015) state in their book that motor abilities are present in performance of all kinds of motor movements, and the motor abilities tests serve for their determination.

There are many factors that influence the level of physical fitness of children and adolescents and understanding of their connection is of great significance, given that the level of physical activity is an important protective factor of later health problems (Gísladóttir, et al., 2019; Ortega, et al., 2008, Robinson, et al., 2015). Previous evidence suggest a positive association of motor abilities and a number of health indicators like the level of physical activity, cardiorespiratory fitness, muscle strength, muscle endurance and healthy body weight (Robinson, et al., 2015). Also, according to Gísladóttir et al (2019), motor abilities are one of the possible predictive factors of physical fitness level because they are an important sign of participation in physical activities of children and adolescents. The authors say that children and adolescents with low level of motor abilities tend to be less physically active, they are less likely to include in sports and they have lower level of physical fitness compared to their peers with higher level of motor abilities. Because of the mentioned, it is necessary to systematically observe the level of motor abilities of children and adolescents in schools, in order to notice irregularities in their development in time and to intervene accordingly.

Nowadays we are witnessing an increase in the trend of reduced movement of children and adolescents, their participation in physical activities, irregular diet and accordingly an increase of overweight and obesity. That the stated is a worldwide public health problem isn't the news. The most common cause of overweight in children and adolescents is excessive calorie intake without their adequate consumption through physical activity, claim Kansra, Lakkunarajah and Jay (2021) in their research. They point out the connection of overweight and different comorbidities like type two diabetes, hypertension, non-alcoholic fat liver disease, obstructive sleep apnea, and those are only some of them.

The stated diseases were once connected with an adult population, but today they also often appear in younger population. Body mass index is a simple and cheap way of body composition assessment, or level of nutrition, and there are research that point to its association with the amount of fat tissue, and future health risks (Adab, Pallan, & Whincup, 2018; Kansra, et al. 2021). Unlike body mass index calculation of adults, which is standardly obtained by the ratio of body mass and the square of height, for children and adolescents the procedure is somewhat different. Body mass index of children and adolescents aged 5 to 19 is associated with their age and sex, and it is determined by the percentile curves and standard deviation according to the recommendations of World Health organization (Kansra, et al., 2021; Mračević,

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2020; WHO, 2022). The connection of motor abilities and body mass index were the subject of many prior research (Cheng, et al., 2016; Greier, & Drenowatz, 2018; Houtari, Heikinaro-Johansson, Watt, & Jaakkola, 2018). The results in one of them suggests that higher body mass index in earlier childhood reduces the level of motor abilities five to ten years later (Cheng, et al., 2016). Research conducted on children from 5th to 8th grade showed the existence of synergistic connection between body weight and motor abilities, where the excess body weight resulted in weaker development of motor abilities, while losing the excess body weight enabled previously obese students to catch up with their normal weight peers (Greier & Drenowatz, 2018).The association between basic motor knowledge and body mass index was proven by Houtari et al (2018) on the sample of subjects 15 and 16 years of age, measured in years 2003. and 2010. It was found that basic motor knowledge have a significant effect on body mass index of both sexes.The goal of this research was to examine the connection of body mass index of eighth grade students and their results in motor abilities test, with the purpose of gaining insight in which tests is that connection more or less expressed, or there isn't any.

METHODS

Sample of subjects

The sample of subjects consisted of 66 male and 64 female students from four elementary schools from the Varaždin city area, who attended eighth grade in the school year of 2018./2019. All the students attended Physical education classes regularly and were of good health status.

Sample of variables

For the purpose of this research the results of the final motor abilities testing of eighth grade students were used. Ten variables were examined out of which six belonged to standard motor abilities tests for elementary schools (Neljak, et al., 2011), two were anthropometric variables (height – HGT and body weight -BW), student's age (exact age at the time of testing) and body mass index – BMI. Tests for measuring motor abilities were: hand tapping (HT – number of repetitions) for measuring the frequency of movement, standing long jump (SLJ – cm) for measuring explosive leg power, shuttle run with carrying objects (SRCO – sec) for testing agility, sit-ups (SU – number of repetitions) for testing repetitive trunk power, sit and reach (SAR – cm) for measuring flexibility of hamstrings and lower back, and pull-up hold (PUH – sec) for testing static arm and shoulder strength.

Testing protocol

The final testing of students' motor abilities was conducted as a part of regular Physical education class in the main part of the class, after the preparation part that consisted of general physical warm up for activities that follow. The testing was announced two weeks before. Eighth grade students don't have prior attempts in tests due to good familiarity to all of them, since they are systematically performed from the fifth grade.

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Data processing

All data were processed by the program package Statistica for Windows and the alpha level of the statistical tests was set at .05. For all 10 variables the basic descriptive parameters were calculated (arithmetic mean, standard deviation, minimum and maximum), both for female and male students. Further data processing was done by linear regression analysis – 6x regression analysis for each motor ability. Body mass index was calculated for each individual student in regard to their birth year and moth by an online BMI calculator for children and adolescents according to the guidelines of the World Health Organization (Pliva health, 2022).

RESULTS

The results of descriptive statistics for male and female students are shown in tables 1. and 2. The number and percentage of students categorized according to their body mass index and nutrition level, are shown in table 3. Consolidated results of 6 regression analysis are shown in tables 4. and 5.

Table 1. *Results of descriptive statistics for male students*

Variable	N	AM	MIN	MAX	SD
HGT	66	169.750	148.500	190.500	8.603
BW	66	64.962	35.500	107.000	17.975
HT	66	35.439	20.000	47.000	4.798
SLJ	66	195.227	95.000	250.000	31.298
SRCO	66	10.306	8.500	14.720	1.298
SU	66	52.985	30.000	82.000	10.313
SAR	66	51.258	30.000	70.000	7.117
PUH	66	33.818	1.000	80.000	22.002
age	66	13.477	-14.100	15.800	6.077
BMI	66	22.242	14.200	33.400	4.842

N: number of subjects; AM: arithmetic mean; Min: minimum value; Max: maximum value; SD: standard deviation; HGT: height; BW: body weight; HT: hand tapping; SLJ: standing long jump; SRCO: shuttle run with carrying objects; SU: sit-ups; SAR: sit and reach; PUH: pull-up hold; BMI: body mass index

Table 2. *Results of descriptive statistics for female students*

Variable	N	AM	MIN	MAX	SD
HGT	66	169.750	148.500	190.500	8.603
BW	66	64.962	35.500	107.000	17.975
HT	66	35.439	20.000	47.000	4.798
SLJ	66	195.227	95.000	250.000	31.298
SRCO	66	10.306	8.500	14.720	1.298
SU	66	52.985	30.000	82.000	10.313
SAR	66	51.258	30.000	70.000	7.117
PUH	66	33.818	1.000	80.000	22.002
age	66	13.477	-14.100	15.800	6.077
BMI	66	22.242	14.200	33.400	4.842

N: number of subjects; AM: arithmetic mean; Min: minimum value; Max: maximum value; SD: standard deviation; HGT: height; BW: body weight; HT: hand tapping; SLJ: standing long jump; SRCO: shuttle run with carrying objects; SU: sit-ups; SAR: sit and reach; PUH: pull-up hold; BMI: body mass index

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Table 3. *Number and percentage of male and female students according to the category of body mass index (WHO, 2022)*

Variable	N	AM	MIN	MAX	SD
HGT	66	169.750	148.500	190.500	8.603
BW	66	64.962	35.500	107.000	17.975
HT	66	35.439	20.000	47.000	4.798
SLJ	66	195.227	95.000	250.000	31.298
SRCO	66	10.306	8.500	14.720	1.298
SU	66	52.985	30.000	82.000	10.313
SAR	66	51.258	30.000	70.000	7.117
PUH	66	33.818	1.000	80.000	22.002
age	66	13.477	-14.100	15.800	6.077
BMI	66	22.242	14.200	33.400	4.842

Table 4. *Results of the regression analysis for the relationship of body mass index and motor abilities of male students*

	BMI					
N=66	b*	Std.Err. of b*	b	Std.Err. of b	t	p
HT	0.033	0.125	0.033	0.124	0.267	0.790
SLJ	-0.455	0.111	-2.944	0.719	-4.092	0.000
SRCO	0.292	0.120	0.078	0.032	2.446	0.017
SU	-0.014	0.125	-0.029	0.266	-0.110	0.913
SAR	0.301	0.119	0.442	0.175	2.522	0.014
PUH	-0.524	0.106	-2.380	0.484	-4.917	0.000

b*: unstandardized beta coefficient; Std.Err of b*: standard error of unstandardized beta coefficient; b: standardized beta coefficient; Std.Err of b: standard error of standardized beta coefficient; t: t-test value p: level of significance; *significant at the p<.05 level; HT: hand tapping; SLJ: standing long jump; SRCO: shuttle run with carrying objects; SU: sit-ups; SAR: sit and reach; PUH: pull-up hold; BMI: body mass index

Table 5. *Results of the regression analysis for the relationship of body mass index and motor abilities of female students*

	BMI					
N=64	b*	Std.Err. of b*	b	Std.Err. of b	t	p
HT	-0.151	0.126	-0.149	0.123	-1.207	0.232
SLJ	-0.274	0.122	-1.432	0.638	-2.245	0.028
SRCO	0.137	0.126	0.032	0.029	1.092	0.279
SU	-0.040	0.127	-0.099	0.315	-0.313	0.755
SAR	0.023	0.127	0.056	0.314	0.179	0.859
PUH	-0.417	0.115	-1.667	0.461	-3.615	0.001

b*: unstandardized beta coefficient; Std.Err of b*: standard error of unstandardized beta coefficient; b: standardized beta coefficient; Std.Err of b: standard error of standardized beta coefficient; t: t-test value p: level of significance; *significant at the p<.05 level; HT: hand tapping; SLJ: standing long jump; SRCO: shuttle run with carrying objects; SU: sit-ups; SAR: sit and reach; PUH: pull-up hold; BMI: body mass index

From table 3. it can be seen that most of male students belong to the normal weight category (66,7%), but a lot of them are unfortunately overweight and obese (10,6% and 7,6%). Also, among male students not so few of them are in the thin (10,6%) and very thin category (4,5%). On the other side, the majority of female students (81,2%) are normal weight, but also among them there are 10,9% overweight and 4,7% are obese. Unlike in male students, only one female student belongs to the thin category and one to the very thin.

The results of the regression analysis for male students shown in table 4., point to statistically significant influence of BMI variable on four motor abilities: standing long jump (SLJ), shuttle run with carrying objects (SRCO), sit and reach (SAR) and push-up hold (PUH), while in variables sit-ups (SU) and hand tapping (HT) no statistically significant difference was observed. On the other side, the regression analysis for female students showed the existence of statistically significant difference only in two variables (standing long jump – SLJ and push-up hold – PUH), where in other variables the difference wasn't found.

DISCUSSION

Statistically significant connection in male students was evident in tests for evaluating explosive leg power, agility, flexibility and static arm and shoulder strength. The negative influence of BMI on tests for measuring explosive leg power, endurance and the ability to solve complex motor tasks, was obtained in the research on students 10 – 11 years of age (Šuk, 2019), which supports our findings. The association of anthropometric characteristics and motor abilities was confirmed by another research conducted on first grade students (Markutović, 2018). According to the author, the upper arm skin fold, as one of the possible indicator of nutritional status, influenced the performance of standing long jump and pull-up hold, while body weight as an anthropometric measure influenced the sit and reach performance (Markutović, 2018). The obtained part of the results also confirms our findings. Statistically significant connection of BMI and agility is confirmed by research conducted on children and adolescents aged 10 to 14, where overweight and obese students achieved notably worse results than their normal weight peers (Nunes, Izar, & de Maio, 2017).

Regarding the statistically significant difference gained in the variable pull-up hold for static arm and shoulder assessment, it could be said that this might be so because heavier students are less likely to be able to hold their entire body in the air, in comparison to lighter weight students.

Furthermore, a very week connection of BMI and hamstrings flexibility was obtained in the research by Arora, D'souza, and Yardi (2016), while research conducted on younger adult subjects hasn't established any connection (Gite, Mukkamala, & Parmar, 2021).

Although most of the subjects among male students belonged to the normal weight category, still there were 12 students who were overweight and obese, which is quite a few. Also, not few of them were in the below average weight category, which is a signal of their malnutrition. Possible reasons for such state could potentially be the reflection of substandard socioeconomic status of students, irregularities in diet or different psychological factors. The stated factors don't enter the domain of our research, but surely should be taken into consideration for the overall students' well-being. Unfortunately, in our sample of subjects, overweight is more pronounced in both male and female students, and the reasons for that may lie among the same factors. Anyway, both occurrences are equally worrying because they represent a potential health risk to students and therefore require reaction of both school and the society as a whole. There are evidence pointing to a significant increase of thinness, overweight and lack of micronutrient intake among adolescents (Rah, Chalasani, Oddo, & Sethi, 2017).

Due to extreme growth and development in that age and accordingly increase in physiological needs, an optimal food and nutrients intake is necessary in orderto satisfy daily energetic needs (Rah, et al., 2017). School age as the most sensitive time when adopting healthy living habits helps to create the foundations for health responsible life in adult age, which should be the goal of any civilized society.

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As for the female students, the regression analysis results shown in table 5., demonstrate statistically significant difference in only two variables – standing long jump (SLJ) and pull-up hold (PUH), which is consistent with the results of male students. In other variables, no significant difference was found. Among the female students the vast majority also belong to those with normal weight, but there is 10 of them in the overweight and obese category, which is certainly worrying.

Unlike in male students, where there was a larger number of thin and very thin, only two female students belonged to those categories, one to each group. The research of Fiori et al (2020) showed that underweight students were worse than their normal weight peers in the tests for upper limb strength assessment, while in tests for explosive arm power, overweight and obese students were better than the rest. Based on the obtained results, authors conclude that overweight and obesity negatively affect aerobic endurance, agility, lower limb power and balance, but positively influence only explosive upper limb power. Underweight on the other hand, negatively affects upper limb power (Fiori, et al. 2020). As the mentioned research used the test for evaluating explosive power of the arms and shoulders, and not static power, the connection to our research cannot be drawn. But still, as indicated in the previously stated research by Markutović (2018), static arm and shoulder strength in the pull-up hold test is negatively associated with higher BMI, which is consistent with our results in this test.

The fact that women tend to be naturally more flexible than men is confirmed by the research conducted on the population of subjects aged 6 to 30 (Valdivia, et al., 2009), as well as by another research on subjects between 20 and 79 years of age (Youdas, et al., 2005). In both of them, the flexibility of hamstrings and lower back was examined, which is precisely what the sit and reach test in our research is used for. It is possible that because of the stated our results of female students in the same test didn't show statistical significance, regardless of the level of nutrition.

Isokinetic indicators of the trunk power in the research of Al-Shenqiti, Emara, Algarni and Khaled (2021), point out that overweight and obesity of adolescents are related to reduced trunk power. BMI of older adolescents negatively correlates with power and endurance of the trunk regardless of sex (Pasupatham, Muthulakshmi, Subbiah, & Revathi, 2021).

On the other hand, research conducted on subjects aged 18 to 25 also shows negative correlation between BMI and trunk power, but only in female subjects (Motka and Shah, 2012). The power of more abdominal muscles was tested by various tests, but negative correlation wasn't obtained in any of the variables in male subjects. Our research hasn't shown significant connection in the sit-ups test for repetitive trunk power assessment in students of both sexes, which partially coincides with the aforementioned research, but we can't say with certainty why is that so.

Possible reasons may lie in not well enough described sample of subjects, which would certainly be an insufficiency of our research and a guideline for the future ones.

Limitations of this research lie in the fact that in the sample of subjects, students that participate in sports in their free time, or any other regular physical activities, weren't singled out, what could have influenced the results. Those students surely have higher level of motor abilities in comparison to their peers that lead a more sedentary lifestyle, which could have impacted the results.

Research of Puciato and et al (2011) and of Ignasiak, Slawińska and Domaradzki (2002) say that certain motor abilities can be influenced by the objective quality of life of children and their families, as well as the socioeconomic status, all of which wasn't covered by our research. Eating habits of the subjects are another important variable also omitted by our research. The information about all the mentioned variables could be gathered by a questionnaire before conducting the testing in future research on similar topics, which would describe the sample of subjects in a more detailed way, and thereby enable making more accurate conclusions. Because motor abilities are an important health indicator, and there are many factors associated with them, it is necessary to conduct future research that would explain more clearly what else can influence or interfere with their progression required for proper growth and development of children and adolescents.

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CONCLUSION

A growing trend of obesity and overweight of children and adolescents is present all over the world (Cali, & Caprio, 2008), which is certainly worrying. Obesity increases the risk of occurrence of many physical and psychological illness (De Leonibus, Marcovecchio, & Chiarelli, 2012; Kansra, et al. 2021; Gurnani, Birken, & Hamilton, 2015; Sahoo, et al., 2015; Rankin, et al., 2016; Topcu, et al., 2016; Witchel, Burghard, Tao, & Oberfield, 2019), and those children are in danger of premature death (Cali, & Caprio, 2008). On the other side, malnutrition and nutritional deficit in the period of intensive growth and development is also very important for overall health status of adolescents. Both conditions surely affect certain disorders which could momentarily have unwanted consequences in terms of health, as well as later in adult life. Motor abilities are, as previously mentioned, an important indicator of participation in physical activities (Mračević, 2020). It is particularly important to develop them in childhood and adolescents in order to acquire habits and set the foundations for leading a healthy, active and quality life in adult age. Calculating the BMI of children in schools along with measuring their motor abilities are one of the ways that can help identify potential health problems of students. It is precisely because of the stated that Physical education classes in elementary and high schools play an irreplaceable role in systematic monitoring the student's health status, and increasing its weekly teaching hours is of outmost importance for healthy development of children and adolescents.

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SAŽETAK

Cilj ovog istraživanja bio je utvrditi povezanost indeksa tjelesne mase učenika osmih razreda sa rezultatima u testovima motoričkih sposobnosti. Svrha istraživanja je dobivanje uvida u kojim je testovima ta povezanost više, odnosno manje izražena, ili povezanosti nema. Uzorak ispitanika činilo je 66 učenika i 64 učenice iz četiri osnovne škole sa područja grada Varaždina koji su polazili 8. razred školske godine 2018./2019. Za potrebe istraživanja korišteni su rezultati finalnih provjeravanja motoričkih sposobnosti u 8. razredima šk.god. 2018./2019. Uzorak varijabli činilo je njih deset: 6 motoričkih, 2 antropometrijske, dob učenika i indeks tjelesne mase. Za svih 10 varijabli izračunati su osnovni parametri deskriptivne statistike (aritmetička sredina, standardna devijacija, minimalna i maksimalna vrijednost), posebno za učenike te učenice. Daljnja obrada podataka učinjena je pomoću regresijske analize - 6x linearna regresija za svaku varijablu (motoričku sposobnost) posebno. Rezultati regresijske analize kod učenika pokazali su statistički značajnu povezanost indeksa tjelesne mase i četiri varijable (skok u dalj s mjesta, prenošenje pretrčavanjem, pretklon raznožno i izdržaj u visu zgibom), dok se kod učenica statistička značajnost očitovala u samo dvije (skok u dalj s mjesta i izdržaj u visu zgibom). Pretilost i prekomjerna tjelesna težina djece i adolescenata rastuća su pojava u cijelom svijetu. Motoričke sposobnosti jedan su od važnih pokazatelja bavljenja tjelesnim aktivnostima te jedan od mogućih pokazatelja razine tjelesne kondicije. Prekomjerna tjelesna težina negativno utječe na stanje i razvoj motoričkih sposobnosti te je utjecaj tjelesne i zdravstvene kulture od iznimnog značaja u prevenciji i promociji zdravih životnih navika učenika.

Ključne riječi: *vježbanje, tjelesna težina, aktivnost*

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EFEKTI KRATKOTRAJNOG KOMBINOVANOG KONDICIONOG TRENINGA NA FIZIOLOŠKE KARAKTERISTIKE VRHUNSKIH ODBOJKAŠICA

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ABSTRACT

This study aimed to investigate the benefits of short-term preseason skill-based conditioning on the physiological characteristics of female volleyball players from the first-division volleyball league over four weeks of training. Twelve female volleyball players (18.33±3.47 years; 177.25±5.28 cm; 65.38±5.93 kg) completed four weeks of game-related drills combined with physical conditioning. Physiological characteristics were measured using a 20-m shuttle run test: average heart rate (HR_{avg}), maximum heart rate (HR_{max}), the maximum number of breaths (BR_{max}), maximum oxygen consumption (VO_{2max}), maximum excess post-exercise oxygen consumption ($EPOC_{max}$) and maximum of metabolic equivalent (MET_{max}). Data collection and extraction were administrated using heart rate monitors and Firstbeat Sports software. After an initial evaluation (T_0), the players were tested after the fourth week of the training cycle (T_1). Heart rate average (HR_{avg}) decreased (-1.9%; $p=0.046$), maximum metabolic equivalent (MET_{max}) (14.2%; $p<0.001$) and maximum oxygen consumption (VO_{2max}) (14.1%; $p<0.001$) increased respectively. The results suggest that the volleyball players continued improving their physiological characteristics during the study. Finally, as a major application, these data provide normative standards of physiological characteristics in the preseason for female volleyball players.

Keywords: *skill-based conditioning, effects, physiological characteristics, female, volleyball*

INTRODUCTION

A preseason's main goal is to increase players' performances in competitions. The most significant fitness improvement occurs in the preseason and is typically maintained or slightly decreased during the in-season period (Hartmann et al., 2015). Physiological characteristics (PC) assessment is a valuable tool that can help coaches and sports scientists assess and monitor the effects of training programs (Drinkwater et al., 2008). However, estimates of the training effects on PC are diverse, partly because different assessment techniques of varying accuracy and precision are used to quantify exercise-related changes in PC (Malina, 2007). PC such as average and maximum heart rate frequency (HR_{avg}; HR_{max}), the maximum number of breaths per minute (BR_{max}), and the maximum oxygen consumption during exercise (VO_{2max}) are essential parameters for the evaluation of the fitness of volleyball players in both aerobic and anaerobic capacity. A metabolic equivalent (MET) and Excess Post-exercise Oxygen Consumption (EPOC) are also important indicators of training programs' effects on players' PC. MET is defined as the quantity of oxygen consumed by the body from inhaled air under resting conditions, and 1 MET is approximately 3.5 $mL \cdot kg^{-1} \cdot min^{-1}$ or 1 $kcal \cdot kg^{-1} \cdot h^{-1}$ (Ainsworth et al., 2011). According to Kenney et al., (2015), all physical activity can be categorized by intensity according to their requirements for oxygen. Therefore, through MET-s calculations, it is possible to categorize the intensity of different physical exercises. During a volleyball match, players could produce up to 8 METs, described as heavy physical activity, on a physical activity scale spectrum (Jetté et al., 1990).

Moreover, physical activities increase total energy expenditure both acutely and chronically. The first condition refers to the energy expenditure during the exercise performance and the recovery, while the second refers to the alteration of the resting metabolic rate (Hill et al., 1995). Concerning the acute effect, it is well established that the post-exercise O_2 consumption does not immediately return to the resting indices. Excess Post-exercise Oxygen Consumption refers to the need for oxygen during the recovery phase following exercise (EPOC) (Gaesser & Brooks, 1984). Volleyball is an intermittent game where a low-intensity aerobic activity follows a period of intense physical effort, so it can be assumed that aerobic capacity is of great importance (Lidor & Ziv, 2010). To improve their volleyball performance, players must incorporate volleyball-specific resistance, plyometrics, sprint, and agility training (Scates et al., 2003). During elite volleyball competition, besides technical and tactical skills, agility, muscular strength, and power, both anaerobic and aerobic fitness are important factors (Marques et al., 2008; Sheppard & Young, 2006). It is hypothesized that the energy requirements for volleyball are provided by phosphagen breakdown and partially by anaerobic glycolysis; however, it is still not apparent which physiological requirements are essential (Lidor & Ziv, 2010).

Furthermore, it is not uncommon that coaches must deal with shortened preseason periods, so it is questionable whether the athletes can be trained at high intensities and yet properly rest and recover between training sessions (Trajkovic et al., 2012). High volumes of instructional training (IT) without increasing the intensity have been proven to have a minimal effect on physical fitness (Gabbett, 2008) and could limit other beneficial training stimuli. Moreover, as volleyball players rely on various skills, technical training can hardly replicate the actual sport-specific demands. However, it should be noted that IT training must also be employed in order to refine technical efficiency (Gabbett, 2008; Trajković et al., 2017). Therefore, applying adequate strategies to plan the training process and implement skill-based conditioning without decay in technique was necessary. The skill-based training approach proved beneficial for increasing vertical jump, sprint, agility, and physiological indicators of physical fitness in female volleyball players (Gabbett, 2008). This approach could be very time-efficient and related to the sport-specific demands (Gabbett, 2008; Gjinovci et al., 2017).

Moreover, skill-based conditioning training could be performed in a HIIT manner, both short and long. HIIT involves brief repeated bouts of high-intensity drills with intermittent rest periods, and it is designed to elicit exercise intensity to approximately VO_{2max} values (Herda & Cramer,

Stojanović, N., Stojanović, D., Zadražnik, M., Bešić, Đ., & Stojanović, T. (2022).The effects of short-term preseason skill-based conditioning on physiological characteristics in elite female volleyball players. *Sportlogia, 18* (1), 35-44. https://doi.org/10.5550/sgia.221801.en.sszds

2016). The benefits of HIIT training are the product of simultaneous motor unit recruitment and maximal cardiac output and provide a stimulus for oxidative adaptation of muscles, which can significantly affect the increase in fitness (Altenburg et al., 2007). However, to induce a sufficient stimulus to increase fitness, it is necessary to apply loads that will initiate the process of positive adaptation to the training stimulus. It is crucial to emphasize the importance of an individual approach when planning the training process due to certain factors that could affect the athlete's adaptation, such as preparedness, biological maturity, chronological age, rate of recovery, and work capacity (Nikolaidis et al., 2012). For example, two different athletes could have the same level of performance but not the same work capacity.

In order to achieve the optimal training stimulus, it is necessary to find a balance between training intensity and training load and rest periods between training sessions to prevent overreaching and to overtrain (Lidor & Ziv, 2010).

It is important to note that some skills in volleyball sessions are more fatiguing than others (Marques Junior, 2014, 2017). Marques Junior (2014) determined the intensity of each volleyball skill according to heart rate frequencies. Jump serve, spike, jump set, block, and sprint on defense are moderate to high, set and defense are moderate, and overhead serve and reception are low, which is a fundamental guideline for planning the training process; training loads should follow the skill-prescribed intensity. The importance of this approach can be valorized in conditions when the coach does not have sophisticated diagnostics to monitor athletes.

Moreover, Herman et al. (2006) recommended Fosters scale for session rating of perceived exertion. Using this method, a coach can evaluate the training intensity for each athlete and employ sound strategies to increase the preparedness of the athletes. This approach could maximize training effects and speed up recovery.

To our knowledge, no previous study examined the effect of preseason skill-based conditioning training programs applied in female competitive volleyball players on PC. In addition, it is unclear whether training sessions offer an adequate training stimulus to improve the PC of female volleyball players in the preseason. Considering that season is very long, and there is limited time for preparation, skill-based conditioning training could provide a sport-specific mode of volleyball training and advantages in terms of time efficiency, motivation, and training compliance (Gamble, 2006, 2007).

Therefore, this study aimed to determine the changes in physiological characteristics following a four-week preseason skill-based conditioning program in female competitive volleyball players.

METHODS

Participants

Twelve elite female volleyball players (mean±SD; age: 18.33±3.47 years; height: 177.25±5.28 cm; body mass: 65.38±5.93 kg) from University Volleyball Club "Bihać-Preminger, "one of the top 10 teams in Bosnia and Herzegovina Premier League (I division) participated in this study. All the players had at least three years of professional and elite training experience. Furthermore, no athletes had a history of serious injury, nor were they taking medication during the study. All experimental procedures, possible risks, and benefits were explained to each player. Recommendations designed for clinical research from the Declaration of Helsinki (2013) of the World Medical Association were applied. This study was also approved and reviewed by the Ethics Committee of the Faculty of Physical Education and Sport, University of Banja Luka.

Procedures

The participants were tested at the start of preseason (T_0 – pretest in the last week of August) and immediately after four weeks of the training program before the regular competitive season (T_1 – post-test in the first week of October).

Stojanović, N., Stojanović, D., Zadražnik, M., Bešić, Đ., & Stojanović, T. (2022).The effects of short-term preseason skill-based conditioning on physiological characteristics in elite female volleyball players. *Sportlogia, 18* (1), 35-44. https://doi.org/10.5550/sgia.221801.en.sszds

Before conducting the testing procedure, each volleyball player's anthropometric measurement (body height and body weight) took place. Afterward, the players were subjected to a standardized warm-up protocol for 10 minutes of low-intensity running ABCs and dynamic stretching. After a three-minute recovery, the respondents started testing according to a predetermined schedule. The T_0 and T_1 were performed in an indoor stadium at 22 - 24 ° C. Both measurements were performed from 11 to 12 AM to avoid diurnal changes, which could affect the measurement result. Forty-eight hours before the test, the players were not subjected to intensive training and were advised to avoid any additional physical activity and great emotional strain. Moreover, the players were advised not to change their dietary habits before each test and not to consume alcohol, cigarettes, or any stimulants. Both tests were performed on Monday, after a weekend rest.

The 20-m progressive shuttle run test was applied to assess maximal aerobic power in female volleyball players. The test was chosen because of its simplicity and excellent reproducibility according to the protocol proposed by Leger et al. (1988). The test-retest reliability coefficient was 0.90 for female volleyball players (Gabbett, 2008).

For measurement purposes, the players were assigned heart rate monitor Suunto Movesense (Suunto Oy, Finland). The device is placed around the chest, at the heart level. The electrodes were coated with gel before the start of the test for more efficient signal reading. Each device is wirelessly connected using dedicated software Firstbeat Sports (Firstbeat Technologies Oy., Finland). Firstbeat Sports software was able to extract the average heart rate (HR_{avg}), maximum heart rate (HR_{max}), the maximum number of breaths (BR_{max}), maximum oxygen consumption (VO_{2max}), and maximum excess post-exercise oxygen consumption ($EPOC_{max}$). A maximum metabolic equivalent (MET_{max}) was calculated by dividing the value of VO_{2max} with 3.5 $mL \cdot kg^{-1} \cdot min^{-1}$ (Ainsworth et al., 2011).

Preseason Conditioning Program

Generally, throughout the four weeks of preparation, players had 11 sessions per week (5 sessions in the fourth week) and played three friendly and two tournament matches (see Table 1). During weeks 1–4, the emphasis was on instructional training (IT) and skill-based conditioning. Apart from IT training, the goal of the preseason conditioning was to increase the intensity of sport-specific training, with the emphasis on high-intensity skill-based conditioning games (SCG) (small-sided and full-court games), and high-intensity skill-based conditioning drills (SCD) (spiking, blocking, jump serving, jump setting, sprinting on defense). SCD was performed at the beginning of the week, emphasizing power production with short bouts of high-intensity volleyball drills. Conversely, SCG was performed at the end of the week, emphasizing prolonged high-intensity intervals. The training frequency was lower in the first (adaptation) and the last week (preseason matches).

SCG was performed as long HIIT (>3 minutes) and SCD as short HIIT intervals (<20 sec), respectively. The work-rest ratio was 1: 2 to 1:3 for SCD and 1: 1 for SCG. In SCD, four sets of 2-4 intervals were performed with passive rest periods between 1st and 2nd, thi^{rd,} and fourth set (3 minutes) and active rest between 2nd and third (15 minutes of setting, reception, overhead serve). The number of intervals in SCG ranged from 3-5.

Due to the high training frequency, it was necessary to apply adequate strategies when determining the training load. For monitoring of training load, we used the session rating of perceived exertion scale (season RPE) (Herman et al., 2006), and for monitoring of daily variations in athlete preparedness, we used the acute: chronic workload ratio (ACWR index) method (Murray et al., 2017; Williams et al., 2017). According to the recommendation, the ACWR index should be 1.0-1.49. The morning sessions included 11.1-33.3% of specific warm-ups, 44.4-78.8% of low-intensity IT training, and 11.1-33.3% of low-intensity recovery-based drills and dynamic stretching. The afternoon included 14.3-33.3% of warm-up, 46.2-64.3% of SCG or SCD, and 11.1-33.3% of low-intensity recovery-based drills and dynamic stretching.

Stojanović, N., Stojanović, D., Zadražnik, M., Bešić, Đ., & Stojanović, T. (2022).The effects of short-term preseason skill-based conditioning on physiological characteristics in elite female volleyball players. *Sportlogia, 18* (1), 35-44. https://doi.org/10.5550/sgia.221801.en.sszds

Table 1. *Four-week preseason skill-based conditioning program*

	1 week		2 week		3 week		4 week	
	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
Mon	IT	SCD	IT	SCD	IT	SCD	Match	SCD
Tue	IT	IT	IT	SCD	IT	SCD	IT	Match
Wed	IT	IT	IT	IT	IT	IT	RB	/
Thu	IT	SCG	IT	SCG	IT	SCG	IT	Match
Fri	IT	SCG	IT	SCG	IT	SCG	RB	/
Sat	IT	/	IT	/	IT	/	Tournament	
Sun	/	/	/	/	/	/	Tournament	

Note. IT: Low-intensity instructional training; SCD: Skill-based conditioning drills; SCG: Skill-based conditioning games; RB: Recovery-based training.

Statistical analysis

The descriptive results are expressed as Means, Standard Deviation (Std.Dev.), Minimal (Min.), Maximal (Max.), and Kolmogorov-Smirnov (K-S) values. Differences from T_0 to T_1 for all physiological characteristics were evaluated with a repeated-measures ANOVA. Effect sizes within subjects were calculated using partial eta squared (η^2_p) according to Keppel (1991). Since this metric is likely to inflate effect sizes, results were interpreted following the likelihood of overestimation as no effect if $0 \leq \eta^2_p < 0.05$; a small effect if $0.05 \leq \eta^2_p < 0.26$; a moderate effect if $0.26 \leq \eta^2_p < 0.64$; and a large effect if $\eta^2_p \geq 0.64$ (Ferguson, 2016). The percentage change (%Δ) from T_0 to T_1 in outcome variables was calculated with the following formula: $[(T_1–T_0)/T_0] \times 100$. STATISTICA 8.0 for Windows (StatSoft, Inc., Tulsa, OK, USA) was used for analysis, and significance was set at $p<0.05$.

RESULTS

Tables 2 and 3 show the descriptive parameters of physiological characteristics on the pre-and post-test. All physiological characteristics measures are normally disturbed, which can be observed based on the Kolmogorov-Smirnov test results.

Table 2. *Descriptive parameters of physiological characteristics – Pretest.*

Variable	N	Mean	SD	Min.	Max.	(K-S) d
$HR_{avg\ (b/min)}$	12	178.42	4.89	169.00	184.00	0.133
$HR_{max\ (b/min)}$	12	197.92	5.20	189.00	206.00	0.156
$BR_{max\ (b/min)}$	12	33.75	3.55	28.00	40.00	0.154
MET_{max}	12	8.67	1.00	7.50	10.10	0.215
$VO_{2max\ (ml/kg/min)}$	12	30.36	3.53	26.10	35.40	0.211
$EPOC_{max\ (ml/kg/min)}$	12	47.08	10.40	28.00	66.00	0.163

Note. N: number of subjects; Mean: the mean; SD: standard deviation; Min.: minimum results; Max.: maximum results; (K-S) d: Kolmogorov-Smirnov distribution normality test results.

Stojanović, N., Stojanović, D., Zadražnik, M., Bešić, Đ., & Stojanović, T. (2022).The effects of short-term preseason skill-based conditioning on physiological characteristics in elite female volleyball players. *Sportlogia, 18* (1), 35-44. https://doi.org/10.5550/sgia.221801.en.sszds

Table 3. *Descriptive parameters of physiological characteristics – Posttest.*

Variable	N	Mean	SD	Min.	Max.	(K-S) d
$HR_{avg\ (b/min)}$	12	175.00	5.59	167.00	186.00	0.167
$HR_{max\ (b/min)}$	12	196.33	7.11	186.00	204.00	0.197
$BR_{max\ (b/min)}$	12	32.75	3.41	28.00	39.00	0.137
MET_{max}	12	9.90	1.11	8.50	11.80	0.153
$VO_{2max\ (ml/kg/min)}$	12	34.65	3.88	29.60	41.30	0.153
$EPOC_{max\ (ml/kg/min)}$	12	43.92	10.49	33.00	72.00	0.201

Note. N: number of subjects; Mean: the mean; SD: standard deviation; Min.: minimum results; Max.: maximum results; (K-S) d: Kolmogorov-Smirnov distribution normality test results.

The results of repeated measures ANOVA analysis are shown in Table 4.

Based on the difference in pre-and post-test results, it can be noticed that in volleyball players, there was a significant decrease in the HR_{avg} ($p=0.046$) and in the MET_{max} ($p<0.001$) and VO_{2max} ($p<0.001$) a significant increase. Effect size (ES) values for physiological characteristics measures are in the range of moderate effects in HR_{avg}, to large effects in MET_{max} and VO_{2max}, HR_{max}, $BR_{max,}$ and $EPOC_{max}$ remained statistically unchanged during the preseason period but decreased by -0.8%, -3.0%, and -6.7% in the percentage could be important to some degree, however with a small effect.

Table 4. *Difference between Pre- and Post-test of physiological characteristics.*

Variable	T_1-T_0	%Δ	F	p	ES
$HR_{avg\ (b/min)}$	-3.42	-1.9	5.05	0.046*	0.31^{ME}
$HR_{max\ (b/min)}$	-1.59	-0.8	1.89	0.196	0.15^{SE}
$BR_{max\ (b/min)}$	-1.00	-3.0	2.00	0.185	0.15^{SE}
MET_{max}	1.23	14.2	58.60	0.000†	0.84^{LE}
$VO_{2max\ (ml/kg/min)}$	4.29	14.1	56.19	0.000†	0.84^{LE}
$EPOC_{max\ (ml/kg/min)}$	-3.17	-6.7	3.26	0.098	0.23^{SE}

Note. T_1-T_0: the difference between post and pretest; %Δ: percentage of the difference between post and pretest; *: statistically significant differences at $p<0.05$; †: statistically significant differences at $p<0.01$; ES: effect size; ^{SE}: small effect; ^{ME}: medium effect; ^{LE}: large effect.

DISCUSSION

This study discovered that the influence of skill-based conditioning training loads applied in 4 weeks of preseason affected physiological characteristics. Decrease in HR_{avg} (-1.9%; $ES=0.31^{ME}$) and increase in MET_{max} (14.2%; $ES=0.84^{LE}$) and VO_{2max} (14.1 %; $ES=0.84^{LE}$) in our players were statistically significant. Other results suggest a slight decrease in value for HR_{max} (-0.8%; $ES=0.15^{SE}$), BR_{max} (-3.0%; $ES=0.15^{SE}$) and $EPOC_{max}$ (-6.7%; $ES=0.23^{SE}$).

The aerobic system is the main energy provision during volleyball match-play, and the average values of VO_{2max} for top-level volleyball players tend to be high (Lidor & Ziv, 2010). While differences may influence VO2max values in standards of play, training regimes, and the phase of the season, a team with superior aerobic fitness would have the advantage of being able to play the game at a higher pace and greater agility throughout the game (Nikolaidis et al., 2012).

A higher level of endurance capacity (higher VO_{2max}, lower HR_{max}) could provide elite players with a better base for on-field performance regarding intensity and demands of volleyball match-play. The decrease in the HR_{avg} is statistically significant, while the slight decrease in HR_{max} (-0.8%) is only at the numerical level, but it is evident that it shows a declining trend. A slight decrease in maximum heart rate could be explained by the fact that it tends to remain stable or slightly reduced after the applied conditioning program, even in highly trained individuals (Kenney et al., 2015). However, there is evidence that highly trained athletes in endurance sports have lower values of maximum heart rate. Individuals with lower maximal heart rates experience longer-lasting cardiac diastole, allowing more efficient ventricular filling and increasing stroke volume (Kenney et al., 2015). Therefore, although HR_{max} is an important parameter, it is not crucial for high performance among volleyball players.

Conversely, HR_{avg} could be a better indicator for monitoring performance because it closely replicates the actual sport-specific demands. Gabbett (2008) reported that skill-based conditioning games are similar to a competitive volleyball match and provided justification for implementing such specific conditioning. However, the values of HR_{avg} obtained in our study are higher than the above, 175±5.59 and 160±2, respectively. The explanation is somewhat logical because our values were extracted from a 20 meters shuttle run test, not from an actual sport-specific condition. The significant increase observed in VO_{2max} after the skill-based conditioning program follows those previously reported in trained female volleyball (Gabbett, 2008; Nikolaidis et al., 2012) and indicates a positive effect of the applied training program. However, the values of VO_{2max} in competitive female volleyball players are 40-56mmol/l (Kenney et al., 2015), which are substantially higher than the values obtained in our study. However, we should emphasize that the volleyball season lasts until the end of March, and the next one starts at the beginning of October. In addition, our players signed the contracts a week before the preseason preparation, so it was impossible to track and maintain their fitness level throughout the off-season, which could ultimately explain the significantly higher increases in VO_{2max} values (14.1%) than expected. The long period between two seasons can be very unfavorable because it is most likely that detraining will occur. There is evidence that trained athletes experience greater VO_{2max} reductions and need a more extended period to regain their previous fitness level, even up to 40 days. The higher the initial fitness level, the smaller the real improvements for the same training volume (Kenney et al., 2015). Moreover, in their review, Lidor and Ziv (2010) reported that VO_{2max} is substantially lower during the preseason compared to the competition period in female volleyball players.

Therefore, skill-based conditioning could be a sound training strategy during the last four weeks of the preseason because it replicates actual sport-specific demands (Gabbett, 2008).

The effects of a four-week preseason intensive skill-based conditioning training program in volleyball can also be observed through a significant increase in the maximum metabolic equivalent (MET_{max}), which is in the high-value zone (Jetté et al., 1990). The decrease in excess post-exercise oxygen consumption (EPOC) by -6.7% is not statistically significant, but these values could be significant in training practice and demonstrate the applied program's effectiveness. Because there are no data available on the long-term effects of exercise on EPOC value, but only those related to the effects of a single training session, it was impossible to compare our results, which could be evidence of the positive effects of the applied program since reducing the EPOC also allows a shorter recovery period for athletes after intense exercise (Børsheim & Bahr, 2003). However, Børsheim and Bahr (2003) suggested that high-intensity drills produce a more extended increase in the EPOC than low-intensity drills (when they have equivalent volume) since high-intensity regime cause greater metabolic stress, therefore producing more considerable energy cost in order to return to homeostasis. Based on the obtained VO_{2max} values, it was expected that the EPOC values should be higher. A possible explanation is that EPOC manifests changes in the fitness level, so if the EPOC is lower during the same physical activity and similar workload, fitness is probably improved because the oscillation in homeostasis is lower (Børsheim & Bahr, 2003).

Stojanović, N., Stojanović, D., Zadražnik, M., Bešić, Đ., & Stojanović, T. (2022).The effects of short-term preseason skill-based conditioning on physiological characteristics in elite female volleyball players. *Sportlogia, 18* (1), 35-44. https://doi.org/10.5550/sgia.221801.en.sszds

Therefore, we assume that the volleyball players accumulated lower EPOC values, most likely due to the multistage nature of the test. We can support this claim by comparing HR_{avg}; therefore, we can notice that the values are significantly lower in the T_1 measurement, which may explain why the overall exercise intensity decreased, which could cause lower EPOC values in the T_1 measurement.

Furthermore, VO_{2max} athletes attain during their sport-specific activity could be higher than the values obtained on another less specific test (Stromme et al., 1977). Therefore, we could suggest that the testing procedure should be more sport-specific to elicit the maximal aerobic power output and EPOC. However, this is only our assumption, and more evidence is needed to support this statement.

High-intensity skill-based conditioning, applied to volleyball players, caused significant improvements in physiological characteristics. An explanation could be found in high-intensity training, where specific anaerobic training can elicit a large percentage of VO_{2max} due to activating many motor units and near-maximal cardiac output. Moreover, high-intensity training can increase the anaerobic threshold and time to exhaustion, stimulating aerobic power and speeding up recovery (Herda & Cramer, 2016). We believe that the last weeks of the preparation period should be sport-specific to transfer the trained abilities to the competition period effectively. Furthermore, we think high-intensity skill-based conditioning can be separated into game-related and skill-specific. The previous statement could be supported by the fact that the efficiency of performing each volleyball skill is related to developing only a few skills at a time. Thus, according to Issurin (2008), combining many skills is not desirable because the positive transfer is smaller. Therefore, individual training sessions should specialize in developing one, possibly two skills, for example, spiking and blocking. Moreover, it should be emphasized that instructional (IT) training had a specific role in developing tested abilities in our study. However, Gabbett (2008) points out that female volleyball players mostly spend training time at low intensities during IT training. Therefore, the increase in VO_{2max} is relatively insignificant. Furthermore, it was impossible to neglect IT training due to the high technical demands of the I-division volleyball league. Although positive, the present study's results are limited only to short-term effects on the examined parameters.

Although positive changes are evident, this does not necessarily indicate that the effects could be projected in the long term. Interestingly, the planning of such a program is quite simple, yet it could be intensified and specific enough to replicate the actual conditions of the volleyball game (Gabbett, 2008). However, the question arises as to whether the effects of such training could apply to less technically efficient volleyball players. It should be noted that volleyball technique is essential because the negative outcome of a volleyball match, at the top level, can be a consequence of only one technical inefficiency.

Due to the higher intensity, it is assumed that the skill-based conditioning approach could disrupt already established skill patterns, especially in less technically efficient volleyball players (Gabbett, 2008).

Conversely, Trajković et al. (2017) found that youth female volleyball players increased their technical proficiency after the 12 weeks of the small-sided games program.

Finally, we recommend that the preseason period be longer, and it is necessary to employ other conditioning modalities, such as strength training and plyometrics.

CONCLUSION

In conclusion, the results of the present study showed that intensive short-therm skill-based conditioning for female volleyball athletes positively affected physiological characteristics during preseason over four weeks. The positive effects of the applied training program on physiological characteristics vastly improved overall athletic performance. However, it remains unclear whether a more extended preparation period would significantly affect the observed variables and sport-specific performance or whether the results of such a program could be generalized to another population (e.g., male players, youth).

Stojanović, N., Stojanović, D., Zadražnik, M., Bešić, Đ., & Stojanović, T. (2022).The effects of short-term preseason skill-based conditioning on physiological characteristics in elite female volleyball players. *Sportlogia, 18* (1), 35-44. https://doi.org/10.5550/sgia.221801.en.sszds

Disclosure statement

The investigators in the present study have no conflicts of interest.

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SAŽETAK

Ova studija je imala za cilj da proceni efekte kratkotrajnog kombinovanog kondicioniranja na fiziološke karakteristike odbojkašica Premijer lige u toku 4 nedelje treninga. Dvanaest odbojkašica (18,33 ± 3,47 godina; 177,25±5,28 cm; 65,38±5,93 kg) završilo je četvoronedeljni trening tehničko-taktičkih vežbi u kombinaciji sa fizičkom kondicijom. Fiziološke karakteristike su merene korišćenjem 20-m shuttle run testa: prosečna brzina otkucaja srca (HR_{avg}), maksimalni broj otkucaja srca (HR_{max}), maksimalni broj udisaja (BR_{max}), maksimalna potrošnja kiseonika ($VO2_{max}$), maksimalni kiseonički dug posle vežbanja ($EPOC_{max}$) i maksimalni metabolički ekvivalent (MET_{max}). Prikupljanje podataka i ekstrakcija vršeni su pomoću monitora otkucaja srca i softvera Firstbeat Sport. Nakon inicijalne evaluacije (T_0), odbojkašice su testirane nakon četvrte nedelje treninga (T_1). Prosečni broj otkucaja srca (HR_{avg}) je smanjen (-1,9%; p=0,046), maksimalni metabolički ekvivalent (MET_{max}) (14,2%; p<0,001) i maksimalna potrošnja kiseonika ($VO2_{max}$) (14,1%; p<0,001) značajno su povećani. Rezultati sugerišu da su odbojkašice nastavile da poboljšavaju fiziološke karakteristike tokom studije. Konačno, primena ovih podataka daje normativne standarde fizioloških karakteristika odbojkašica u pripremnom periodu.

Ključne reči: *kombinovani kondicioni trening, efekti, fiziološke karakteristike, žene, odbojka*

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UTICAJ FIZIČKE AKTIVNOSTI NA PREVENCIJU I BROJ PADOVA KOD STARIJIH OSOBA

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ABSTRACT

Regular physical activity can bring significant health benefits to people of all ages, and the need for physical activity does not decrease with age, but it has been proven that it can prolong a healthier and more independent life, prevent disability and significantly contribute to improving the lives of the elderly. In addition to the fact that each type of physical activity to a certain extent improves motor skills (strength, coordination, balance, agility, ...), mental health (self-esteem, quality of life) and reduces the risk of cardiovascular and all other causes of death, regular participation in exercise promotes mobility and functional independence in adults. A fall is an event in which a participant without their own intention comes to a lying position on the ground or at a lower level. Regardless of the health status of the individual, falls are associated with insufficient movement, reduced opportunities to perform daily activities (dressing, bathing, housework, ...) and the risk of being admitted to institutions where the care of dependent persons is taken. Arthritis, depression, cognitive impairment, vision, problems with balance and unbalanced gait, decreased muscle mass, as well as excessive use of medication increase the risk of falling. The total volume and type of physical activity needed by the elderly is not very well defined. However, it can be concluded that the combination of physical activity (strength training, endurance training, exercises for the development of balance and mobility, ...) and adequate nutrition (sufficient intake of essential amino acids/protein sources) is of crucial importance for preserving physical condition, motor skills and the health status of persons of the third age, and thus also in the prevention of falls. The aim of this study is to describe and find the best training programs for the prevention of falls in the elderly.

Keywords: *exercise program, third age, falls*

1. INTRODUCTION

Life expectancy has increased significantly in the last few decades, and according to the latest Eurostat data, the population over 65 years currently accounts for 19.7% of the total world population, and by 2050 it is expected to reach up to 30% (Tornero-Quiñones, Sáez- Padilla, Díaz, Robles & Robles, 2020). In the process of aging, there is a deterioration of the health condition and physical fitness, which is reflected in the deterioration of the organism's functioning in the form of a decrease in physical, psychological and social functioning (Machado, Bazán, & Izaguirre, 2014; Velasco et al., 2015). Considering that aging is not only influenced by biological, but also psychological, social and environmental factors, whether this process will be effective also depends on each person to adapt to the changes that are taking place (Franco, 2018). Regular physical activity (PA) can bring significant health benefits to people of all ages, and the need for PA does not decrease with age, but it has been proven that PA can prolong a healthier and more independent life, prevent disability and significantly contribute to improving the lives of the elderly (Division of Aging and Seniors, 2011). According to the guidelines for PA, the elderly population should apply a minimum of 150 accumulated minutes per week of moderate to high intensity defined PA, in addition to weight-bearing exercises to develop strength, and flexibility exercises should be performed two or more times to improve them (Australian Government, The Department of Health, 2008; Office of Disease Prevention and Health Promotion, 2008; Department of Health, Physical Activity, Health Improvement and Protection, 2011; Canadian Society for Exercise Physiology, 2012). According to Byrne, Hills, Hunter, Weinsier & Schutz (2005), MET represents a physiological concept that is considered to be a simple procedure for expressing energy consumption during some PA, and as an increase in resting metabolic rate (RMR). However, the definition of MET varies from author to author. In this regard, Morris et al. (1993) explained that MET represents the amount of oxygen that the body consumes from inhaled air, adding that in basal conditions it is an average of 3.5 ml of oxygen/kg per minute. This definition is based on Jette, Sidney & Blumchen (1990) who defined MET as the metabolic rate at rest, i.e. the amount of oxygen consumed at rest, sitting quietly on a chair. Moderate to high FA intensity is most often reflected in any type of activity where the metabolic equivalent (MET) is ≥3.

Studies that dealt with this topic, i.e. assessing the level of PA in adults, concluded that a very small percentage (<5%) of the elderly population meets this criterion (The Health and Social Care Information Centre, 2009; Sun, Norman & While , 2013; Van Holle et al., 2014), so in the United Kingdom that percentage is only 2.4% (Davis et al., 2011), while in Canada no one met this criterion (Colley et. al, 2011). On the other hand, the highest percentage of the active population (87.04%) was reported by Hurtig-Wennlof, Hagstromer & Olsson (2010). In addition to the low level of participation in PA, the fact is that a sedentary lifestyle prevails among the elderly population, as they spend more than 85% of their daily time in this way (Fitzgerald et al., 2015; Jefferis et al., 2015). In addition to PA improving motor skills (strength, coordination, balance, agility, ...), mental health (self-esteem, quality of life) and reduces the risk of cardiovascular and all other causes of death, regular participation in PA improves mobility and functional independence in adults (McPhee et al., 2016; Zelenovic et al., 2021).Other studies have proven that PA can reduce the risk of various types of tumors, such as lung and prostate cancer, and generally have a positive effect on healthier aging by having certain benefits for the metabolism of old people (Cunningham, O'Sullivan, Caserotti & Tully, 2020). Also, PA has a preventive effect on the occurrence of sarcopenia, weakness and the risk of cognitive decline (Heyn, Abreu & Ottenbacher, 2004; Peterson et al., 2009; Sofi et al., 2011) and reduces the risk of obesity, heart disease and type 2 diabetes (Reiner, Niermann, Jekauc & Woll, 2013).

2. EPIDEMIOLOGY OF FALLS IN THE ELDERLY

Given that this literary work investigates the occurrence of falls in old people and their connection with PA, it is necessary to answer some questions that are studied in epidemiology. Epidemiology represents the basic quantitative science of public health and aims to examine the spread, determinants, treatments and possible control of certain unwanted phenomena, i.e. diseases (Rothman & Greenland, 1998). Falls are the second leading cause of injury-related mortality and morbidity in the elderly worldwide (Park, 2018), as approximately 35-40% of people over 65 experience this accident once a year (Hausdorff, Rios & Edelberg, 2001; Lundebjerg et al. al., 2001; Todd & Skelton, 2004). A fall is defined as an event in which the participant without his own intention comes to a lying position on the ground or at a lower level (Hauer, Becker, Lindemann & Beyer, 2006). Such events in old age can cause numerous consequences, such as exhaustion and isolation from society, and at the same time require high economic losses both for the individual and for the entire population (Stenhagen, Nordell & Elmstahl, 2013). At this age, an accidental fall is the first cause of unexpected death (Robitaille & O'Loughlin, 1990), and if the fall does not result in death, it becomes the main reason for disability, as well as for loss of independence and the need for institutionalization (Hausdorff, Rios & Edelberg , 2001). In their work, Pavlović et al. (2015) found that out of 300 elderly subjects who were placed in a health center or nursing home in Bosnia and Herzegovina, 17.1% of them experienced at least one fall in the previous 12 months.

3. ETIOLOGY OF FALLS AMONG ELDERLY PEOPLE

The etiology of falls depends on many factors, so the risks of falls themselves are numerous. Fifteen percent of falls occur under the influence of some external factor and mostly occur in younger and more active people, and require special medical treatment. Approximately the same number of falls occurs due to the occurrence of some neurological disorders such as epilepsy (Dionyssiotis, 2012). The other 70% of falls that occur are the result of the interaction of multiple factors (Rubenstein, Powers & MacLean, 2001; Campbell & Robertson, 2006). Regardless of the individual's general state of health, falls are associated with insufficient movement, reduced opportunities to perform daily activities (dressing, bathing, housework, ...) and the risk of being admitted to institutions that care for non-independent persons (Dionyssiotis, 2012; based on Tinetti & Williams, 1998). A small number of falls were caused by one factor; the largest number of falls is the result of a combination of the so-called chronic (physical and health status) and acute (environmental influence) risks (Rubenstein & Josephson, 2002; Campbell & Robertson, 2006). Maintaining good posture, i.e. correct body posture during daily physical activities, is based on the individual's ability to synchronize several systems in a certain cycle: sensory, cognitive and musculoskeletal system. During natural aging, there is a decrease in the normal functioning of these processes and systems (Rubek, 2006; Rubenstein, 2006). In the process of aging, in older people, their weakness, or fragility, increases, and thus the chances of unwanted events such as functional impairment, lack of independence and falls increase (Casas & Izquierdo, 2012; Laredo-Aguilera, Carmona-Torres & Mota-Cátedra, 2017). Frailty is defined as a biological state in which there is a poor reaction of vital physiological systems to maintain homeostasis after a stressful event (Mañas, del Pozo-Cruz, García-García, Guadalupe-Grau & Ara, 2017). Several studies (Cesari et al., 2002; Avdic, Pecar & Mujic-Skikic, 2004; Morris et al., 2004; Reyes-Ortiz, Al Snih, Loera, Ray & Markides, 2004; Sieri & Beretta, 2004) have attempted to examine what these factors are and how much of an impact they have on the decline in a certain population. The combination of factors that influence falls has led to the possibility of predicting the possibility of falls in the elderly. Among the many risks, there are also some protective factors such as physical activity. And all of the above when combined with reduced cognitive abilities, greatly contributes to

the increased risk of falls in elderly people (Zecevic et al., 2006; Kendrick et al., 2014). According to research, arthritis, depression, cognitive impairment, vision, problems with balance and unbalanced gait, decreased muscle mass, as well as excessive use of medication can increase the risk of falling (Rubenstein & Josephson, 2002; Campbell & Robertson, 2006).

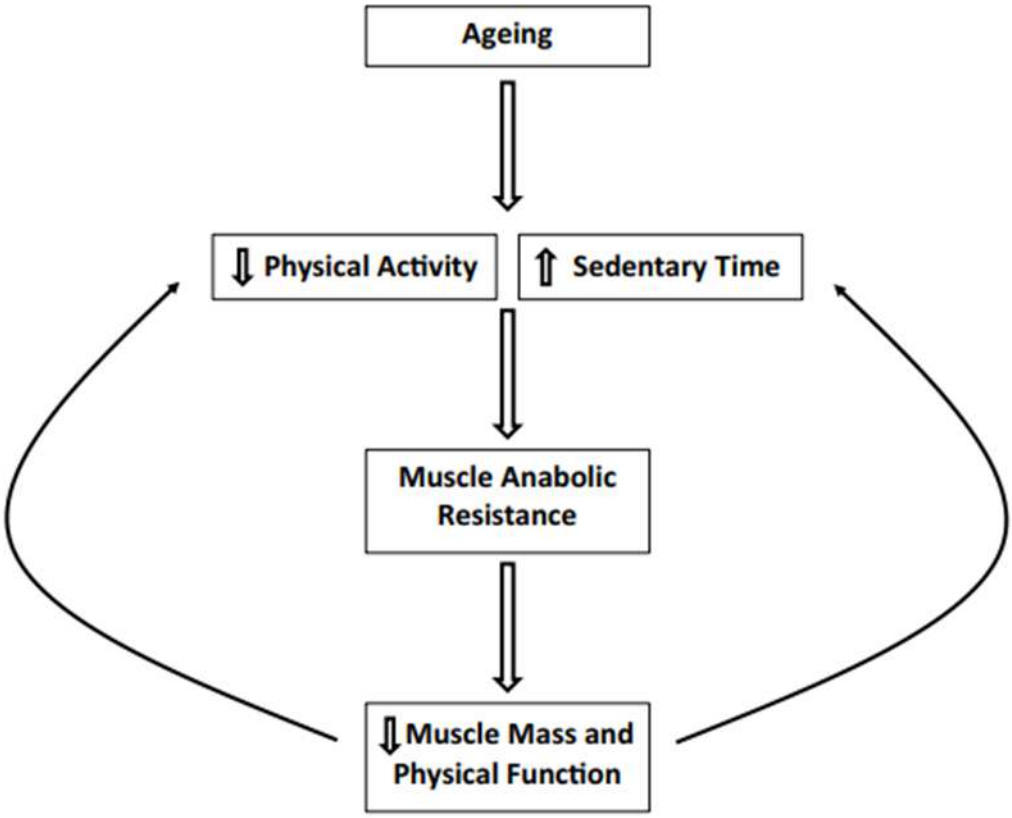

Diagram 1. *Interaction between physical activity, sedentary lifestyle and muscle anabolic resistance (adapted from Shad, Wallis, van Loon & Thompson, 2016)*

3.1 Unbalanced gait and balance disorder

A good balance represents a quick synergistic interaction between different physiologists and cognitive elements that enable a quick and precise response to a perturbation, or a disorder. This interaction represents a complex relationship between systems that enable rapid and precise changes to prevent decline (Richardson, 2017). Timely detection of impaired gait and impaired balance, as well as appropriate intervention in the right measure can contribute to preventing dysfunction and loss of independence (Salzman, 2010).

3.2 Cognitive impairments

Neuro-cognitive functions (perception, memory, thinking, learning, ...) have a great influence on the risk of falling (Kearney, Harwood, Gladman, Lincoln & Masud, 2013). Impairment of cognitive abilities, regardless of diagnosis, in elderly people also increases the chance of falling (Lord, Sherrington, Menz & Close, 2007). The increasing number of different forms of dementia, as well as the degree of cognitive impairment in the elderly, has increased the trend of falls in this population (Booth, Harwood, Hood, Masud & Logan, 2016).

3.3 Musculoskeletal condition and pain

There is a strong connection between a painful musculoskeletal system and the individual's reduced interest in engaging in FA leading to weakness, a decline in overall body functioning, a reduced sense of well-being and the appearance of independence. Muscle weakness, in addition to difficulties with walking, balance and use of walking aids, is a significant factor for the risk of falling. Any disorder of the entire musculoskeletal system, especially the lower extremities (lack of strength, orthopedic problems, etc.) is directly related to an increase in risk (Dionyssiotis, 2012).

3.4 Vision

Visual impairment as a reason for falls in adults is an underrepresented area of research, however, it is generally recognized as an important risk factor. Visual impairment and blindness increase with age and are often overlooked as a fall risk because these two phenomena occur in a slow process, sometimes so much so that it is not even noticed (Zhang, Shuai & Li, 2015).

3.5 Use of medication

Another possible cause of disturbed and unbalanced gait leading to falls is the use of several (four or more) medications (Dionyssiotis, 2012; according to Leipzig, Cummin & Tineti, 1999). Providers should recognize that polypharmacy is the source of many iatrogenic diseases. You should be especially careful when using medications with an effect on the central nervous system because they can affect reaction speed, memory, balance and brain blood flow (Michalcova, Vasut, Airaksinen & Katarina, 2020).

3.6 Physical inactivity

Sedentary lifestyle, the so-called today's modern disease is one of the main causes of falls in the elderly. Although there are a number of causes that alone or in combination can cause falls, it has been established that lack of walking and balance problems are the most common reasons for falls in the elderly (Lee & Paffenbarger, 2000; Kannus, Sievänen, Palvanen, Järvinen & Parkkari, 2005; Zelenovic et al., 2022). As a consequence of such habits, the physical condition of the elderly deteriorates and there is a decrease in muscle strength and coordination of the lower extremities combined with unsteady gait and balance (Daley & Spinks, 2000; Owino, Yang & Goldspink, 2001).

4. FALL RISK ASSESSMENT PROCEDURES

No procedure, which aims to assess the risk of falls in elderly people in care homes or society in general, has been used and certified throughout Europe (Dionyssiotis, 2008). However, there are some procedures that were used in some works.

- STRATIFY (St Thomas Risk Assessment Tool in Falling Elderly Inpatients) is a procedure for identifying patients with an increased risk of falling. However, this procedure is intended only for hospitalized persons (Oliver et al., 2008).
- One of the measuring instruments is PROFET (Prevention of Falls in the Elderly Trial), which serves to help monitored individuals in the intensive care unit in recognizing whether there is a risk of adverse events with permanent consequences (Close et al., 1999).
- In the literature review (Nandy et al., 2004), a group of questions was designed to identify people living in the community who are at high risk of falling. The authors used the FRAT (Falls Risk Assessment Tool) procedure, which can be carried out by non-medical personnel, because it is recommended to use this procedure to examine people who are not placed in hospitals or nursing homes. If four out of five questions are answered, the accuracy of this test protocol is 97%.
- In her study, Lips (1997) used a procedure by which she examined the risks of falls in 1285 people over 65 years of age with reported vision problems, previous falls and the use of a group of drugs for the treatment of anxiety, depression and the like. However, this procedure proves to be insufficiently precise and reliable.
- Assessment of the normal physiological state (Physiological Profile Assessment) is a procedure developed in their work by Lord, Menz & Tiedemann (2003), and aims to examine which system affects

stable and upright body posture (gait, balance, vision, proprioception, strength, ...). The disadvantages of this procedure are reflected in the fact that its implementation requires special training.

- According to the guidelines of the American and British Geriatrics Associations, the "Get up and Go Test" proved to be a simple test for people with reduced strength and balance after a fall. However, the disadvantage is that this test only examines basic movements of daily life such as standing up, walking, turning and sitting, and does not examine barriers to participation that may be encountered in the elderly (Todd & Skelton, 2004).

5. RECOMMENDATIONS OF PHYSICAL ACTIVITY FOR REDUCED FALL RISKS

There are different interventions for the prevention of falls, and they are divided into those that include the entire population without exception, and specific groups in which the risk of falling is increased, namely: women, frail elderly people or people who have experienced at least one fall in the past (Billis et al., 2011). Such interventions may be designed to reduce a single internal or external risk factor or may be focused to reduce a combination of risk factors (Moreland et al., 2003). However, PA represents a key role in the prevention of falls by limiting the reduction of muscle mass and strength, and stimulating postural control and accelerating recovery after injury (Bianco et al., 2014; Faraldo-García et al., 2016; Patti et al., 2017). It has been proven that a higher level of PA (MET≥3) reduces the risk of falling between 30 and 50% (Melzer, Benjuya & Kaplanski, 2004; Bellafiore et al., 2011; Gillespie et al. 2012). In almost every published study, which aimed to examine the risks of falls in the elderly, the conclusion was that PA, and even daily activities, represent an effective method for maintaining balance and preventing falls (Gillespie et al., 2003; Rao, 2005; Fernandez-Arguelles, Rodriguez-Mansilla, Antunez, Garrido-Ardilla & Muñoz, 2014). However, there is still uncertainty as to which type of PA can provide the best results for the purpose of reducing the risk of falls (Gine-Garriga, Roque-Figuls, Coll-Planas, Sitjà-Rabert & Salvà, 2014; Gobbo, Bergamin, Sieverdes, Ermolao & Zaccaria, 2014). As stated in the introductory chapter, according to the guidelines for PA in older people (Australian Government, The Department of Health, 2008; Office of Disease Prevention and Health Promotion, 2008; Department of Health, Physical Activity, Health Improvement and Protection, 2011; Canadian Society for Exercise Physiology, 2012) recommended that PA for strengthening muscle groups be performed two or more times for a total of 150 minutes per week at a moderate intensity (Piercy et al., 2007). Some review studies have addressed the recommendations of different specific exercise programs (strength, flexibility and balance training) that could influence fall risk regulation (Nelson et al., 2007; Borges et al., 2012). Exercise consisting of several components (strength and endurance training) is an effective intervention for health and improving the general physical condition of older people, and leads to the prevention of undesirable events such as falls and damage to the functionality of certain systems (Izquierdo, Cadore & Casas, 2014). On the other hand, exercises aimed at improving strength and balance are very effective in improving independence and preventing falls in the elderly (Mañas et al., 2018). In essence, specially controlled and programmed exercise adapted to the elderly can lead to functional independence and maintenance of strength and flexibility, which in fact are key factors that contribute to reducing the risk of falls in the elderly (Gómez, Borba-Pinheiro, Gois & Da Luz, 2015). Also, it has been proven that programs based on moderate to high intensity aerobic exercise and endurance can be used for the same purpose (de Vries et al., 2012; de Labra et al., 2015). Aerobic training has a positive effect on cardiovascular functions, prevents muscle atrophy and improves the quality of health and life (Navas-Enamorado et al., 2017). However, this type of PA activity should be carried out under controlled conditions with the presence of an expert, and with the consent of a doctor. Since balance is the ability to stand upright and move, it should be noted that training such as Tai Chi can play an important role in preventing falls (Melzer, Benjuya & Kaplanski, 2004).

6. CONCLUSION

Falls in the elderly are one of the most common phenomena that occur due to numerous internal and external factors, and they alone or in combination can lead to fatal consequences. The benefits of PA for improving musculoskeletal function and metabolic health are well known, while the total volume and type of PA activity required for the elderly is not well defined. However, it can be concluded that the combination of PA (strength training, endurance training, exercises for the development of balance and mobility, ...) and adequate nutrition (sufficient intake of essential amino acids/protein sources) is of crucial importance for preserving the physical condition, motor skills and health status of third-age people, and therefore in the prevention of falls. Based on the facts presented, the strategy for choosing an exercise program to improve the neuromuscular and cardiovascular status of the elderly should include the following:

- weight training is performed two or three times a week, through three sets of 8 to 12 repetitions with an intensity that progressively increases from 20 to 30% of 1RM;
- to improve functional abilities, endurance training should be based on performing tasks such as walking with progressive growth from 5 to 30 minutes;
- training for the development of balance should include exercises such as standing on one or both legs, walking on a line, walking heel-toe, transferring weight from the left to the right leg, as well as a modified Tai Chi program;
- multi-component exercise programs should include a gradual increase in the volume, intensity and difficulty of exercise performance, along with the simultaneous performance of resistance, endurance and balance;
- such programs should be retested to further examine their impact.

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APSTRAKT

Redovna fizička aktivnost može da donese značajne zdravstvene benefite kod ljudi svih godina, te se potreba za fizičkom aktivnošću ne smanjuje sa brojem godina već je dokazano da ona može produžiti zdraviji i samostalniji život, spriječiti invaliditet i značajno doprinijeti poboljšanju života kod starijih osoba. Pored toga što svaka vrsta fizičke aktivnosti u određenoj mjeri pobošljava motoričke sposobnosti (snagu, koordinaciju, ravnotežu, agilnost, ...), mentalno zdravlje (samopoštovanje, kvalitet života) i umanjuje rizik od kardiovaskularnih i svih drugih uzroka smrti, redovno učestvovanje u vježbanju pospješuje mobilnost i funkcionalnu nezavisnost kod odraslih osoba. Pad je događaj u kojem učesnik bez sopstvene namjere dolazi u ležeći položaj na zemlji ili na nižem nivou. Bez obzira na zdravstveno stanje pojedinca, padovi su povezani sa nedovoljnim kretanjem, smanjenim mogućnostima za izvođenje svakodnevnih aktivnosti (oblačenje, kupanje, kućni poslovi, ...) i rizikom za prijem u ustanove u kojima se vodi briga o nesamostalnim osobama. Artritis, depresija, kognitivna oštećenja, vid, problemi s ravnotežom i neuravnoteženim hodom, smanjenje mišićne mase, kao i prekomjerna upotreba medikamenata povećavaju rizik od pada. Ukupan obim i vrsta fizičke aktinosti potrebna za starije osobe nije baš najbolje definisana. Međutim, može se zaključiti da spoj fizičke aktivnosti (treninzi snage, izdržljivosti, vježbe za razvoj ravnoteže i mobilnosti, ...) i adekvatne ishrane (dovoljan unos esencijalnih amino kiselina/izvora proteina) je od krucijalnog značaja za očuvanje fizičkog stanja, motoričkih sposobnosti i zdravstvenog statusa osoba treće dobi, a samim tim i u prevenciji padova. Cilj ovog rada se ogleda u opisu i pronalaženju najboljih trenažnih programa za prevenciju padova kod starih osoba.

Ključne riječi: *program vježbanja, treća dob, padovi*

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Psychological Factors Influencing Pro-Enviromental Attitudes in Children

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ПСИХОЛОШКИ ФАКТОРИ ФОРМИРАЊА ПРОЕНВИРОМЕНТАЛНИХ СТАВОВА КОД ДЕЦЕ

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ABSTRACT

One of the main requirements of modern society, and for the sake of its survival, is the formation of socially responsible behavior towards the greatly endangered environment. Every day we are faced with the problems of pollution, global warming, depletion of the ozone layer and many others. Therefore, it is of paramount importance to influence the youngest generations to develop attitudes that will develop a high awareness of the need to protect nature and how to treat it. In this sense, today, and for the sake of the future, we must actively work on the development of pro-environmental attitudes in children, which would manifest themselves in pro-environmental behavior tomorrow. The development of this cognitive component, that is, the attitude requires the society to instil in the child knowledge about nature, its benefits, but also its demands and the inseparability of man from it, which affects the child's affective relationship towards it, the feeling of attachment to the environment that becomes an integral part of values. With their conative component, attitudes also initiate individuals to act. This especially necessary during the current COVID-19 pandemic and the unresolved question of the origin of the virus. Was it created artificially in laboratories or is it of natural origin, as nature's response to man's relationship to it. Some studies show that children in the first grades of elementary school understand the phenomenon of environmental pollution, they even know about different types of pollution, but they still do not understand the causes of these events. Therefore, although there is not much research dealing with this problem, we consider it important to analyse current knowledge about the psychological factors influencing the development of pro-environmental attitudes in children.

Key words: *pro-environmental attitudes, pro-environmental behaviour, identification, self-efficacy*

INTRODUCTION

Early childhood experience significantly affects the formation of personality in general, including the formation of attitudes that will govern the behaviour of an adult. Therefore, different socialization agents, such as family, kindergarten, school, etc., have their own role in this process. They are the ones who instil in the child information that will be the foundation for the formation of a future attitude, and who are role models for the child with their personal example of pro-environmental behaviour. The processes of identification with authorities and introjection of their values allow children to develop motivation to establish functional adaptive behaviours towards the environment. This affects the formation of beliefs and values that have an even greater intentional power than the attitudes themselves. Beliefs can be acquired in different ways, but they are mainly the result of the interaction between the environment and the personality traits of the individual who acquires them (Poškus, 2017). The beginning of everything is perception and the way an individual sees things. Schumm and Bogner (Schumm, Bogner, 2016) find a positive correlation between the perception of the environment and acquired knowledge about the environment. Perception is largely conditioned by the attention that is directed to interesting content. Therefore, environmental content should be presented in the most interesting way possible. Also, the development of a sense of self-efficacy, as a personal belief in the ability to establish control over the level of efficiency of personal action and control over events that affect our lives, with adequate information about the impact of those events, contributes to the development of pro-environmental behaviour. That feeling of self-efficacy is, in itself, a significant motivational element. Another important aspect is the individual factor of connection with nature, because this connection greatly contributes to the development of pro-environmental attitudes and values, creating a positive emotional relationship of the child towards it. Guiding the child towards desirable activities can lead to the formation of habits (as repeated actions) which will result in pro-environmental actions in the future, in the behaviour pattern of the individual. Self-categorization in peer groups, in which pro-environmental behaviours prevail, can play a role in the formation of a "pro-environmental" specific identity at the moment of identity formation.

A number of factors influence the development of pro-environmental attitudes. In the literature, attitudes towards the environment, knowledge about environmental topics, and individual properties such as gender, culture, level of education, political beliefs, etc. are mostly emphasized (Evans et al, 2018). At least two of these factors directly represent the results of learning and experience. Early childhood represents the period of the most intensive learning, so we can expect that values and behavioural patterns related to environmental protection take place intensively in this period.

PRO-ENVIRONMENTAL ATTITUDES AND PRO-ENVIRONMENTAL BEHAVIOR

Pro-environmental attitudes can be defined as a predisposition and prerequisite for pro-environmental behaviour. The authors (Hines et al.: Eilam, Trop, 2012) state that pro-environmental behaviour is an intention to act and as a step towards acquiring pro-environmental behaviour.

Environmental behaviour is a reflection of man's attitude towards nature. This behaviour can be understood as a dimension that ranges from hostile behaviour towards the environment, through controversial or inconsistent environmental behaviour to a pro-environmental attitude towards the natural environment (Krajhanzl, 2010).

Pro-environmental behaviour is a prerequisite for preserving a healthy environment, but also for establishing sustainable development as a process that strives to establish a balance between social, environmental and economic requirements (Mitrović, Mitrović, 2020). It can be defined as

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"behaviour intended to benefit the environment, while pro-environmental behavioural intentions refer to the desire to engage in actions related to the preservation of the environment in the future" (Weimer et al, 2017). Pro-environmental behaviour aims to reduce negative effects on the environment. There is a high probability that a person who has pro-environmental attitudes will also exhibit such behaviour, but this connection need not be direct or consistent. Someone can be careful when using the amount of water and thus show pro-environmental behaviour. This, however, does not mean that the behaviour is caused by a pro-environmental attitude, this person may in fact just be someone who does not want to pay for water use. In addition, one of the main obstacles to behavioural change is that many environmental issues are essentially social dilemmas in which the conflict between immediate individual and long-term collective interest is resolved (Palomo-Velez et al., 2020).

The most famous theory of pro-environmental behaviour was given by Stern (Stern: Goldman et al, 2020). According to him, a comprehensive model should include: *individual value-oriented variables* such as attitudes, norms, beliefs, goals, which in the educational sense correspond to the goals of affective learning; *individual abilities* that include the knowledge and skills required to act in accordance with the goals of cognitive learning; *contextual factors* that include opportunities and limitations, aspects of the social and physical environment such as material resources, technology, legal regulations, etc.; *habits* as a result of accumulated experiences of previous behaviours. Hansmann and Steiner (Hansmann, Steimer, 2017) add to this social factors such as position, roles, group dynamics, etc.

There is an interdependence among these factors and their intercorrelations result in a certain type and measure of pro-environmental behaviour.

PRO-ENVIRONMENTAL EDUCATION

The goal of environmental education is to familiarize children with the need to take care of the environment by providing them with opportunities and contents that promote pro-environmental behaviour. Clayton and Myers (Clayton, Myers, 2009) emphasize that the success of pro-environmental education depends on the child's knowledge of biology and ecology, the level of cognitive development, affective factors resulting from the level of the child's connection with nature, as well as motivation, above all, the level of self-efficacy. In general, we can talk about two different approaches to environmental behaviour: anthropocentric and ecocentric (Alagoz, Akman, 2016). The anthropocentric approach is oriented towards man and his needs and is close to an egocentric attitude, while the ecocentric approach emphasizes the importance of balance in nature and the survival of not only man, but also all other living beings, which represents an altruistic orientation aimed at the conservation and protection of natural resources (Shumm, Bogner, 2016).

Research by Boeve and Petegem (Boeve-de Pauw, Petegem, 2011) shows that knowledge about the environment is negatively correlated with an egocentric attitude towards the environment. Research conducted with preschool children aged five to six (Kahriman-Ozturk et al., 2012) showed that in explaining their reasons for pro-environmental actions most children still express anthropocentric attitudes. The authors explain this by the fact that children of this age belong to Piaget's preoperational stage of cognitive development, which is still characterized by a dominant egocentrism that prevents them from seeing things from the perspective of the external environment.

After investigating different samples of young children, some authors (Khan: Evans et al., 2007) find that there is a significant degree of agreement in moral reasoning about different environmental topics among children belonging to different cultures and social statuses. The same authors conclude that children clearly identify and recognize environmental issues and that between the age of six and eight there is a shift from an anthropocentric understanding to an understanding of the impact of abuse of the environment and the damage caused by that abuse. These pro-environmental tendencies are profiled by the eleventh year of life. Such results

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are in agreement with Piaget's findings, who points out that egocentrism, as a developmental phase, turns into a more socialized behaviour after the age of six. However, based on research conducted in our country, in which primary and secondary school students were compared (Jovanović, Živković, 2016), the authors conclude that students of these age groups do not differ in terms of pro-environmental behaviour, which they believe is the consequence of the curricula that are primarily focused on acquiring environmental knowledge, and not on the development of moral and affective segments of personality. One of the goals of pro-environmental education is the acquisition of environmental awareness. "Environmental awareness, in addition to knowledge about changes in nature caused by human action, also contains understanding about the possibilities and ways of solving environmental problems" (Bulatović et al., 2019). Therefore, curricula should include pro-environmental content, acquisition of skills and ways of mastering what the student should know and how to acquire skills for pro-environmental action (Kos et al., 2016).

Various authors agree that there is no difference between cognitive and affective learning, i.e., learning in the classroom and outside of it, and learning activities should be designed to allow for different classroom and outside of classroom experiences (Pittman, 2012). The physical design of the school has its own influence on learning. Gifford et al. (Gifford et al, 2011) emphasize that there are differences between small and big schools because big schools have a greater variety of activities, but they also highlight that students from big schools primarily learn as observers, while students from smaller schools, which lack some resources, learn as participants and also acquire more skills through direct involvement in the activities.

Therefore, the perfect learning situations are those in which students can participate, communicate, develop critical thinking skills, develop creativity and an ethical attitude towards decision-making in solving environmental problems (Wals et al, 2014).

This can also allow for the development of self-efficacy in children, which is a good basis for the adoption of certain behavioural models. The theory of planned behaviour predicts the control of perceived earlier behaviours, which indicates that those that the individual perceives to have performed successfully will be more likely to be adopted, which is the basis for feelings of self-efficacy (Yadav, Pathak, 2016). Therefore, children should not only be passive recipients of information (Kos et al., 2016) on how to behave pro-environmentally, but should be provided with opportunities to play an active role in the independent acquisition of knowledge that will allow them to understand the impact of their activities on the environment.

FACTORS AFFECTING THE FORMATION OF PRO-ENVIROMENTAL ATTITUDES

There are a number of factors that influence the formation of pro-environmental attitudes and, consequently, pro-environmental behaviour. The results of the research that analysed the correlation between gender and pro-environmental attitudes give contradictory and weaker correlations, but in general, if significant differences were shown, they speak in favour of girls showing more pronounced pro-environmental attitudes (Schumm, Bogner, 2016). Research on the influence of mother, as a figure who by nature has a protective relationship, also does not provide consistent results or significant correlation with pro-environmental behaviour. One extensive study of pro-environmental attitudes and pro-environmental behaviour, with children aged six to eight, was conducted by Evans et al. (Evans et al., 2007). Their research shows that children of this age express desired environmental attitudes and strive to behave in an ecologically and socially responsible way. They reliably report pro-environmental attitudes and behaviours, but have a low level of commitment to engage in various activities. The authors attribute this to methodological causes, suggesting that it is necessary to design more challenging environmental situations and behaviours in which children of this age could engage. Evans' later longitudinal research

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(Evans et al, 2018), however, shows that early experiences in nature, around the age of six, as well as time spent in nature in childhood, along with a good education, are significant predictors of pro-environmental behaviour in later adolescents because they lead to the formation of connections between the child and nature, which later results in specific behaviour. Moreover, experience that children have in the wild, such as scouting activities, are more likely to be predictors of pro-environmental behaviour than experiences in tamer natural conditions, such as gardening. The same research also shows that children who grew up next to mothers who expressed pro-environmental attitudes and behaviours show significant changes in pro-environmental behaviour, compared to other peers, after the age of twelve, which is explained by the maturation of the child. Parents have the main and special influence on the development of their children. Gronhoj and Thogersen (Gronhoj, Thogersen, 2012) find that in the comparison of pro-environmental attitudes and pro-environmental behaviour, it is the behaviour that is positively correlated with the child's pro-environmental behaviour. This shows the importance of the parents' personal example, especially considering that children primarily identify with what is obvious. Trying to test the hypotheses of parental role and parental status, and the question of whether having a child increases the frequency of expressing pro-environmental behaviour, Thomas et al. (2018) conclude that this behaviour is manifested more often only by those parents who had their first child, but who in the past also expressed a high level of concern for environmental issues. Other research, however, shows that parents whose families are larger have greater knowledge about the environment and have more positive attitudes about its preservation (Palomo-Velez et al., 2020).

The same authors advise promoting messages to children that would encourage parents to think about the negative consequences of not acting towards nature protection. Locus of control as a predictor of individual activities also affects pro-environmental behaviour. Individuals with an internal locus of control, who realize that the causes of their behaviour are within themselves and that a change in behaviour also changes the environment, more often behave in an environmentally responsible manner, while individuals with an external locus of control and the belief that nothing depends on them, that everything is a matter of coincidences and fate are less likely to see the consequences of their behaviour (Weimer et al., 2017).

Therefore, we can assume that children with an internal locus of control will more easily adopt pro-environmental attitudes. Talking about the influence of school on pro-environmental behaviour, some authors talk about "situational strength" which refers to the degree of presence of pro-environmental signs, as associative elements, which both teachers and students could perceive and understand in a similar way (Runhaar et al, 2019). In a "powerful situation" there is an abundance of associative cues that send an unambiguous message and exert psychological pressure to exhibit the desired behaviours. Procedural matters and activities are aligned here. If there is no such compliance, then ambivalence and ambiguity about the expected behaviour occurs, which creates a "weak situation".

CONCLUSION

The modern way of life and the trends it brings require intensified care for the preservation of the environment. The entire development of man occurs as a striving for balance through the processes of accommodation and assimilation, i.e., the adaptation of man to the environment, as well as the environment to the man himself in order to survive in it. T adjustments should be balanced, because many times throughout history, man has expressed the desire not only to use, but also to abuse nature, which has led to a serious imbalance that, in the end, endangers man himself. Therefore, it is of crucial importance to promote various types of pro-environmental behaviours. The prerequisite for this is to learn and establish pro-environmental attitudes and beliefs from early childhood, as a predisposition for this kind of

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behaviour. Considering the sequence of children's cognitive development, their understanding goes through different stages and requires maturation in order for the behaviours to manifest in the desired way. Precisely because of this, in the process of pro-environmental education, children should be allowed to participate in numerous activities during which they will directly try out pro-environmental behaviour's and directly perceive their effects. In this way, starting from the fact that children will behave pro-environmentally because adults ask them to do so and because it is socially desirable and often rewarded, children can acquire the intrinsic values of pro-environmental behaviour through the learning process, which will, consequently, make it continuous and effective.

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САЖЕТАК

Један од кључних захтева модерног друштва, а зарад његовог опстанка, јесте формирање социјално одговорног понашања према увелико угроженој животној средини. Свакодневно се срећемо са проблемима загађења, глобалног загревања, смањења озонског омотача и многим другим. Стога је од превасходног значаја утицање на најмлађе генерације да развију ставове који ће доприносити високој свести о потреби заштите природе и начину опхођења према њој. У том смислу данас, а зарад будућности, морамо активно радити на развоју проенвиромената лних ставова код деце који би се сутра манифестовали у проенвиромената лном понашању. Развој когнитивне компоненте става захтева од околине усађивање знања детету о природи, њеним благодетима, али и њеним захтевима и нераздвојности човека од ње, што утиче и на успостављање афективног односа детета према њој, осећања привржености животној средини која постаје саставни део вредности. Ставови са својом конативном компонентом иницирају и деловање индивидуе. Ово се посебно истиче као потреба у садашње време пандемије КОВИД-19 и неразрешеног питања порекла вируса. Да ли је он настао вештачки у лабораторијама или је природног порекла, као одговор природе на однос човека према њој. Нека истраживања показују да деца у првим разредима основне школе разумеју феномен загађења животне средине, чак знају и за различите врсте загађења, али још увек не спознају узроке тих дешавања. Стога, иако нема много истраживања која се баве овим проблемом, сматрамо значајним анализу садашњих сазнања о психолошким факторима утицаја на развој проенвиромената лних ставова код деце.

Кључне речи: *проенвиромената лни ставови, проенвиромената лно понашање, идентификација, самоефикасност*

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Anthropometric Characteristics and Agility of Wheelchair Basketball Players : Differences and Relationship with Functional Classification [original scientific article]

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ANTROPOMETRIJSKE KARAKTERISTIKE I AGILNOST KOŠARKAŠA U INVALIDSKIM KOLICIMA: RAZLIKE I POVEZANOST SA FUNKCIONALNOM KLASIFIKACIJOM

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SUMMARY

The aim of this study was to determine: (1) differences in anthropometric characteristics and agility between different functional classes of wheelchair basketball players and (2) the relationship between anthropometric characteristics and agility with the functional classification of wheelchair basketball players. The sample of participants consisted of 40 wheelchair basketball players, aged 33.9 ± 11.2 years. Anthropometric characteristics (longitudinal and circular dimensions, as well as skinfold thickness) were assessed, and agility was measured using the modified T-test and Figure-of-Eight test. The results of the one-way analysis of variance showed significant differences with very large effects between players of different functional classes in body mass, sitting height, and sitting reach height, while significant differences with large effects were recorded in the agility assessment tests: the T-test and the Figure-of-Eight test. Also, the results of the correlation analysis indicate that there are significant moderate positive correlations of sitting height and reaching height with functional classification.

Key words: *disability, t-test, sports, motor skills, athletes*

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INTRODUCTION

Wheelchair basketball (WB) is one of the most popular adapted sports for people with disabilities. According to estimates by the International Wheelchair Basketball Federation (IWBF), this sport is practiced by more than 100,000 players from 95 countries around the world (IWBF, 2021). Wheelchair basketball is a dynamic, high-intensity activity that requires a large number of skills for wheelchair maneuvering (e.g., propulsion, acceleration, stopping and changing the direction of the wheelchair) and ball handling (e.g., shooting, passing, dribbling, etc.).

The official rules of the WB game are to a large extent identified with the rules in classic basketball, but they are also specific in part, i.e. adapted to athletes with disabilities. Given the presence of participants with various impairments and the use of wheelchairs in the game, the IWBF has developed a classification system in order to balance the wide variety of functional abilities of players between teams and to ensure that all eligible players have an equal right and opportunity to play. The classification system implies a process by which the total score of the team's potential is matched with the team's potential of the opponent (Kozomora et al., 2019). Based on the functional ability of the players, the classification is done by scoring in the range of 1.0 to 4.5 points, so that the total score of one team does not exceed the limit of 14 points (IWBF, 2018). A Class 1 player has no or very poor trunk control in any plane. A Class 2 player has active rotation of the upper trunk, which allows partial range of motion in the transverse and sagittal planes. A Class 3 player has full range of motion in the transverse and sagittal planes but lacks full action in the frontal plane. A Class 4 player has full range of motion in the transverse and sagittal planes and full range of motion to one side in the frontal plane, while a Class 4.5 player has full control of motion in all planes.

For success in wheelchair basketball, it is very important that players possess strong basic wheelchair ability, such as agility. It is also recommended that wheelchair basketball players focus on achieving maximum agility because if a player cannot move their wheelchair efficiently around the basketball court and change direction quickly, it does not matter how well they perform other skills of the game (Frogley, 2010). Agility and the ability to repeat sprints and change direction are considered very important wheelchair basketball performances (Iturricastillo, 2021). There are factors that can influence agility in wheelchair basketball players, such as anthropometric characteristics, upper body strength, and wheelchair propulsion technique (Vanlandewijck et al., 2001; Rice et al., 2011). In wheelchair basketball, the analysis of anthropometric measures and complete body composition is very important. It can help trainers choose key anthropometric measures to use during training in order to increase the success rate (Cavedon et al., 2018). Davis (1993) investigated the motor efficiency of the upper limbs and emphasized that the distribution of muscle mass and anthropometric measures of the upper limbs and trunk, which is the center of gravity when sitting in a wheelchair, are very important for the successful performance of a motor task. Speed may also affect agility, given that some performance tests are related to speed (Vanlandewijck et al., 1999; de Groot et al., 2012). However, it is still not fully clarified how and to what extent agility is manifested in relation to the functional classification of players or whether certain anthropometric characteristics contribute to the manifestation of agility. It is considered that the assessment of the level of ability of wheelchair basketball players in relation to the functional classification is an important part that should be further investigated in order to provide the possibility of more equal competition (Brasile, 1990). Given the insufficient number of studies on this topic, the aim of this study is to determine: (1) differences in anthropometric characteristics and agility between different functional classes of wheelchair basketball players and (2) the relationship between anthropometric characteristics and agility with the functional classification of wheelchair basketball players**.**

METHODS

A sample of participants

The sample of participants for this study consisted of 40 male wheelchair basketball players (Table 1) from clubs in the Balcan region: KKK "Nais" from Niš, KKK "Bijeljina" from Bijeljina, KKK "Zmaj" from Gradačac, SSOSIK from Kruševac, as well as national team members from Serbia, Montenegro and Bulgaria. Testing protocol was conducted during tournaments in Bijeljina and Bojnik. Only players who voluntarily agreed to participate in the testing

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protocol were included. This study was conducted in accordance with the Declaration of Helsinki of the World Medical Association (World Medical Association, 2013). The privacy of the players was protected by the fact that the data was used only for the purposes of the study and was not available to third parties. For comparative analysis, the total sample was divided into four classes in relation to the official IWBF scoring of the functional classification. Class 1 (n = 10) consisted of players with scores of 1.0 and 1.5, Class 2 (n = 13) players with scores of 2.0 and 2.5, Class 3 (n = 7) players with scores of 3.0 and 3.5 and Class 4 (n = 10) players with points 4.0 and 4.5.

Table 1. *Basic characteristics of the sample*

	N	**Mean ± SD or %**
Age (years)	40	33.9 ± 11.2
Sitting Height (cm)	40	93.4 ± 6.7
Body Mass (kg)	40	78.7 ± 17.8
IWBF classification		
Class 1 (classes 1.0 and 1.5)	10	25.0%
Class 2 (classes 2.0 and 2.5)	13	32.5%
Class 3 (classes 3.0 and 3.5)	7	17.5%
Class 4 (classes 4.0 and 4.5)	10	25.0%

IWBF – International Whellchair Basketball Federation;
Mean - average value; SD – standard deviation.

Instruments and procedures

Measuring instruments for assessing the anthropometric characteristics of the sample:

- Sitting height (cm)
- Seated reach height (cm)
- Arm span (cm)
- Forearm circumference (cm)
- Upper arm circumference (cm)
- Forearm skinfold thickness (mm)
- Biceps skinfold thickness (mm)
- Triceps skinfold thickness (mm)
- Suprailiac skinfold thickness (mm)
- Subscapular skinfold (mm)

Measuring instruments for the assessment of sample agility

- Modified T-test (sec)
- Modified Figure-of-Eight test (number of laps)

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Anthropometric characteristics

An anthropometer according to Martin GPM 101 (GPM Switzerland) with a precision of 0.1 cm was used to assess longitudinal dimensions (sitting height, sitting reach height, and arm span). A centimeter tape with a precision of 0.1 cm was used to assess the circular dimensions (forearm circumference and upper arm circumference). A GPM (GPM Switzerland) caliper with a measurement accuracy of 0.2 mm was used to assess forearm, biceps, triceps, suprailiac, and subscapular skinfold thicknesses.

Modified T-test

The T-test was carried out in accordance with a modified testing protocol for wheelchair basketball players (Yanci et al., 2015), in which the wheelchair was only moved forward during the test. The participant is positioned 0.5 m behind cone "A", in whose extension the starting line is drawn. The distance between A and B is 9.14 m. When participant is ready, he/her pushes the wheelchair forward as fast as possible to cone B. The subject then moves towards cones "C" "D", and "B" (in order) touching the top of each cone, and finally returns (moving forward) to cone "A" (Figure 1). For accurate time measurement, Witty photocells (Microgate, Italy) were used. The subject performed the test twice, and the best result in seconds was recorded.

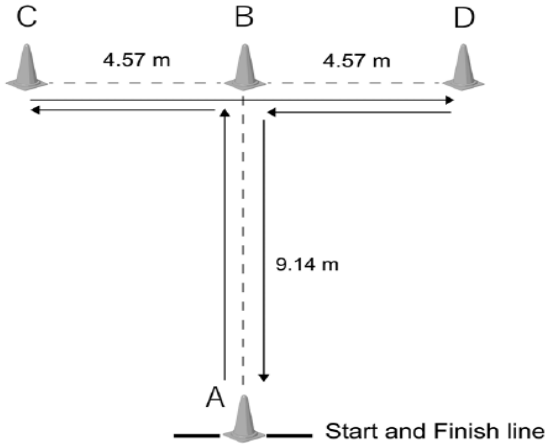

Figure 1. *Sketch of the T-test (Tachibana et al., 2019)*

Modified Figure-of-Eight test

The protocol for performing the Figure-of-Eight test is provided by Vanlandewijck, Daly, and Theisen (1999). After the signal, the participant pushes the wheelchair around two cones in a figure-of-eight path, as fast as possible. The cones are placed 5 m apart (Figure 2). Scoring was recorded as the maximum number of laps that the subject completed in 1 minute.

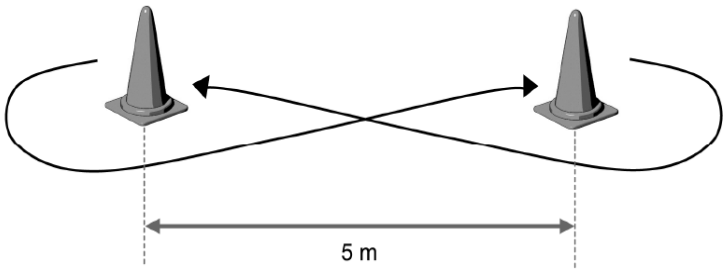

Figure 2. *Sketch of the Figure-of-Eight test (Tachibana et al., 2019)*

Stojanović, T., Zadražnik, M., Božić, D., Veljković, A, Marković, A., & Stamenković, A. (2022). Anthropometric characteristics and agility of wheelchair basketball players : differences and relationship with functional classification. *Sportlogia, 18* (1), 68-77. https://doi.org/10.5550/sgia.221801.en.szba

Statistical analysis

Data processing and analysis was performed with the statistical package IBM SPSS v.23. Descriptive parameters were calculated for all variables included in this study. The assumption of a normal distribution of the monitored variables was checked with the Shapiro-Wilk test. To determine the differences in anthropometric characteristics and agility in relation to the functional classes of players, a one-way analysis of variance (One-way ANOVA) was applied for variables with normal distribution, while in the case of variables that do not meet the assumption of a normal distribution, the Kruskal-Wallis test for independent samples was applied. For further analysis of statistically significant differences between groups, the Bonferroni post hoc test was applied.

The significance of the differences is presented using the Effect Size based on the following criteria: < 0.20 trivial; 0.20-0.50 small; 0.50-0.80 moderate; 0.80-1.3 large and > 1.3 very large (Cohen, 1988). Spearman's rho correlation analysis was used to determine the relationship between anthropometric characteristics, agility and functional classification of players. Statistical significance was set at the $p < 0.05$ level.

RESULTS

Demographic data, anthropometric characteristics and agility according to the functional classification of the players are shown in Table 2. The results of the Shapiro-Wilk test for checking the normality assumption showed normal distributions for all variables except for the Figure-of-Eight test where deviations from the normal distribution were observed. The significance of differences in demographic characteristics, anthropometric characteristics and agility in relation to functional classification can be seen in Table 2. The results of one-way analysis of variance showed significant differences with very large effects between players of different functional classes in body mass, sitting height and sitting reach height ($p = 0.005$, $d = 1.31$; $p = 0.005$, $d = 1.31$; $p = 0.001$, $d = 1.46$, respectively), while significant differences with large effects were noted in the agility tests, T-test and Figure-of-Eight test ($p = 0.046$; $d = 1.03$; $p = 0.026$, $d = 0.90$, respectively).

Table 1. *Demographics, Anthropometric characteristics and agility according to functional classification*

Variable	Class 1 (n = 10)	Class 2 (n = 13)	Class 3 (n = 7)	Class 4 (n=10)	p	ES
Age (years)	34.0 ± 9.2	32.3 ± 12.1	31.7 ± 12.0	37.5 ± 12.2	.686	0.41
body mass (kg)	83.4 ± 19.2	69.4 ± 13.8	70.1 ± 10.2	92.3 ± 16.4	**.005***	1.31
Sitting height (cm)	91.0 ± 8.7	90.5 ± 5.1	93.4 ± 2.5	99.4 ± 4.7	**.005***	1.31
Seated reach height (cm)	142.4 ± 9.2	142.2 ± 8.1	143.7 ± 3.3	154.5 ± 6.3	**.001***	1.46
Arm span (cm)	182.1 ± 7.8	182.4 ± 6.6	181.3 ± 6.6	190.0 ± 9.9	.068	0.94
Forearm circumference (cm)	30.5 ± 3.6	29.1 ± 2.7	27.5 ± 1.8	31.0 ± 2.6	.072	0.90
Upper arm circumference (cm)	36.0 ± 5.7	33.3 ± 5.2	31.7 ± 2.6	35.2 ± 3.2	.220	0.70
Skinfolds						
Forearm (mm)	8.2 ± 3.8	6.0 ±2.2	6.8 ± 3.2	6.1 ± 1.9	.272	0.67
Biceps (mm)	9.6 ± 6.2	6.2 ± 2.6	5.5 ± 2.5	6.0 ± 1.8	.080	0.90
Triceps (mm)	12.2± 3.6	10.0 ± 5.3	7.2 ± 3.9	9.7 ± 3.4	.138	0.81
Suprailiac (mm)	20.4 ± 6.3	15.4 ± 7.1	13.2 ± 8.5	16.2 ± 3.8	.149	0.81
Subscapular (mm)	16.8± 6.4	16.3 ± 8.0	13.1 ± 7.9	17.5 ± 4.1	.606	0.46
Agility						
T-test (sec)	17.7 ± 2.0	15.7 ± 1.1	17.1 ± 1.8	17.1 ± 1.8	**.046***	1.03
Figure-of-Eight test (no. of laps)	7.7 ± 1.2	9.0 ± 0.8	8.7 ± 0.5	8.7 ± 1.1	**.026***	0.90

Legend: Data are presented as mean ± standard deviation (Mean ± SD); p - statistical significance of one-way analysis of variance (ANOVA) or Kruskal-Wallis (Figure-of-Eight test); * - $p < 0.05$; ES – effect size (Cohen's d).

Stojanović, T., Zadražnik, M., Božić, D., Veljković, A, Marković, A., & Stamenković, A. (2022). Anthropometric characteristics and agility of wheelchair basketball players : differences and relationship with functional classification. *Sportlogia, 18* (1), 68-77. https://doi.org/10.5550/sgia.221801.en.szba

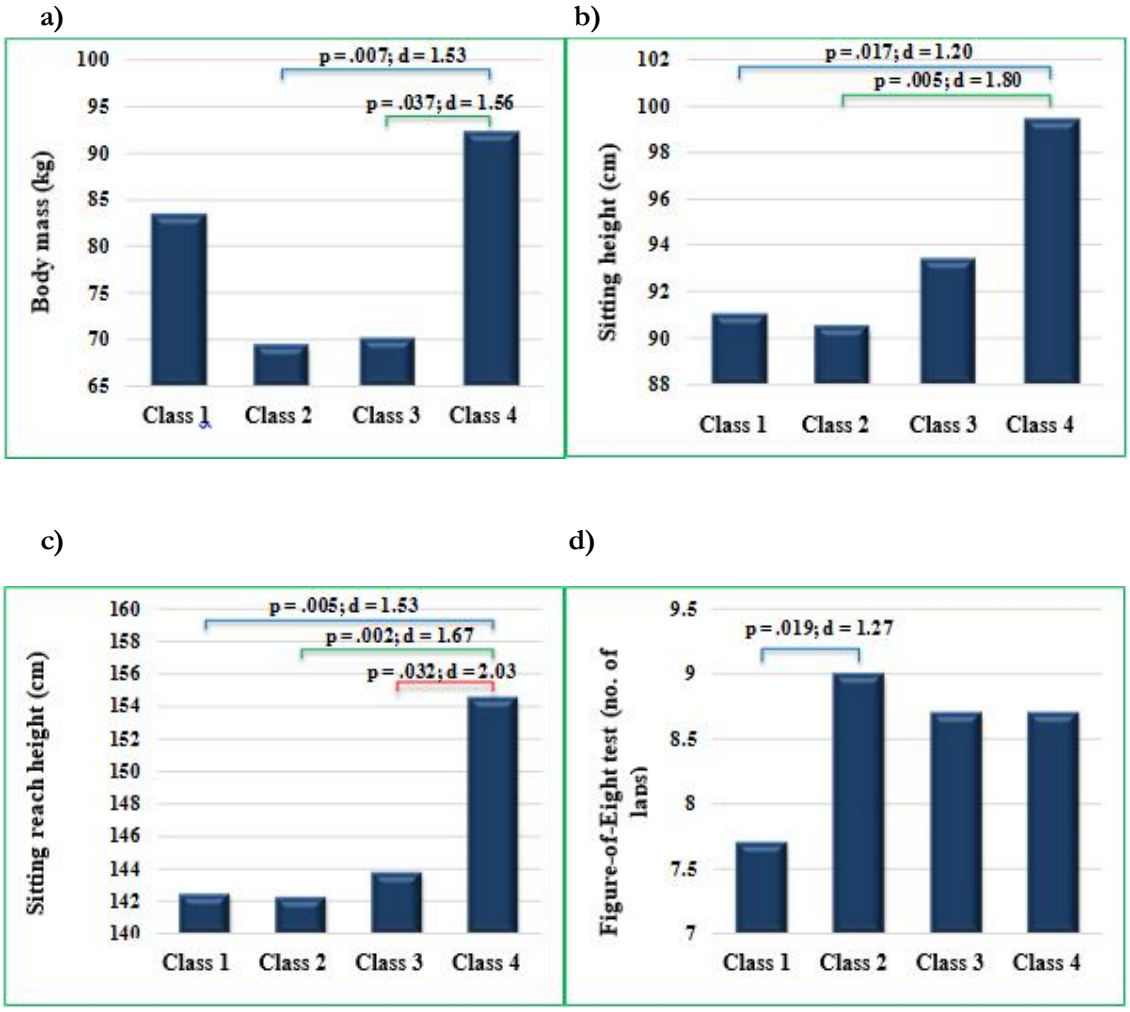

Chart 1. *Results of Bonferroni post-hoc analysis. (a) body mass; (b) sitting height; (c) sitting reach height and (d) figure-of-eight test.*

Further analysis of the post-hoc test determined between which functional classes there was a significant difference in the mentioned variables (Chart 1). More precisely, body mass (Class 2 vs. Class 4, d = 1.53; Class 3 vs. Class 4, d = 1.56), sitting height (Class 1 vs. Class 4, d = 1.20; Class 2 vs. Class 4, d = 1.80), sitting reach height (Class 1 vs. Class 4, d = 1.53; Class 2 vs. Class 4, d = 1.67; Class 3 vs. Class 4, d = 2.03) and figure-of-eight test (Class 1 vs. Class 2, d = 1.27).

The analysis of variance revealed significant differences between the classes in the T-test, however, the post-hoc analysis found that the differences observed between Class 1 and Class 2 were still above the significance threshold (p = 0.054), and for that reason they were not shown graphically.

The results of the correlation analysis are shown in Table 3. Significant moderate positive correlations were found between sitting height and functional classification, as well as between sitting reaching height and functional classification.

Other correlation coefficients show that there is no significant relationship between anthropometric characteristics and agility, agility and functional classification, or other anthropometric characteristics and player functional classification.

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Table 3. *Correlation between anthropometric characteristics, agility and functional classification of wheelchair basketball players*

Spearman's (*r*)	T-test	Figure-of-Eight test	Class
Sitting height	.159	-.019	**.456****
Sitting reach height	.089	-.020	**.393***
Arm span	-.199	.125	.214
Forearm circumference	.101	-.110	-.046
Upper arm circumference	.044	-.113	-.126
Forearm skinfold	-.033	.184	-.116
Bicep skinfold	.044	-.157	-.274
Triceps skinfold	-.039	-.170	-.288
Suprailiac skinfold	.179	-.222	-.273
Subscapular skinfold	.092	-.006	-.020
Class	.019	.252	/

** - correlation is significant at the $p < 0.01$ level; * - correlation is significant at the $p < 0.05$ level.

DISSCUSION

This study was conducted with the aim of determining: (1) differences in anthropometric characteristics and agility between different functional classes of wheelchair basketball players and (2) the association between anthropometric characteristics and agility with the functional classification of wheelchair basketball players. The results showed that there were significant differences with very large effects between classes in body mass, sitting height, and sitting reach height (d = 1.31; 1.31; 1.46, respectively), as well as large effects in the tests for the assessment of the Figure-of-Eight and the T-test (d = 0.90; 1.03, respectively). Furthermore, the correlation analysis revealed a moderate but significant relationship between sitting height and sitting reach height and functional classes of players. Finally, no significant association was recorded between anthropometric characteristics and agility, nor between agility and functional classification.

Significant differences in body mass with very large effects occurred between Class 4 players who had a significantly higher body mass compared to players belonging to Classes 2 and 3, but not significantly higher compared to players with the lowest functional capacity (Class 1). The results are in agreement with previous research, where it was also confirmed that players of higher classes are heavier compared to their teammates of lower classes (Gil et al., 2015; Yanci et al., 2015; Zacharakis et al., 2020). Such results are expected. However, it is interesting that Class 1 players have a higher body mass than Class 2 and 3 players, but not significantly. A possible explanation for this trend is that Class 4 players have the highest body mass because they have full functional capacity. Body weight declines in lower grade players due to the nature of injuries or illnesses that lead to atrophy in the lower body or amputation of one or both lower limbs. However, as a consequence of the excessive reduction of muscle mass, due to atrophy of the muscles of the lower extremities and reduced trunk control, there is an increase in the fat component (Laughton et al., 2009) and a different distribution of adipose tissue and thus excessive accumulation in the abdominal region (Buchholz & Bugaresti, 2005; Cavedon et al., 2018). In present study, no significant correlation was recorded between body mass and functional classification, while Gil et al. (2015) reported a significant positive correlation (r = .68). This result should be viewed with caution considering that the research included a small number of respondents (N = 13). Sitting height and sitting reach height differed significantly between classes. It is evident that players of Class 4 have a significantly higher sitting and reaching height compared to players of lower classes (except for sitting height between Classes 4 and 3). Such differences between players of higher and lower classes have been confirmed in previous research (Cavedon et al., 2015; Gil et al., 2015; Yanci et al., 2015). However, in Greek wheelchair basketball players the differences were not significant (Zacharakis et al., 2020). Also, our

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results showed that sitting and sitting reach height significantly positively correlate with the functional classification of players. Similar results were reported by Cavedon et al. (2015) in 52 young wheelchair basketball players, also classified into four groups. Cavedon et al. (2015) further explain that the sitting reach height is achieved when the body is extended so that the angles of the shoulder and elbow joints approximately reach an angle of 180° and such a position depends on the amplitude of movement of the upper body parts. Furthermore, some spastic disorders are often associated with reduced range of motion in one or more joints, thereby reducing the player's ability to lift the upper limbs. In summary, the degree of impairment of a player determines the seated reach height, which is considered to be significantly related to performance in field tests to assess speed, agility and situational motor skills of wheelchair basketball players (Cavedon et al., 2015; Cavedon et al., 2018), which was not confirmed in our study. Accordingly, further research is needed in order to obtain additional information about the relation of sitting reach height with various kinetic and kinematic parameters that are part of wheelchair management, but also the success in performing certain elements of the game itself. The results of tests for the assessment of agility showed that there are significant differences in relation to the functional classification. It is interesting that in agility tests the best results were achieved by players of Class 2, and the weakest by players of Class 1. However, a significant difference between these classes was confirmed only in the Figure-of-Eight test. The T-test revealed significant differences between all classes, but not individually between classes, which is in agreement with the findings of several studies (Yanci et al., 2015; Molik et al., 2010; Tachibana et al., 2019). Previous research also reported that lower class players achieved better results in other tests of agility (figure-of-eight, slalom, etc.) and acceleration (5 m, 20 m) compared to higher class players (Gil et al., 2015; Tachibana et al. al., 2019; Ceruso et al., 2022).

A possible explanation is that players of lower classes (functional abilities) are more dependent on wheelchairs during daily activities. As a result, they have different propelling biomechanics and energy efficiency compared to higher class players and even fully functional players (Croft et al., 2013). Also, Gil et al. (2015) reported that there was a significant association between years of wheelchair use and the ability to perform 5 and 20 m acceleration and agility tests. Therefore, it is not surprising that in our study, Class 2 players, who use their wheelchairs for daily activities, while having better trunk stability than class 1 players, performed better in agility tests compared to higher class players who use wheelchairs for training and competition only. In present study, no association of agility tests with functional classification were recorded, which is in agreement with the research of Ceruso et al. (2022) where also no correlation was noted between the official IWBF classification and field tests for speed, and agility.

It should be noted that this study has certain limitations. The first and main limitation is the small sample of participants, which to some extent reflected on the results in terms of concealing potential differences between functional classes, especially for some variables where there was a large effect of differences. A small sample of participants is a frequent problem in research with such a specific sample and brings with it certain difficulties in drawing conclusions and comparing results. Second, in this study the testing was conducted during the tournament, as this was the only way to collect a sample with similar characteristics (elite wheelchair basketball players from the region). Given the time constraints during testing, the choice of motor skills and ability tests was limited.

CONCLUSION

Based on the analyzed results, we came to the conclusion that body mass, sitting height and sitting reach height are anthropometric characteristics that differ significantly in relation to the functional classification of players. The difference between players of higher classes compared to players of lower functional classes is especially noticeable. Also, agility as a very important ability to maneuver the wheelchair differs in relation to the functional classification, but more in favor of players of lower classes. Future research should repeat this similar study, but on a larger sample in order to obtain more precise information about the sensitivity of the functional classification, which some authors consider to be subject to revision. Also, the database of motor tests adapted and validated for wheelchair basketball players should be expanded. Future research should also examine to a greater extent the biomechanical parameters of wheelchair basketball players and their potential impact on classification, motor skills, and performance indicators in the game.

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SAŽETAK

Ciljevi ovog istraživanja su bili da se utvrde: (1) razlike u antropometrijskim karakteristikama i agilnosti između različitih funkcionalnih klasa košarkaša u kolicima i (2) povezanost između antropometrijskih karakteristika i agilnosti sa funkcionalnom klasifikacijom košarkaša u kolicima. Uzorak ispitanika činilo je 40 košarkaša u kolicima, uzrasta 33.9 ± 11.2 godina. Procenjivane su antropometrijske karakteristike (longitudionalne i cirkularne dimenzije, kožni nabori), a za procenu agilnosti korišćeni su modifikovani T-test i osmica test. Rezultati jednosmerne analize varijanse ukazuju na postojanje značajnih razlika sa veoma velikim efektima između igrača različitih funkcionalnih klasa kod telesne mase, sedeće visine i sedeće dohvatne visine, dok su značajne razlike sa velikim efektima zabeležene kod testova za procenu agilnosti: T-testa i osmice testa. Takođe, rezultati korelacione analize ukazuju na to da postoje značajne umerene pozitivne korelacije sedeće visine i dohvatne visine sa funkcionalnom klasifikacijom.

Ključne reči: *invaliditet, t-test, sport, motoričke sposobnosti, sportisti*

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Guideliness for Authors

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.

General remarks on papers

All manuscripts are submitted to the journal's editors, who, after reading the manuscripts, decide about the further procedure: (1) the manuscript is immediately sent for review; (2) if there are any objections and suggestions, the manuscript is sent back to the author for corrections; (3) rejection of the manuscript. The editor may decline the manuscript in the following cases: (1) the topic of the manuscript is not relevant; (2) a manuscript with a similar topic has already been published in the journal; (3) the manuscript does not conform to the standards of the journal. If the manuscript is not accepted, a short notice is sent to the author, but the manuscript is not sent back. The process of preliminary evaluation lasts up to 4 weeks. 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:

• Original scientific paper is a first publication of original research results in a form that the research can be repeated, and the asserted facts verified. It is organized in accordance with the IMRAD scheme for experimental research or in a descriptive way for descriptive science areas.

Uputstvo za autore

Namjera časopisa

Časopis SportLogia iz oblasti sporta i fizičkog vaspitanja izdaje se dva puta godišnje i objavljuje izvorne naučne članke, pregledne naučne članke, kratke naučne članke, izlaganje sa naučnog skupa i stručne članke iz područja sporta i sportskih aktivnosti, fizičkog vaspitanja, rekreacije, kineziološke antropologije, trening metoda, biologije sporta i vježbanja, sportske medicine, biomehanike, istorije sporta i menadžmenta u sportu kao i priloge iz drugih nauka (medicine, sociologije, psihologije, filozofije, prirodnih nauka i matematike) primjenjenih na sport.

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Svi rukopisi dostavljaju se uredništvu časopisa koji, nakon što ih pročita, određuje dalji postupak: (1) odmah šalje rukopis na recenziju; (2) ako ima određenih primjedbi i sugestija, rukopis vraća autoru na doradu; (3) odbija rukopis. Urednik može da odbije rukopis u sledećim slučajevima: (1) tema koju obrađuje rukopis nije relevantna; (2) rukopis sa sličnom temom već je objavljen u časopisu; (3) rukopis ne ispunjava standarde časopisa. Ukoliko rukopis nije prihvaćen, autoru se šalje kratko obavještenje, ali rukopis se ne vraća.

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Svi članci obavezno podliježu recenziji. Za svaki članak predviđena su dva recenzenta iz relevantne naučne oblasti i oba su anonimna Imena autora takođe su i za recenzente anonimna (double blaind recension). Ukoliko članak, prema mišljenju recenzenata, ne zadovoljava kriterije časopisa, uredništvo članak ne prihvata. Postupak recenzije traje 8 do 12 sedmica. Ukoliko pak recenzenti pozitivno ocjene članak, svrstavaju ga u jednu od kategorija:

• Izvorni naučni članak predstavlja prvu objavu orginalnih istraživačkih rezultata u takvom obliku da istraživanje može da se ponovi, a utvrđene činjenice da se provjere. Organizovan je po šemi IMRAD za eksperimentalna istraživanja ili na deskriptivan način za deskriptivna naučna područja.

Guideliness for Authors

• Scientific work review is a review of papers on a specific topic, works of an individual researcher or a group of researchers whose aim is to summarize, analyze, evaluate or synthesize already published information. It brings new syntheses which also include results of author's own research.
• Short scientific article is an original scientific article which may skip some elements of IMRAD. It concisely presents results of a completed own research or of an ongoing research.
• Scientific gathering presentation is a comprehensive article that has previously been briefed to a scientific gathering, but it has not been published in its comprehensive form in the Paper Collection Book of the gathering.
• Professional article is a review of something that is already known, with an emphasis on the usability of the results of the original research and the spread of knowledge. The complexity of the text is adjusted to the needs of the professional and scientific aspects of the journal. After reviews have been done, the editorial board will analyze them. If needed, the paper is sent back to the author who must comply with the suggestions and objections made by the reviewers. Once they have redone the paper, the authors need to specifically describe, on a separate sheet of paper, how they have resolved the reviewer's suggestions.
Only those papers that have been placed in one of the categories and which have two positive reviews will be published.

Text style and organization
Scientific articles must adhere to the IMRAD scheme (Introduction, Methods, Results and Discussion).

Title
The title page of the manuscript should contain the following information: (1) a concise, but informative title. Use of abbreviations is not encouraged; (2) the author's names (do not include degrees); the last one is introduced by "&"; (3) the affiliation of the authors, town and state; (4) the name and address of the corresponding author (must include title, degree and position of the corresponding author, phone and fax numbers - zip code for the country and city, and email address).

Summary, large summary and key words
The summary should be brief and Self-explanatory. It should cover a general presentation of the topic

Uputstvo za autore

• Pregledni naučni članak predstavlja pregled najnovijih radova o određenom predmetnom području, radova pojedinog istraživača ili grupe istraživača sa ciljem da se već publikovane informacije sažmu, analiziraju, evaluiraju ili sintetizuju. Donose nove sinteze koje, takođe, uključuju I rezultate sopstvenog istraživanja autora.
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Naučni članci se organizuju po šemi IMRAD (Introduction, Methods, Results, i Discussion).

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Naslov rada treba da sadrži sledeće informacije: (1) kratak ali informativan naslov u kome se ne preporučuje korištenje skraćenica; (2) ime autora bez titule gdje se ispred posledenjeg autora stavlja "i"; (3) institucija u kojoj autor-i radi, grad i država; (4) ime i adresa autora predviđenog za korespodenciju (naučno zvanje, položaj, broj telefona i faksa, poštanski broj grada, državu i e-mail adresu).

Sažetak, veliki sažetak i ključne riječi
Sažetak treba da bude kratak i razumljiv sam po sebi. U sažetku se ne traba pozivati na tekst članka. Treba da obuhvati opšti prikaz teme (predmet i cilj rada), rezultate i zaključak. Autori ne bi trebali da tom prilikom koriste skraćenice. Sažetak treba da sadrži 150-250 riječi. Velik sažetak ne smije da pređe 1800 karaktera (do tri stranice u duplom proredu), i treba da sadrži naslov rada, ključne riječi i tekst sažetka.

Guideliness for Authors

(the purpose and the objective of the paper), results and conclusions. Authors should not use abbreviations. The abstract should include 150-250 words. Authors from abroad write the large summary in their native languge (the summary has to be reviewed), and the authors whose native language is BCS write the mentioned summary in one of the official languages of the IOC Assembly (article 27 of Olympic Charter), except English. The translation should be made by relevant person. Large summary should not exceed 1800 characters (up to tree pages of double spaced text), and should include title, keywords and summary text. Three to six words, which are not part of the title, need to be singled out. The Key words need to reflect the contents of the paper.

Introduction

This part of the paper ought to inform the reader of the issues dealt with in the research and the results of previous analyses. The purpose of the research should also be clearly stated in this part.

Methods

This part should consist of the following subtitles: entity sample, variables, procedures, tastings, statistical analysis. Units of measurement, symbols and abbreviations must conform to international standards. Measurements of length, height, weight and volume should be given in metric units (meter, kilogram, liter).

Results

The results should be presented as tables, graphs and pictures, possibly processed statistically and be concisely presented in the text.

Tables, graphs and pictures showing the results of individual analyses need to be indicated in the text for easier reader navigation.

Discussion

The authors are expected here to comment on the results and compare them with literature data. The discussion must be professional and correspond to experimental data. Practical implications are welcome.

Conclusion

Contains clearly stated scientific assertions, open issues and recommendations for further research.

Tables, graphs and pictures

Each table and any illustration (black and white only) must be submitted on a separate sheet of paper. Tables should be numbered in the order in which they occur in the text and referred to as, for example, "Table 1". Each table should be accompanied by a short title. Tables should be accompanied with interpretations (legends). It will also be deemed informative if the tables include indications of important

Uputstvo za autore

Autori iz inostranstva veliki sažetak pišu na maternjem jeziku (sažetak mora da bude lektorisan), a autori kojima je maternji jezik BHS ovaj sažetak pišu na jednom od jezika Međunarodnog olimpijskog komiteta, naravno osim engleskog, na koje se simultano prevodi na svim Skupštinama MOK-a (član 27 Olimijske povelje). Prevođenje mora da uradi stručna osoba. Potrebno je izdvojiti i dati tri do šest ključnih riječi koje se ne nalaze u naslovu. Ključne riječi moraju da odražavaju suštinu sadržaja rada.

Uvod

Ovaj dio rada treba da informiše čitaoca o problemima datog istraživanjai rezultatima prethodnih analiza. Cilj istraživanja takođe treba jasno navesti u ovom dijelu.

Metode

Ovaj dio treba da se sastoji od sledećih podnaslova: uzorak entiteta, varijable, procedure testiranja, statistička analiza. Mjerne jedinice, simboli i skraćenice moraju da poštuju međunarodne standarde. Mjere dužine, visine, težine i zapremine moraju da budu u metričkim jedinicama (metar, kilogram, litar).

Rezultati

Rezultati bi trebalo da budu predstavljeni kroz, tabele, grafikone i slike, statistički obrađene i koncizno interpretirane.

Tabele, grafikoni i slike koje pokazuju rezultate pojedinih analiza trebaju da budu naznačene u tekstu kako bi se pažnja čitaoca skrenula na njih.

Diskusija

Od autora se očekuje da iznesu dokaze istraživanja i da ih uporede sa dosada objavljenim istraživanjima u toj oblasti. Diskusija mora da bude stručna i u skladu sa podacima eksperimenta. Poželjno je da diskusija obuhvati i praktične implikacije rada.

Zaključak

Sadrži jasno izrečene naučne tvrdnje, otvorena pitanja i preporuke za daljnja istraživanja.

Tabele, grafikoni i slike

Svaka tabela, grafikon i slika (samo u crno bijeloj tehnici) treba da bude dostavljena na posebnom listu papira. Tabele treba da budu numerisane po redoslijedu kojim se pojavljuju u tekstu i označena kao npr. "Tabela 1". Svaka tabela treba da ima kratak naslov. Potrebno je dodati legende za tabele. Takođe bilo bi informativno ako bi se u tabelama naznačile značajnije korelacije i značajnije varijable. Tabele treba posebno priložiti.

Ilustracije, grafikoni i slike obilježavaju se sa "Slika 1". Fotografije se šalju u elektronskoj formi u rezuliciji najmanje 300 dpi i formatu .tif (slike) i .eps (grafike). Svaka slika treba da ima kratak naslov.

Guideliness for Authors

correlations and relevant variables. Tables should be submitted separately.
Illustrations, graphs and pictures shall be marked as "Figure 1". Photographs are sent in electronic form in a resolution not smaller than 300 dpi and in a .tif (figures) and .eps (graphics) format. Each figure needs to have a short title. In case that the figures are taken over from another paper, the title should not include the original name. In such a case, the source where the picture was taken from should be indicated under the picture.
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