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Abstract: Like every other social manifestation, sport also had a dynamic development during its history. This dynamism has been analyzed in accordance with the role which sports has in society and in the lives of individuals. The paper gives an analysis of the development of sports and the prevailing concepts on this development viewed from the aspect of two basic approaches to the role of sports: finalistic and instrumental. The explanation of these two roles in the period of sports development, a different perception of the role of sports, the manifestation components and modalities of sports give the possibility to differ between several characteristic concepts of sport: the (1) humanistic, (2) classicist or academic, (3) national-political and (4) utilitarian-economic concepts. They mark the development and changes in sports which are characteristic for the period from the end of the 19th century until today. The analysis of these concepts of sports does not indicate the direction of analyzing historical periods, but points out the characteristics, ideas and values represented in certain concepts, also describing the relationship and role of society in sports within each separate concept.

Key words: the role of sport, concepts of sport

INTRODUCTION

What is the role of sport in society, and what in the life of an individual? There are two basic approaches in seeking the answers for these and similar questions – finalistic and instrumental. According to the finalistic approach, the significance of practicing a sport is in realizing the aims which are an expression of the nature of the sport itself. People practice sports due to the satisfaction it offers them, the satisfying of their natural need for movement and physical exercises.
Sports activity is valuable in itself. It appears spontaneously when conditions for it exist. Practicing sports and an interest for sport go together, bringing about rich and dynamic experiences. The second approach to understanding the role of sports is instrumental. Sport is only a means – an instrument – for carrying out individual, group and social aims – numerous and various effects which are outside of sport itself. In short: people practice sports primarily due to aims which by their meaning and contents are outside of sports, while sports are an efficient and a relatively optimal means which can make them accessible.

There is a reason to claim that the instrumental approach is closer to the needs of contemporary man and society. This is also shown by the basic concepts on the role of sports in the lives of individuals and the community.

Based on everyday events in sports and around sports, the opting of people for different forms of participation in sports activities, as well as the typical behavior of contemporary sports clubs, organizations and their prominent members, activists and managers, it is possible to conclude that there is general agreement that sport is necessary, useful, that it has or can have a significant role in the life of the community, in social groups and the life of every individual. Negative manifestations which make up the “other face of sport” are not attributed to sports, as they are not inherent to sports. It is believed that they are possible to control to a certain extent or even remove totally. However, with these general conclusions about the positive, simple side of sports and the events which make up its other, dark side, all agreement on the comprehension of the nature of sport, its aims and possible impact on the social and individual plan is ended.

THE CONCEPTS ON THE SOCIAL AND INDIVIDUAL ROLE OF SPORTS

If it is taken into consideration that during more recent history, sport has undergone abrupt changes and developed its contents and organizational aspect and that these changes were mainly a reflection of an ever-wider acceptance of sports as one of the most significant domains of social life, the following question can be asked: is there in the foundation of these different concepts of basic components and modalities of contemporary sports one or more concept which enables a strategic approach to sports – the perceiving of the basic values and
normative, practical and operational problems in sports?* It is usually concepts which take on the role of these non-formalized perceptions on the aims and tasks of sport. It is possible to differentiate between several contemporary concepts on the social and individual role of sport, among which according to their comprehensiveness and scope, four concepts are the most prominent. They stand for the general relationship towards sports during newer times – from the end of the 19th century until today.

Chronologically speaking, the universalistic concepts of sports – the humanistic and classicist - were the first to occur. Their roots are in the ancient and enlightenment periods. But with the abrupt development of organized sports, which occurred with the strengthening of civic society, as well as due to social changes at the end of the 19th and 20th centuries, particularistic concepts – national-political and utilitarian-economic – were prominent in most developed countries. All the mentioned concepts continued to be represented in the sports lives and general cultures of contemporary societies, but the national-political and utilitarian-economic concepts prevailed.

This paper is not involved with the history of these concepts, but with their basic ideas to the extent to which they are represented in contemporary sports life, and eventually, the relation of society towards sports.

THE HUMANISTIC CONCEPTION OF SPORTS

The practice of sport is a human right. Every individual must have the possibility of practicing sport in accordance with his needs.

Olympic Charter,
Fundamental principles

The humanistic concept of sports perceives a significant living content which should be accessible to all people, wherever they live, whichever activity they practice. It points to a full range of sports activities which engage the physical, psychological and social potentials of the individual and which make sport a significant and inimitable

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* Some components are formalized in the Law on Sports and other state documents. In the second half of the 20th century, there were several scientific-professional discussions among sports theoreticians and practitioners which defined the elements which might be the starting points to formulate one or more concepts of the social role of sports, such as for example, Polič, B. et al., (1980): Society and physical culture, collection of works, Workers’ University Veljko Vlahović, Subotica.
condition for a full, balanced psychophysical and psychosocial development and functioning of every individual. The humanistic value of sport especially comes to the fore in the stimulating and directing of the development of children and youth, and the shaping of individual and social behavior of the members of the newer generations. Sport is a general advantage which has the capacity to offer satisfaction and joy to everyone who accepts it freely and with a personal engagement. It is up to society and its leading institutions to create the conditions for this extent of engagement which can be created by all individuals, every human being, within an appropriate environment.

According to the humanistic concept, the basic values of sports and within sports are:

- **EQUAL OPPORTUNITY**: Everyone has the same rights to practice sports within the limits of their possibilities; men and women, young and older people, and individuals from rural and urban environments. At the same time, equality is a value which is aimed at and a standard upon which the social character of sports is assessed.

- **INCLUSIVITY**: Every child, every young man and woman, every adult and every elderly person, every individual regardless of large or small physical limitations should be offered the stimulus to be included in some sort of practicing of sports.

- **ACCESSIBILITY**: Most sports and sports activities should be accessible to everyone who wishes and loves to practice sports. If young people, as well as the general public, cannot enter the sports environment just like they can go into a city park, practicing sports becomes a privilege of the select in that kind of environment. – Accessibility is a basic value, as sports can be very demanding in regards to conditions and means which should be at the disposal of those who wish to participate in them. The alternative to sports can be activities which jeopardize personal growth and a productive life.

- **MASSIVENESS**: All children and youth, as well as all adults, should know everything about sports, about sports sites, as well as about the experts which are at their disposal for advice, instructions, support and direction. Massiveness is not only a pragmatic issue, it is also an issue of the quality of the social system and setting. Massiveness is a value which is based on realizing the principles of equality, inclusivity and accessibility, as well as systematic informing.
EXCEPTIONALITY: The manner and extent of participating in sports are very numerous, from an informal or ad hoc improvised game, from a programmed aimed training, testing and confirmation at competitions, to achieving top records in all categories – personal, club, regional, national, international, Olympic. For many young people, especially those who see in sports a possibility of self-actualization, it becomes an area of dedication, high aspirations and exceptional results.

The mentioned values are represented in democratic societies, in their national visions of the role of sports.*

The humanistic concept especially emphasizes the role of sports in the creative structuring of free time. Sports activities are a universal means to promote the quality of free time, and thus also other areas of the life of contemporary man. As contents of free time, sports are accessible to both young and old people, regardless of social class. Sport not only reflects and builds up physical and mental health, it also enriches and ennobles life with the social environment it creates.

The value and practical significance of the humanistic concept is very receptive to the governing principles of a concrete social system, a political-economic order, national and regional culture, religious creed and practice. One of the aims of the humanistic concept is for the borders of this kind to be opened and overcome.

According to the humanistic concept, the task of society is to create conditions for a balanced development of all areas of sports, starting from the most massive forms such as school or developmental sports, amateur or activist sports, recreational or health, up to top or elite competitive sports (Havelka and Lazarević, 1981).

One of the variants of the humanistic concept which from the middle of the last century was merely theoretical and partly also practically developed in professional sports circles in this country, and which is still the foundation of the appraisal of sport, physical exercising and recreation is the understanding that physical culture is a significant segment of general culture, whether culture is viewed from a national or international aspect, or generally the aspect of contemporary civilization. The expression “physical culture”, rejected by many contemporary theoreticians, who replaced it with the term “sports”, relates to the

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* For example: The national strategy for youth in the Republic of Serbia, 2008; Proposal to the Law on sports, 2009; documents of the Olympic Committee, European National Sports Confederation, NGO – European non-governmental sports organizations.
concept which is significantly broader and more comprehensive that the concept of sports. The concept of physical culture encompasses (1) sports, which includes developmental or children’s and youth sports, standard or competitive amateur, and top or competitive elite sports, (2) P.E. classes in schools, (2) recreational sport in sports centers of the local community and companies, as well as (3) massive sports manifestations, as for example sports meets, competitions and other events for the general public.

CLASSICIST OR ACADEMIC CONCEPTS

The classicist concept of sports is related to esthetic ideals and aims in the regard of physical exercises and body shaping. The primary function of participating in sports is the cultivating of the body and body movements, in order to achieve beauty and harmony. Within the framework of the classicistic concept, there were various artistic and stylistic movements whose aims in the area of body shaping veered towards “ideal proportions, the harmony of movements in the structure of the game, linking body movements, dance and music.” The classicist concept is largely exclusive, even though it can be represented on different social levels. Its exclusivity lays more in the nurturing of ideals of youth and beauty than in the accessibility of sports and the quasi-sports activities via which it is realized.

The classicistic concept has a broadly accepted academic variant. The academic concept propagates sports activism, ideals characteristic for youth and generally amateur sports. It is important to participate in organized sports activities, and other participants should be respected and supported.

In the first place is the ennobling of social life, and with this also the personal life of the participants in sports activities. A great significance is given to mass sports events and games.

NATIONAL-POLITICAL CONCEPT

With the development of international sports associations and numerous world and regional competitions, top sports have increasingly and definitely taken up a primary and central position in the sports life of certain nations (states). International competitions were instrumental for the founding of certain ideological values and attitudes. Sports is understood as an area which highlights the qualities of a nation in regards to its vitality, psychophysical abilities, the need for prominence.
and willpower or decisiveness to be the best or a member of a narrow, exclusive circle of an elite.

The competing for international prestige, for the rating of a state on the international level, is linked with patriotic feelings in athletes, and the sports public and citizens in general. Within the framework of the national-political concept, three pragmatic orientations dominate:

- The strengthening of the country’s defense forces – a mentally and physically strong population is the foundation of defense.
- Confirmation of a nation – the expressing of the values of a nation through success in sports, owing to the comparative position on the competitive rank lists.
- Promotion of current politics – the endorsement of politicians and political parties through public performances in society with the most successful and popular athletes.

This concept stresses that sports activities realize their full value, even their full sense, when they are carried out in front of a broad, general public. Special significance is given to celebrating and observing sports successes, and not only in those sports which traditionally attract the most spectators, but also those which are not talked about much outside confined sports circles.

THE UTILITARIAN-ECONOMIC CONCEPT OF SPORTS

This orientation in the understanding of the social and individual role of sports is a consequence of social development and changes which have taken place or are still taking place in a large number of countries. In many countries, sports are partly or totally directed towards market conditions, and the appropriate state institutions have retained only the commitment to secure financial support for the representative sport. However, both representative and top sports demand much greater funds than those which the states are prepared to earmark. Creating elite athletes and achieving top results is a very demanding and long-term process which requires increasingly greater investments, which directs sports towards market commerce, that is, a consistent compliance with economic principles. Sport has increasingly become a branch of commerce, or to be more precise, has taken on the characteristics of commerce – professionalism, commercialization, organization and management according to the logic of economic models. Today sport is a significant branch of production, services and consumption. No longer is there a reluctance to talk about top athletes in terms of production and sale, comparable to material production and trade, encompassing
everything from building modern stadiums, halls, swimming pools, to building sports objects and equipment, and to creating “branded” sports clothes, shows and other merchandise intended not only for sports fans but also for the general public.

When we are talking about the professionalizing of sports, we imply the following:

- Sport as a profession – for athletes and various experts (coaches, managers, physicians, physiotherapists, psychologists, etc.)
- The market of sports talent, recorder breakers and experts, clubs and schools, etc.
- When speaking of sports as a branch of commerce, this implies:
  - The building of sports and recreational centers;
  - Production of sports equipment, clothes, shows, etc.;
  - Rendering services – recreation, training, sports tourism;
  - Sports spectacles;
  - Sport as a promoter of a consumer style.

Today we can see two groups of managers or administrators in sports – for some, sports is unique, distinctive and should not be managed in the same way as a business activity, and for others sports is a part of the business world and needs to accept the principles and standards which prevail in that area. A third group accepts both attitudes, depending on the situation: the large clubs which make up division one and participate in events on the international scene are business organizations, while volunteer sports organizations focus only on the specific characteristics of sports and in that sense are unique cultural and sports endeavors.

The critical appraisal of the commercialization of sports should be given consideration. Commercialization directs the development of sports towards an increasingly higher degree of professionalization, bureaucratization and specialization, as well as leading to an undervaluing of the needs of the community and the developmental and recreational function which sports has in relation to the members of this community. Objectively speaking, contemporary sport is commercially complex, absolutely dependent on professional, worthy and developed management. According to contemporary standards, sports cannot be successful either on the level of the global or the local community if it is exclusively based on amateurism and occasional volunteer engagements.

Even though in sports the tradition of amateur, free and intrinsically motivated engagement is highly valued, sports organizations and clubs more and more visibly opt for management modeled after commercial companies. For, it is not only administrative workers who
have employee status, but also players, professional and technical personnel and the entire management structure. If sports organizations wish to have a steady quality of activities, to realize planned results and for the operative whole to function successfully, they cannot rely any more on management for satisfaction, prestige and entertainment, disregarding the principle and management models which are affirmed in the commercial world. Prominent and deserving individuals, also including present top politicians, that is, individuals who love sports and are ready to set aside some free time and work capacities, can have a significant role in securing the support to the organization, reinforcing resources and cooperation with the environment, but the basic functions of managing the organization must remain in the organization itself, in the jurisdiction of the professionals employed in the organization.  

Management in sports is faced with the problem of opting for some of the concepts or, which is even more likely, creating an optimal combination of conceptions. Judging by the existing professional literature, as well as sports practice, the utilitarian-economic concept is increasingly dominant.

The authors who propagate the economic-utilitarian concept stress that today many sports organizations aim for profit as well as first place in the competition system (Smith & Stewart, 1999). Managers today are forced to convert the available human and material resources (especially players) into economic equations in which the division of labor, efficiency, regulation, rational work procedures and control management become crucial management issues. Sport is a special form of business, but it is not so unique that it cannot be put within a commercial framework.

During the last half century, and especially the last three decades, the trends of stressed commercialization and professionalization have penetrated all the areas of sports and changed it immensely. Sport has become a complex construction of business endeavors which has established a new area of competition in sports – a struggle for maximum commercial effects in conditions of strong competition. The commercial complexity of sports is best manifested in the preparations and realization of the largest international competition – the Olympic Games. Over 10,000 athletes gathered at the Olympics in Peking from over 200 countries. The copyright sales for TV broadcasts and use of

* This comment is necessary as often “experienced”, “prominent”, “influential” and similar individuals who are not integrated into the organization are given key positions, or even worse, their ad hoc decisions have ultimate power, and staff must defer to them and carry out their decisions.
Olympic logos, mascots and other symbols for commercial use covered one third of the costs of the preparations which amounted to billions of dollars. From the Olympic Games in Sidney (2000), to the ones in Athens (2004), the financial costs were fourfold, which also happened with the Olympic Games in Peking in 2008. Sports are still the central contents of the Olympics, but not the only one, and not even the largest generator of financial gain. The number of new records set speaks of the quality of sports, and the number of medals testifies as to the sports development of the participating countries. The success of the games as an event does not only depend on the quality of sports activities and set records, but also on the intensity of economic activities and the quality of the total management of the games. The preparations for the Universiad (the Student Olympics) in Belgrade in 2009 showed what a complex endeavor it is and that efficient management is a condition for success.

The organization and realization of large sports events clearly shows how sports have changed in the last twenty to thirty years and that the maintaining of the achieved level and especially the developing of national sports necessitates highly trained staff of various profiles in order to secure successful results. Sports organizations vie in strengthening their financial funds and broadening the circle of sponsors, as well as capturing the interest of potential members, fans and the general public. Not only large, but small organizations as well are forced to make development plans, take on market research, and lead promotional campaigns with the aim to maintain their memberships, raise the activity level, develop new forms of activities, etc. All these changes strengthen the need for a permanently employed qualified and competent staff.

Today, in the international framework, there is an ongoing process of "managementization of sports" which contains in itself commercialization, professionalization and the standardization of activities and measuring of results. After athletes, the most numerous category in sports are coaches, followed by managers. Considering the nature of their work, managers are not a homogenous category. Along with athletes and experts of various profiles, there is also the sports community. The more complex the circumstances and activities are in sports and around sports, the more increased is the significance and role of psychological factors linked with the behavior of the participants.

In all the described developmental conceptions, the fact that sports is under the strong influence of society, the social system and the changes in it, is clearly recognized and thus, it in a large measure represents a reflection of social development and social events, and due
to the significance it is given, sports are realistically a very prominent
segment of social life. Sport is, however, at the same time also one of the
factors which significantly impacts many events in society, and partly
also its total development. Broad mobilizing influences and effects of
sports become attractive aims of the most varied social groups. This
confirms a significant relatedness between sports and society, a network
which is manifested in causal-consequential effects.

Due to differences in the development of society, social relations
and degrees of awareness of the significance of sports for society, there
are differences in the kinds, characteristics and degrees of development
of certain concepts of sports.

It should be stressed that certain concepts of the social and
individual roles of sports (for example, the national-political and
utilitarian-economic concept) put in the second place, or often totally
repress the original, authentic orientation to realize the humanitarian role
of sports. In other words, in the strategy of developing sports, the
authenticity of sports should be insisted upon, as well as the achieving of
their original values which are contained in the needs of humans to
develop through sport, and then in the very relevant fact that sport can
efficiently direct and stimulate the development of children and youth,
and shape their individual and social behavior. If the humanistic values
of sports are not repressed, participants have a discerning and creative
relationship with sports, which enables them to develop and improve a
wide range of personal competencies and to satisfy developmental and
social needs, which in turn contributes to achieving important personal
and social aims. This means that the most important characteristic of
sport in each of its segments, in every conceptual orientation, should be
its humanistic value.

The psychological dynamic has always been present in sports,
regardless whether we perceive, recognize, register, interpret, or actively
shape. Without motivation there is no inclusion, without learning there is
no performance, without strategically planned training sessions there are
no efficient and significant effects. The issue of the concepts of the
social and individual role of sports is constantly open. Social
circumstances change, though the interests and ambitions of people, the
life styles they have and towards which they aim change even more
quickly and extensively.

References:
THE RELATEDNESS OF CAUSAL ORIENTATIONS AND PERCEPTIONS OF BASIC PSYCHOLOGICAL NEEDS WITH THE MOTIVATIONAL APPROACHES OF SPORTS COACHES

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Abstract: The orientation of the motivational approach of coaches in the direction of supporting the autonomy or controlling the behavior of an athlete has theoretical as well as practical implications (Ryan & Deci, 2007). The aim of the research was to determine whether the motivational approach of coaches was linked with personal factors, operationalized through causal orientations, or with environmental factors whose impact was operationalized as the perceiving of some degree of the satisfying of basic psychological needs. Some 122 examinees were researched, students of the Sports College of Belgrade of both genders, aged between 19 and 38. The scale of a general orientation of causality was applied, a scale of the satisfying of basic psychological needs and a scale of a coach’s motivational orientation. The results show that the dominant approaches of future coaches are based on a high support of autonomy and a moderate control of athletes’ behavior. The motivational approaches of coaches are more significantly related with causal orientations than with the perception of basic needs. Research results show that especially significant for further research is the potential influence of personal and environmental factors on the motivational approach of coaches based on a moderate support of the athletes’ autonomy.

Key words: motivational approach, basic needs, causal orientation, autonomy, control
INTRODUCTION

There is a rift in professional literature regarding the issues of a congenital tendency towards psychological growth and development, distinctive independence and autonomous and responsible behavior. There are authors who see human nature as self-organized, with an innate tendency towards development and self-realization (Rogers, 1942; Maslow, 1982; Deci, 1996). Some other authors consider that it is more appropriate to speak of a human tendency towards conditioning and reactivity towards social stimuli (Watson, 1931; Skinner, 1973). The position on the essence of human nature is not just a theoretical but also a practical issue. The a priori belief of the essence of human nature essentially affects the behavior and performance of those who are in a position to have an impact on others, such as sports coaches.

The idea of the self-determination of behavior and consequently, accountability for personal performance, is linked with the belief that the individual has control over events (the inner locus of causality). The tendency towards behavior control is related with the belief that external factors (other people) or impersonal factors (coincidence or luck) control events. Deci and Ryan claim that there are individual differences in regards to the view of the location of causality (Deci & Ryan, 1985).

It is also considered that supporting autonomy or controlling the behavior of others is related with personal experiences which are formed under the influence of social factors. If the history of an individual who is in a position to decide about others contains the experience of autonomy, it is likely that such a person will also support the autonomy of others. And vice versa, the person who has experienced behavior control is most likely to apply the controlling approach when in the position to have an impact on others (Deci & Ryan, 1987).

The aim of this research was to determine if a coach’s motivational approaches are linked with the personal factors represented by individual differences in regards to causal orientation or with environmental factors which contribute or preclude the perceiving of the degree of satisfying the personal basic psychological needs of coaches for autonomy, competence or connecting with others. The general presumption was that the motivational approach of a coach was also related with environmental factors. The potential relatedness of a coach’s motivational approaches and environmental factors imply the usefulness of a systematic training of coaches in the direction of developing a motivational orientation and approach which is founded on the support of the autonomy of athletes. Research has shown that the experience of
self-determination and autonomy is positively linked with self-motivation and intrinsic motivation, general psychological well-being, mental health and an optimal functioning of the personality (Ryan & Deci, 2006).

THE THEORETICAL PART

Causal orientations

Explicit or implicit general motivational directions which are founded on the principle of a certain cause of personal behavior are called causal orientations. Deci and Ryan write about three types of causal orientations or orientations of causality: autonomous, controlling and impersonal (Deci & Ryan, 1985). Each one of these three causal orientations is present in every individual, though to a different degree. The degree to which each of these three causal orientations is represented indicates individual differences among individuals, which denote relatively permanent personality traits.

The autonomous causal orientations indicate the degree to which a person is directed towards the aspects of the environment which incite intrinsic motivation, enable optimal challenges and offer feedback on personal efficiency for a specific task. The individuals in whom these types of causal orientations are represented to the greatest degree will demonstrate much more personal initiative than individuals in whom the other two causal orientations dominate. They will seek actions which are appealing and which represent a personal challenge and will assume responsibility for their own behavior.

The controlling causal orientation indicates the degree to which the person is directed towards awards, deadlines, ego-inclusion, structurality and directness which comes from others. Individuals in whom this causal orientation dominates rely on awards and other types of social control. Such individuals are to a large extent “adjusted” to the demands of others, and not to what they demand from themselves. Feedback information is directed towards the maintaining of self-worth and a positive self-image, and not on efficiency in responding to a specific task.

An impersonal causal orientation indicates the degree to which an individual believes that the achieving of an aim or result is entirely outside his or her control, and that a specific achievement is largely the result of coincidence or luck. Those in whom this causal orientation dominates usually feel very anxious and inefficient. They feel they
cannot in any way have an impact on events or deal with the set demands or the occurring changes. They tend to be deficient on motivation and harbor the desire that everything remains “as before.”

**Basic psychological needs**

Empirical research, inspired by the theory of self-determination, has shown that there are three innate psychological needs (Deci & Ryan, 1985): a need for autonomy, a need for competence and a need for connection. These needs differ from the concepts of basic needs such as mentioned for example by Abraham Maslow (Maslow, 1982). The basic needs within the framework of Maslow’s hierarchy of human needs usually refer to the needs which are found at the foundation of this hierarchy – physiological needs. In the context of the theory of self-determination, these refer to the basic needs which are of a psychological and social nature. The satisfying of basic psychological needs for autonomy, competence and a connection with others contributes to the development of self-motivation, mental health and supporting the autonomy and competence of others. When the subjective experience of the degree of satisfying the basic psychological needs for autonomy, competence and a connection with others is hindered and when the degree of satisfying these needs is low or insufficient, there is a lessening of efficiency and self-motivation, a breakdown of general mental well-being and an inclination towards behavior control. Individuals whose basic psychological needs are not sufficiently met or have been hindered are most likely, when they have the opportunity to influence others, to use the approach which is based on behavior control.

The need for autonomy is related with the perception of an internal locus of control. When the locus (place) of control is internal, the individual has a subjective experience of “maintaining control over the situation” and feels that his or her actions are autonomous and self-determined. The feeling of autonomy is the main prerequisite for the founding and development of intrinsic motivation, mental health and the use of the approach which is founded on supporting the autonomy of others in situations when the individual has the opportunity to have an impact.

Competence relates to the feeling of efficiency in interaction with the social environment and the sense that there is a possibility to develop and use personal capacities. The need for competence directs individuals to search for challenges according to their potential, thus endeavoring to maintain and develop skills and abilities by using various...
activities. Competence is not an acquired skill, but a feeling of confidence in personal abilities and efficiency in action.

Connection relates to the feeling of belonging, the sense that there is involvement with other people and that others are involved with the individual, a relatedness with other individuals and the community at large. The need for a connection is not related with the achieving of a specific aim (for example, becoming the member of a group), but rather, correlates to the subjective feeling of security acquired by associating with others. It is considered, in the context of reviewing the motivation of adults and motivational approaches, that the need for a connection, in contrast with the need for autonomy and competence, has a more distal role (Deci & Ryan, 2000a).

**Motivational approaches of sports coaches**

The relationship between a coach and an athlete is a reciprocal process within which each one mutually impacts the other. Coaches do not behave identically towards all athletes. The behavior of a coach is a reaction to perceived behavior and the motivation of the athlete. However, the personal orientation of the coach, as a more permanent dispositional orientation, significantly impacts his a priori attitude regarding the approach which most efficiently motivates the athlete (Mageau & Vallerand, 2003).

There are coaches who feel that the autonomy of persons which are in some way in a subordinate position, such as is the case with athletes, should be respected and valued. Such coaches to a large extent show consideration for the feelings and personal states of the athletes and support their autonomy in work. The second type of coach puts more value on the use of control and holds authority in high regard. This kind of “controlling” coach regulates the way of thinking and behavior and offers extrinsic awards for development.

Even though a great deal of research has shown that the style which supports the autonomy stimulates intrinsic motivation and has a positive effect on the total psychological development and mental health, the controlling style continues to dominate in sports (Ryan & Deci, 2007). The aim of this research is to determine the kind of motivational approach upheld by our future sports coaches, as well as whether it is linked with personal and environmental factors which emphasize either autonomy or behavior control.
AIMS AND HYPOTHESES

The main aim of the research was to determine if the motivational approach of a coach is related with causal orientations, which are presumed to maintain dispositional individual differences in regards to an a priori belief in the causes of events, or with the perceiving of basic psychological needs which reflect personal experiences with social factors which either support or hinder the need for autonomy, as well as the need for personal competence and connecting with others.

The aim was also to investigate which kind of motivational approach dominates in sports coaches – whether the approach is one which supports athletes’ autonomy or behavior control.

The tasks of the research were also to determine the individual differences between coaches, i.e. which causal orientation is dominant (autonomous, controlling or impersonal) and whether environmental factors contribute to the perceiving of the satisfying of the psychological needs of coaches (for autonomy, competence and connecting with others).

The basic hypothesis is that the motivational approach of a coach is also linked with personal factors as causal orientations, but also with environmental factors which lead to the perceiving of a different degree of satisfying basic psychological needs for autonomy, competence and connection. It has been assumed that the approach of a coach supporting autonomy would be related with autonomous causal orientation, as well as with the perceiving of the satisfying of the need for autonomy and competence. By controlling the coach’s approach, it is assumed that it will be linked with the controlling and impersonal causal orientation and the perceiving of a low degree of the satisfying of the need for autonomy and competence.

METHOD

Variables and Instruments

Three variables were used, two independent and one dependent. The independent variables were causal orientation and the perceiving of the degree of the satisfying of basic psychological needs. The causal orientation was operationalized as autonomous, controlling and an impersonal orientation of causality, and the perceiving of the degree of the satisfying of basic psychological needs was operationalized as
perceiving the degree of the satisfying of the need for autonomy, the need for competence and the need for connection. The dependant variable is the motivational approach of the coach and was operationalized as high autonomy, moderate autonomy, moderate control and high control.

Three instruments were used in the research. Two of them were taken over from foreign authors, translated into Serbian and adapted. An instrument was created especially for the needs of this research.

The General Causality Orientation Scale was used to gauge causal orientations. The original instrument contains 12 vignettes and 36 items (Deci & Ryan, 1985). Each vignette describes a typical social situation or an achievement situation and is backed up with descriptions of possible reactions to situations which reflect an autonomous, controlling or impersonal causal orientation. On a seven-degree Likert-type scale, the examinee indicated to what extent it is possible to react in the described situation in each of the depicted ways. The scores on each of the three subscales (autonomous, controlling, and impersonal) reflected the relative representation of causal orientations. The reliability of the instrument in this research has been determined by Cronbach’s alpha equal to 0.75.

The perceiving of the degree of the satisfying of the basic psychological needs for autonomy, competence and connection was gauged by the Basic Needs Satisfaction Scale (according to Deci & Ryan, 2000b). This instrument gauged the subjective perception of the degree of the satisfying of the needs for autonomy, competence and connection with others generally. The scale contained a total of 21 items. Seven assertions related to the need for autonomy, six gauged the need for competence, and eight the need for connecting. The examinees assessed on the seven-degree Likert-type scale to what extent each assertion is correct. The value of Cronbach’s alpha in this research was 0.79.

To test a coach’s motivational approaches, a Scale of the Motivational Orientation of the coach was constructed for the needs of this research. The scale was modeled after similar instruments intended to test the motivational approach of individuals who are in some sort of position of authority, such as for example teachers (Deci, Schwartz, Sheinman & Ryan, 1981; Reeve, Bolt, & Cai, 1999). The coaches’ scale of motivational orientation consisted of 8 vignettes and 32 items. The vignettes described potential situations in which coaches can find themselves while working with younger athletes. For every described situation, four possible ways of reacting were on offer (high autonomy,
moderate autonomy, moderate control, high control). The examinee was asked to express his or her opinion on the seven-degree Likert-type scale on how appropriate each of the four described reactions was. The value of Cronbach’s alpha was 0.81.

Sample

The sample consisted of 122 examinees, first and second-year students of the Sports College of Belgrade, from the sports coaching department. The higher percentage of the examinees was males (78.7%), with 21.3% female examinees. The age of the examinees was from 19 to 38. More than half of the examinees (54.1%) were aged between 19 and 22, while only 10% examinees were over 28.

RESULTS

The obtained results show that a high orientation towards autonomy dominates as a motivational approach in future sports coaches (Mean=5.52, SD=0.71; t=86.561 p<0.01). The approach based on moderate behavior control (Mean=5.12, SD=0.83; t=67.618 p<0.01) follows, then the approach based on a moderate support of autonomy (Mean=4.95 SD=0.87; t=62.544 p<0.01), while a high orientation towards behavior control is in the last place (Mean=3.79, SD=0.91; t=45.929 p<0.01).

Diagram 1: Motivational approaches of sports coaches: HC – high control; MC – moderate control; MA – moderate autonomy; HA – high autonomy
The values of the t-test for the obtained average values have a statistical significance, but the high values of the standard deviations indicate potential individual differences, especially in regards to the motivational approach which is based on athletes’ behavior control. Thus, this, like all other analyses, has also been done alternatively – without an outlier. The results of these analyses are shown in Tables 2, 3, 4. Removing the outlier decreases the individual variations in responding to the items which gauge the four approaches to athletes, but the entire order of motivational approaches remains unchanged (Diagram 1).

The testing of the perceptions of basic psychological needs has shown that with future coaches, generally speaking, the need most satisfied is connecting with others (Mean=5.63 SD=0.74; t=83.804 p<0.01), followed by the need for competence (Mean=5.15 SD=0.78; t=72.734 p<0.01), while the least satisfied is the need for personal autonomy (Mean=5.08 SD=0.81; t=68.860 p<0.01). All the obtained average values have a statistical significance. When the outliers are removed (Table 3), the values of standard deviations are decreased, and the need for competence is only slightly more satisfied than the need for autonomy (Diagram 2). A positive or negative effect of social factors reflects primarily the perceiving of the satisfying of the need for autonomy. Considering that the need for autonomy is the least satisfied basic psychological need, it can be concluded that the impact of the general social factors to which the examinees from this research are exposed is not the most optimal.

Diagram 2: Basic psychological needs of coaches: AUTON – autonomy; COMPET – competence; RELATED – relatedness
The testing of the causal orientation shows that represented to the highest degree with future coaches is the autonomous orientation of causality (Mean=5.20 SD=0.67; t=85.120 p<0.01), followed by the controlling orientation of causality (Mean=4.58 SD=0.66; t=76.520 p<0.01), while the impersonal causal orientation is the least present (Mean=2.74 SD=0.95; t=31.747 p<0.01). All the obtained average values are significant, and the analysis of causal orientations was also done without an outlier (Table 4). The obtained results indicate that future coaches have an inner locus of causality to the highest degree, i.e. a belief that they have control over events. The belief that external factors, other people, coincidence or luck, manage events in their lives is present to a lesser degree. An impersonal causality, as a reflection of some kind of acquired helplessness, is the least represented as a general orientation of causality in young coaches (Diagram 3).

![Diagram 3: Causal orientations of sports coaches: AO – autonomous orientation; CO – controlling orientation; IO – impersonal orientation]

The working out of correlations shows that certain motivational approaches are linked with the perceiving of the degree of satisfying the need for competence and with causal orientations (Table 1). A correlational analysis was also without an outlier (Table 5), but except for specific values of a certain coefficient of correlation, the results did not change significantly. It was shown that motivational approaches, which are based on high behavior control and a moderate support of autonomy, were significantly negatively related with the subjective experience of the degree of satisfying the need for competence in life generally.
Mladenović, M.: The relatedness of causal orientations and perceptions...

Table 1: The relatedness of motivational approaches of coaches with basic psychological needs and causal orientations (N=122)

<table>
<thead>
<tr>
<th>Motivational approaches of the coach</th>
<th>Basic psychological needs</th>
<th>Causal orientations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Need for autonomy</td>
<td>Need for competence</td>
</tr>
<tr>
<td>High autonomy</td>
<td>-0.006</td>
<td>-0.060</td>
</tr>
<tr>
<td>Moderate autonomy</td>
<td>-0.002</td>
<td>-0.193*</td>
</tr>
<tr>
<td>Moderate control</td>
<td>0.158</td>
<td>0.021</td>
</tr>
<tr>
<td>High control</td>
<td>0.022</td>
<td>-0.215*</td>
</tr>
</tbody>
</table>

* p<0.05  ** p<0.01

Table 2: Motivational approaches of the coach (without an outlier, N=101)

<table>
<thead>
<tr>
<th>Motivational approach of the coach</th>
<th>Mean</th>
<th>SD</th>
<th>t-test</th>
<th>df</th>
</tr>
</thead>
<tbody>
<tr>
<td>High autonomy</td>
<td>5.52</td>
<td>0.63</td>
<td>87.245**</td>
<td>.000</td>
</tr>
<tr>
<td>Moderate control</td>
<td>5.18</td>
<td>0.76</td>
<td>67.907**</td>
<td>.000</td>
</tr>
<tr>
<td>Moderate autonomy</td>
<td>4.99</td>
<td>0.76</td>
<td>65.510**</td>
<td>.000</td>
</tr>
<tr>
<td>High control</td>
<td>3.78</td>
<td>0.76</td>
<td>49.516**</td>
<td>.000</td>
</tr>
</tbody>
</table>

** p<0.01

Table 3: Basic psychological needs of the coach (without an outlier, N=101)

<table>
<thead>
<tr>
<th>Basic psychological needs of the coach</th>
<th>Mean</th>
<th>SD</th>
<th>t-test</th>
<th>df</th>
</tr>
</thead>
<tbody>
<tr>
<td>Need for connection</td>
<td>5.69</td>
<td>0.67</td>
<td>85.059**</td>
<td>.000</td>
</tr>
<tr>
<td>Need for competence</td>
<td>5.19</td>
<td>0.66</td>
<td>78.585**</td>
<td>.000</td>
</tr>
<tr>
<td>Need for autonomy</td>
<td>5.18</td>
<td>0.63</td>
<td>82.082**</td>
<td>.000</td>
</tr>
</tbody>
</table>

Table 4: Causal orientations of the coach (without an outlier, N=101)

<table>
<thead>
<tr>
<th>Causal orientations of coaches</th>
<th>Mean</th>
<th>SD</th>
<th>t-test</th>
<th>df</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomy (internal locus)</td>
<td>5.29</td>
<td>0.49</td>
<td>107.736**</td>
<td>.000</td>
</tr>
<tr>
<td>Control (external locus)</td>
<td>4.57</td>
<td>0.61</td>
<td>75.440**</td>
<td>.000</td>
</tr>
<tr>
<td>Impersonal causality</td>
<td>2.67</td>
<td>0.81</td>
<td>33.250**</td>
<td>.000</td>
</tr>
</tbody>
</table>

Motivational approaches of sports coaches have a significantly positive correlation with causal orientations. The approach which is based on a moderate or high support of the autonomy of athletes was significantly linked with the autonomous orientation of causality. The
controlling approach of the coach, regardless whether it involves a high or moderate orientation towards behavior control, correlated significantly with the controlling and impersonal causal orientation. However, the orientation towards the approach which moderately supports the autonomy of the athlete was significantly linked not only with the autonomous causal orientation, but also with the other two orientations of causality – controlling and impersonal.

**Table 5:** The relatedness of motivational approaches of the coach with basic psychological needs and causal orientations (without an outlier, N=101)

<table>
<thead>
<tr>
<th>Motivational approaches of the coach</th>
<th>Basic psychological needs</th>
<th>Causal orientations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Need for autonomy</td>
<td>Need for competence</td>
</tr>
<tr>
<td>High autonomy</td>
<td>0.162</td>
<td>0.032</td>
</tr>
<tr>
<td>Moderate autonomy</td>
<td>-0.021</td>
<td>-0.204*</td>
</tr>
<tr>
<td>Moderate control</td>
<td>-0.088</td>
<td>-0.080</td>
</tr>
<tr>
<td>High control</td>
<td>-0.077</td>
<td>-0.320**</td>
</tr>
</tbody>
</table>

**DISCUSSION**

The research results have confirmed the basic theory according to which motivational approaches of sports coaches are also related with personal and environmental factors. However, the hypothesis which presumes that the approach which is based on supporting the autonomy of athletes would be linked with the autonomous causal orientation and the perceiving of the satisfying of the needs for autonomy and competence has not been confirmed entirely. It has been shown that approaches which are based on a high or moderate support for autonomy correlate positively with the autonomous causal orientation, but the moderately autonomous approach is also linked with the controlling and the impersonal orientation of causality. On the other hand, the research results show that the approach which is based on a high support of autonomy is not significantly linked with perceiving the satisfying of basic psychological needs. A moderate autonomous approach is related significantly, albeit negatively, only with perceiving the satisfying of the need for competence.
This fact indicates that the orientation towards a high autonomous approach in young coaches is linked with personal factors which direct an individual towards the perceiving of causality as internal. Sports coaches who on the level of personal disposition believe it is they who are in control of events (and not other people, coincidence or luck), are most likely to use the autonomous approach in a situation when they have the opportunity to have an impact on athletes. The lack of a correlation between the perceiving of a degree of satisfaction of basic psychological needs and a motivational approach directed towards a high level of supporting autonomy, indicates that the impact of more general social factors is not significantly linked with the orientation of a coach towards supporting the autonomy of an athlete. The approach of a coach who highly values and stresses the autonomy of an athlete is linked exclusively with a personal orientation towards autonomy. It can be presumed that with young coaches with a stressed dispositional orientation towards autonomy there is some sort of “resistance” towards disadvantageous social influences which jeopardize and hinder the perceiving of the satisfying of the need for personal autonomy, as well as competence.

The motivational approach of a coach which is based on a moderate support of autonomy is related not only with the autonomous orientation of causality, but also with the controlling and impersonal orientations. Such a fact leads to the conclusion that a moderate support of the autonomy of athletes also contains a certain “vacillating” of the coach which can in due course progress into the controlling approach if, for an example, the controlling or impersonal causal orientation prevail. A negative relatedness of the moderate autonomous approach and the perceiving of the degree of satisfying the need for competence indicate that the possible course which can redirect a young coach from supporting autonomy to controlling an athlete is the perceiving of the hindering of his personal need for competence. The impact of the hindering of the need for competence, as well as the influence of the controlling and impersonal causal orientation on a coach’s moderate autonomous approach, has yet to be researched.

The controlling approaches of coaches, as presumed by the hypothesis, are significantly linked with controlling and impersonal causal orientations. In regards to the relatedness with the perceiving of the satisfying of basic psychological needs, it was shown that only the approach which is orientated towards high behavior control is negatively related with the perceiving of the need for competence. Thus, the tendency to use the approach which is based on behavior control is not
related with the perceiving of a low degree of satisfying the basic need for autonomy, but rather, with perceiving the degree of the satisfying, i.e. the lack of the satisfying of the need for competence.

The theory of self-determination stresses the satisfying of the need for autonomy as a key factor which mediates between the individual and environmental factors. Based on such a theoretical concept, it is presumed that the perceiving of the satisfying or hindering of the need for autonomy will correlate with the autonomous or controlling approach. However, it has been shown that with young coaches the satisfying of the need for competence has a more significant role. It can be said that such a conclusion is not entirely surprising if it is presumed that an activity needs to be competently taken control of, and only then can the need for autonomy be actualized.

The testing of the degree of the satisfying of basic psychological needs has shown that the impact of social factors is not the most optimal, and the need for autonomy is the least satisfied. However, it seems there is a certain resistance to the hindering of personal autonomy in the social context, if there is a strong dispositional orientation in the direction of autonomous behavior. Such a fact offers significant implications, not just theoretical, but also practical. By way of a social impact in systematically supporting the feeling of autonomy and competence during the training of sports coaches, perhaps it is possible to additionally contribute to dispositional orientations in the direction of a development of autonomous and responsible behavior.

**CONCLUSION**

Research results show that the motivational approach dominates in our young coaches, an approach based on the supporting of autonomy, but also moderate behavior control. The orientation towards the autonomous or controlling approach in motivating and working with athletes is primarily related with causal orientations, i.e. a general belief in the causes of events. The coaches which believe that they have an impact on events in their lives will most likely use the approach which is based on supporting athletes’ autonomy. And vice versa, coaches who believe that external or impersonal factors manage events in their lives are most likely to value more and apply the controlling approach. However, the approach which is based on the moderate supporting of the autonomy of others, perhaps under certain conditions such as the perceiving of the hindering of the need for personal competence, can “re-orient” the coach into the direction of the controlling approach if there is
a relatedness with the controlling or impersonal causal orientation. Such a possible impact of perceiving the hindering of the need for competence, as well as the controlling or impersonal causal orientation, towards the motivational approach which is based on a moderate support of autonomy, has yet to be researched. The approach which is based on the supporting of autonomy is an invaluable resource for a positive impact on the entire development of athletes and thus further researching of the conditions and influences which can “impede” the coach from such an approach is relevant, as well as researching the conditions and influences which support the autonomous approach.

References
Abstract: The maximum force of muscles used during a swim stroke in different conditions of effort was measured on a sample of 11 swimmers who were able to swim the 100 m crawl in under one minute and 11 students of the third year of the University of Physical Education and Sports who are not professional swimmers, with the aim to quantify the correlation between the value of effort realized in situational and laboratory conditions. Force was first measured during the carrying out of five different exercises with effort in the gym, and then during tethered swimming. Force in the swimming pool was measured by a mechanical dynamometer fastened to the pool’s edge by one end, and on the other to the swimmer’s belt. By applying discriminatory and causal statistical procedures, an attempt was made to explain the influence of a specific swimming technique on displaying force in specific conditions of effort. Comparing the values of force measured in the gym (laboratory conditions) it has been determined that trained swimmers and non-professional swimmers (students) are not statistically significantly different, but that during measuring of force in the swimming pool (tethered swimming) swimmers had much better results. A correlational analysis showed that there was no significant relatedness between the values of force obtained in situational conditions and force measured during the performing of the majority of exercises with effort, except in the test of lat pulldown exercises.

Key words: swimming, force, testing
significantly impact the competition results in sports in which a large external resistance is being overcome, that is, a great force is being developed or an effort of a great volume is being carried out in a short time interval. Movement in the swimming pool is secured by the difference between the propulsive and retropulsive forces. Propulsive forces affect the direction of the body’s movement (propelling it forward). They appear during the propulsive movements of the swimmer whose direction is counter the swimming direction. Propulsive movements are realized by parts of extremities in the form of a swim stroke. In the crawl technique, the average propulsive force of the arms of top swimmers amounts to over 70, and a mere 11 Newtons for the legs (Jarić, 1997). Retropulsive forces resist movement and are directed in the reverse direction. They are caused by retropulsive movements which occur while the body parts (most often the arms) move through the water in the direction of swimming. Swimming, thus, is more efficient if it is carried out by greater propulsive, and smaller retropulsive forces. The impact of other biomechanical parameters such as the following should not be overlooked either: the cross sectional area of the body, changes in the distance of the body from the axis of rotation of the kinetic chain, the hydrodynamism coefficient, the desynchronizing of the movement, and the characteristics of the fluid (i.e., water) in which the activity is realized.

Mostly used in working with swimmers was testing with the method of tethered swimming due to the reliability of data and the simplicity of the measurement process. According to Dopsaj (2005), most research (Magel, 1970; Boone and Thompson, 1983; Keskinen, 1989; Rinehardt, 1991; Hooper, 1998; Vorontsov, 1999) was directed towards observing the maximum or average pull force. Many authors (Absonešov, 1966; Gordon, 1968; Onoprijenko, 1968; Safrjan, 1969) quoted by Dopsaj (2005), measured the total pull force developed during tethered swimming with a dynamometer and determined that the real pull force during swimming reached the values between 51 and 94 kgm, i.e. less than 1.6 to 2.5 times than the pull force in swimming with loads. Regardless of the fact that every separate stroke strength reaches a maximum with swimmers, total indicators of maximum strength are also necessary. This is confirmed by conclusions made by Rosenblatt (1972) which resulted in the law of medium loads: optimal conditions for muscle work depend on the maximum strength – the greater it is, the larger the limit of optimal work ability. By applying the crawl technique, a high correlation of 100m swimming results with an isometric force realized in movement which simulates the beginning and middle of a
Guzina, B.: The force of muscles used during a swim stroke in various conditions

swim stroke has been determined, as well as a correlation with the dynamic force realized by medium and large loads and the pull force in water carried out in swimming with the arms only. Nawley and Williams (1991) determined that the ability of achieving a maximum speed of swimming at a 25-yard (22.86m) stretch shows a very high numerical agreement with the strength of arms achieved in dry-land testing in an isokinetic regime.

The subject of this research also relates to the displaying of pull force during tethered swimming and its relatedness with some indicators of absolute strength measures in working with standard weights in the gym. Considering that tethered swimming is quite similar to real competition conditions, and that testing in a gym is realized in standardized and strictly controlled conditions, it is possible to also quote as the subject of this paper the displaying of the swimmer’s force in laboratory and situational conditions. The research was realized with the aim to respond to the question on how much the conditions of movement impact the parameters of force.

WORK METHOD

This is an empirical paper of a transversal character which measured the force of used muscles in situational (water) and conditional laboratory (dry-land) conditions of two groups of examinees, marked as swimmers competitors and recreational swimmers. Situational conditions presume tethered swimming, during which the test subjects were connected to a mechanical dynamometer (Diagram 1) via a rope fastened to the body (Diagram 2), which registered the pull force. The test subjects swam using only their hands in a 10 second time interval; the legs were inactive due to the position of the rope (Diagram 3). The precision of measuring the pull force ranged from a level of 0.2 kp (≈ 2 N).

Diagram 1: The mechanical dynamometer which registers the pull force during tethered swimming.
In laboratory conditions (in the gym) a battery of four tests was applied to assess the absolute strength of the used muscles during the carrying out of the swim strokes: (1) bench press, (2) lat pulldowns, (3) shoulder press and (4) pec deck flyes and a test of isometric force – (5) hand dynamometry.

The examinee sample was made up of 22 healthy young men aged between 22 and 24, divided into two groups. The first group encompassed 11 test subjects which had regular swim training for at least five years and who managed to swim a 50-meters stretch in less than 30 seconds during the testing. In the second group, there were 11 third-year students of the Faculty of Physical Education and Sports who were adept at the crawl technique, but who do not swim regularly. The swim times of these 11 students, measured during the 50m crawl test, exceeded half a minute, and thus they were marked as stronger recreationists. All the measurements were carried out in Banjaluka at the Šeher and Aqua Park swimming pools, as well as in the gym of the Faculty of Physical Education and Sports. A special mechanism was constructed for measuring the pull force, which enabled the registering of the maximum value of the force of every test subject with the mechanical dynamometer. The method of repetitive maximums was used to calculate the absolute strength measured by the tests in the gym. The subjects were asked to carry out every task with a load till fatigue, afterwards which the lifted weight was multiplied with the appropriate coefficient for a certain number of successful repetitions (Table 1).

The results for both groups of subjects were first submitted to a discriminatory analysis. By applying the T-test for independent samples, the differences between the average values of the swimmers and
recreationists calculated for all six indicators of myogenic traits (pull force, four tests of absolute strength and hand dynamometry) were tested. After that, applied was the Spearman method of the rang-correlational analysis which quantifies the links between the following:

- The pull force carried out in the swimming pool and the remaining five tests of myogenic abilities
- The results of a 50-m crawl and six variables of force and strength
- The results obtained by applying five tests of force and strength in the gym.

The correlational coefficients in the first case were calculated specifically for the group of swimmers and for the group of recreationists, while the remaining two were obtained on the level of the complete sample.

**Table 1: Coefficients for calculating the maximum results in tests intended for the assessment of absolute strength.**

<table>
<thead>
<tr>
<th>Number of repetitions</th>
<th>Coefficient</th>
<th>Number of repetitions</th>
<th>Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>6</td>
<td>1.20</td>
</tr>
<tr>
<td>2</td>
<td>1.07</td>
<td>7</td>
<td>1.23</td>
</tr>
<tr>
<td>3</td>
<td>1.10</td>
<td>8</td>
<td>1.27</td>
</tr>
<tr>
<td>4</td>
<td>1.13</td>
<td>9</td>
<td>1.32</td>
</tr>
<tr>
<td>5</td>
<td>1.16</td>
<td>10</td>
<td>1.34</td>
</tr>
</tbody>
</table>

**RESULTS**

By a mere cursory analysis of the individual results of a 50-crawl stretch, it is easy to see the large differences in the results realized by test subjects from different subsamples. Whereas all the swimmers swam this stretch in under 30 seconds, not even one student of the Faculty of Physical Culture accomplished this. The significance of the perceived difference was also definitely confirmed by the T-test results (Table 2) in which the realized level of significance (p) was far below the theoretical limit of 0.05. The average result which was realized by a group of swimmers was 26.69 seconds, while the arithmetic mean of the students was 40.57 seconds. Besides this, a far lesser variational range (Max – Min) was marked with the swimmers, which logically speaking was also reflected on the homogeneity of the results. In fact, the calculated values of the variation coefficient (V) pointed to a high homogeneity of results in 50m swimming stretches within both subsamples, but with swimmers that value was halved.
Table 2: Descriptive statistical parameters obtained by a results analysis of the 50m crawl (values expressed in seconds).

<table>
<thead>
<tr>
<th>Group</th>
<th>Average</th>
<th>Std. Er.</th>
<th>Std. Dev.</th>
<th>V</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swimmers</td>
<td>26.69</td>
<td>0.459</td>
<td>1.488</td>
<td>0.06</td>
<td>29.95</td>
<td>24.54</td>
</tr>
<tr>
<td>Students</td>
<td>40.57</td>
<td>1.456</td>
<td>4.828</td>
<td>0.12</td>
<td>48.34</td>
<td>33.20</td>
</tr>
</tbody>
</table>

T-test = -9.112  p = .000*

A discriminative analysis was also conducted of all statistical series obtained by testing the pull force and absolute strength of the used muscles, consisting in comparing the average values calculated specifically for every subsample (swimming and students). All the conclusions were drawn with reliability at 95% (p = .05). Based on the realized level of significance (p), statistically significant differences were determined with only two tests – the shoulder press, where statistically better results were realized by examinees from the subsample of students, as well as during the measuring of the pull force realized during tethered swimming, in which test subjects from the group of swimmers were significantly better (Table 3 and Diagram 4). In all four remaining tests (Bench Press, Lat Machine, Pec Deck and hand dynamometry), the students had slightly better average results (Diagram 4), but insufficiently good for that difference to be claimed as statistically significant. In each of the four cases, the realized level of significance (p) far exceeded the theoretical limit of 0.05.

Table 3: Results obtained by applying the T-test on the average values of swimmers and students.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Swimmers</th>
<th>Students</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pull force in pool (kp)</td>
<td>13.73</td>
<td>4.55</td>
<td>3.524</td>
<td>.002*</td>
</tr>
<tr>
<td>Bench Press (kp)</td>
<td>77.01</td>
<td>77.85</td>
<td>-0.118</td>
<td>.907</td>
</tr>
<tr>
<td>Lat Machine (kp)</td>
<td>98.01</td>
<td>91.55</td>
<td>1.288</td>
<td>.212</td>
</tr>
<tr>
<td>Shoulder Press (kp)</td>
<td>49.42</td>
<td>58.84</td>
<td>-2.467</td>
<td>.023*</td>
</tr>
<tr>
<td>Pec Deck (kp)</td>
<td>42.99</td>
<td>46.44</td>
<td>-1.269</td>
<td>.219</td>
</tr>
<tr>
<td>Hand dynamometry (kp)</td>
<td>40.09</td>
<td>43.00</td>
<td>-0.893</td>
<td>.382</td>
</tr>
</tbody>
</table>

The results of the correlational analysis pointed to the lack of a significance relatedness between the pull force and all five laboratory tests of force and strength. The exception was the correlation of pull force with the results achieved by swimmers at the lat pulldown test (Table 4). This fact points to the fact that the swimmers were well-trained and had the ability to rationally use the adductors in the shoulder joint as a key muscle during the swim stroke.
Table 4: The numerical relationship (expressed by the Spearman coefficient of the rank-correlation - ρ) between the pull force and five tests of myogenic abilities in the subsample of swimmers and students. The asterisk (*) marks the coefficients significant on the level of 0.05.

<table>
<thead>
<tr>
<th>Variable</th>
<th>P</th>
<th>p (Sig.)</th>
<th>p (Sig.)</th>
<th>p (Sig.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bench Press</td>
<td>.394</td>
<td>.231</td>
<td>.346</td>
<td>.297</td>
</tr>
<tr>
<td>Lat Machine</td>
<td>.648*</td>
<td>.031</td>
<td>.164</td>
<td>.629</td>
</tr>
<tr>
<td>Shoulder Press</td>
<td>.292</td>
<td>.384</td>
<td>.436</td>
<td>.180</td>
</tr>
<tr>
<td>Pec Deck</td>
<td>.370</td>
<td>.263</td>
<td>.416</td>
<td>.203</td>
</tr>
<tr>
<td>Hand dynamometry</td>
<td>.328</td>
<td>.325</td>
<td>.033</td>
<td>.924</td>
</tr>
</tbody>
</table>

Diagram 4: The relation of the average values of myogenic variables of swimmers and students.

Table 5: The numerical relationship (expressed by the Spearman coefficient rank-correlation - ρ) between the results obtained by swimming with the 50m crawl technique and all six tests of myogenic abilities based on the complete sample. The asterisk (*) marks the coefficients significant on the level of 0.05, and two (**) on the level of 0.01.

<table>
<thead>
<tr>
<th>Variable</th>
<th>P</th>
<th>P (Sig.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pull force in pool</td>
<td>-.764**</td>
<td>.000</td>
</tr>
<tr>
<td>Bench Press</td>
<td>-.293</td>
<td>.185</td>
</tr>
<tr>
<td>Lat Machine</td>
<td>-.457*</td>
<td>.032</td>
</tr>
<tr>
<td>Shoulder Press</td>
<td>-.134</td>
<td>.553</td>
</tr>
<tr>
<td>Pec Deck</td>
<td>-.001</td>
<td>.995</td>
</tr>
<tr>
<td>Hand dynamometry</td>
<td>-.026</td>
<td>.908</td>
</tr>
</tbody>
</table>
Diagram 5: The scatter diagram which shows the numerical relationship between the results obtained during the 50m crawl and two tests which produced a significant coefficient of correlation (the size of the pull force during tethered swimming and lat pulldown exercises).

For a most direct determining of the numerical correlation between myogenic abilities (force and strength) and the results realized in swimming, a correlational analysis was carried out between the results realized by swimming the 50m crawl and the statistical series formed from the results obtained by measuring force and absolute strength in all six tests (Table 5). The correlation coefficients were calculated based on
the complete sample, considering that this realized a larger variability of results and created a chance for a clearer perception of numerical laws.

The calculated correlational coefficients ($\rho$) and the realized levels of significance ($p$) indicated that the swimming speed of the 50m crawl was linked with the pull force measured during tethered swimming ($\rho=0.764; p=.000$), and then with the results of lat pulldown exercises ($\rho=0.457; p=.032$). The negative values of the correlation coefficient, of course, were a consequence of expressing the swimming tests in time units. The relatedness of the pull force was far more emphasized, which indicates a more proper distributing of correlational points on the scatter diagram (Diagram 5).

**DISCUSSION**

Splitting the sample into two subsamples – conditionally speaking, swimmers and students, was a result of their swimming the 50m crawl. The time of 30 seconds was taken as the margin value, which is considered sufficiently indicative for someone to be proclaimed a trained, or, on the other hand, an untrained swimmer. That the deductive division of the sample on swimmers and students was carried out well was shown by the T-test which provided an extremely low level of significance (.000).

By comparing the results of swimmers and students realized in tests of force and strength, in most cases there were no statistically significant differences. In four of five tests, the myogenic parameters of swimmers and students were substantially stable. The exception is only the shoulder press test in which the students showed themselves to be significantly stronger. This can probably be explained by the fact that swimmers during training pay little attention to developing the abductors in the shoulder joint (primarily of the deltoid muscle) by standard gym exercises. On the other hand, the shoulder press is a favorite exercise of all gym-goers, and is also often found in the program of Sports College students. The most significant difference showed itself to be, however, the one between swimmers and students in the sense of displaying pull force in situational conditions. As was expected, swimmers had significantly greater values of the pull force during tethered swimming. The average values were on the level of over 13 kp (nearly 13 N) and exceeded threefold the students’ average. When the correlational analysis determined an exceedingly high relatedness of the pull force measured in the swimming pool and the 50m swimming results, it could be definitely concluded that the ability of transforming myogenic
potential in realistic conditions of movement through water was far more important than the absolute force size which an individual possessed. This once again confirms the long-standing Consilman speculation on the significance of the “sensation of water”. What substantiates the concept of a specific ability of trained swimmers to use their potential in realistic competitive conditions is also the fact of the larger absolute strength of the main adductors in the shoulder joint (m. pectoralis major and m. latissimus dorsi) which were dominantly engaged in the lat pulldown test. This conclusion corresponds to the research results which were conducted by Bradshaw and Hoyle (1993), as well as Hisu and associates (1997). They came to the conclusion that in the process of training directed towards the increasing of the level of work abilities in the sense of strength, only the exercises which deal with the agonistic muscle groups during the swim stroke have an impact on improving swimming results.

**Table 6:** The correlational matrix with coefficients calculated the indicators of force and strength of the complete sample. One asterisk (*) marks the coefficients significant on the level of 0.05, and two (**) on the level of 0.01. Above the diagonal are the values of the realized level of significance (p).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bench Press</td>
<td>1</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.107</td>
</tr>
<tr>
<td>Lat Machine</td>
<td>.803**</td>
<td>1</td>
<td>.032</td>
<td>.004</td>
<td>.023</td>
</tr>
<tr>
<td>Shoulder Press</td>
<td>.787**</td>
<td>.458*</td>
<td>1</td>
<td>.000</td>
<td>.199</td>
</tr>
<tr>
<td>Pec Deck</td>
<td>.796**</td>
<td>.588**</td>
<td>.817**</td>
<td>1</td>
<td>.199</td>
</tr>
<tr>
<td>Hand dynamometry</td>
<td>.353</td>
<td>.482*</td>
<td>.285</td>
<td>.285</td>
<td>1</td>
</tr>
</tbody>
</table>

A general deduction after comparing the homogeneity of two subsamples is that students in all the indicators of force and strength were less homogeneous than the swimmers. This relationship was to be expected, considering that the swimmer subsample in itself is balanced by sharper criteria applied during the former selection carried out via long-term training. It was interesting to analyze numeric relationships between statistical series composed of results of classical tests of force and strength carried out in the gym. All the obtained correlation coefficients, calculated for the complete sample, showed them to be statistically significant already at the level of 0.01, except the coefficient which quantified the relationship between the results on the lat machine and during the shoulder press (Table 6). This relation of empirical results is logical and completely expected, considering that in all tests almost
the same muscle groups dominated as the executors of the main movements. This especially pertains to three tests with the highest correlation coefficients – *Bench Press, Lat Machine* and *Pec Deck* – in which the agonists were the adductors in the shoulder joint. Unlike in some of the former research papers, in this research the hand dynamometry did not show a significant link with any of the applied tests of absolute strength, except for *lat pulldown* tests. This is perhaps a logical result of testing, considering the fact that the strength of the hand grip was only expressed during the test on the *lat machine*.

**CONCLUSION**

The maximum force of muscles used during a swim stroke in different conditions of effort was measured on a sample of 11 swimmers who were able to swim the 100m crawl in under one minute and 11 students of the third year of the University of Physical Education and Sports who are not professional swimmers, with the aim to quantify the correlation between the value of effort realized in situational and laboratory conditions. The testing was carried out in various conditions. The first to be measured was the pull force realized in the swimming pool during tethered swimming in a 10-second interval, and then five tests of force and strength in the gym were applied. After quantifying the correlation between the measured values, it was possible to conclude the following:

- Trained swimmers and non-professionals (students) do not differ significantly in displaying force and strength in laboratory conditions (in the gym).
- Trained swimmers and student differ significantly in the displaying of pull force realized during tethered swimming.
- Only the results of the swimmers in the *lat pulldown* test had a statistically significant link with the pull force in the pool, while in the student group not one test of force and strength showed itself to be significant for displaying force in water. This is explained by a specific impact of training on the used muscles (the adductors in the shoulder joint).
- The pull force calculated in the pool had the most significant link with the results of the 50m crawl, followed by the absolute strength of the adductor muscles in the shoulder joint. The other tests carried out in the gym did not prove themselves to be statistically significant.
• Once more it has been confirmed that for the efficiency of movement through water, of far more importance is the specific ability of transforming myogenic potential into real force than the value of the maximum strength of the used muscles.

References
Scientific article

EFFECTS OF SPECIFIC GAMES DIRECTED AT THE PREVENTION OF FLAT FEET IN PRE-SCHOOL CHILDREN

UDK 796.012.424:611.986-053.4

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Abstract: A longitudinal research was carried out with the aim to determine the efficiency of various treatments directed at improving the status of the foot on a sample of 270 boys and girls aged from 5.5 to 6.5 years, divided into three subsamples (the experimental group consisted of 120 respondents, the first control group consisting of 70 and the second of 80 test subjects) who regularly attended pre-schools during the six-month experiment. A specific model of preventive games was applied with the experimental group. The first control group operated according to the classical physiotherapy program which implied 2-3 morning activities lasting from 15-20 minutes. The third (second control) group was not submitted to any kind of systematic work. The status of the foot was assessed with the help of the classical plantography method in three time periods – as initial, transitive (control) and final assessments. The data was mathematically processed and after statistical analysis, a very high percentage of flat feet among the respondents was noted (as much as 59.26% had the first degree, and 25.19% the second degree of flatfootedness, while a mere 15.56% had normal feet). The most optimal results were determined in the experimental group in which there was a drastic decrease of deformity and a significant increase of children with normal feet. In this group, the second degree of flatfootedness was almost eliminated (a mere 0.83%). In the first control group, there was a somewhat slighter but also significant progress, while in the second control group there were no statistically significant changes. The application of the experimental preventive games model led to a significant improvement of the status of the foot after only three months of work, while the positive effects of the physiotherapy exercises were shown after only six months. The greater efficiency of preventive games can be explained by a better motivation of children to perform which enabled a larger volume and intensity of exercising, due to which there was a greater strength of the foot and the calf muscles.

Key words: flat feet, preventive exercising, games, pre-school children
THE SUBJECT OF THE PAPER

Following the development of civilization, the human movement has progressed from an existential self-preservation means to its total absence in an everyday regime of work and rest. Contemporary man is increasingly faced with the appearance of hypokinesis (insufficient movement) which is considered to be the main cause of numerous modern illnesses. This does not relate only to adults, but more and more to children of school, as well as pre-school, age. Along with bad habits and insufficient awareness on the part of the parents regarding the significance of physical activities for the proper development of their children, modern forms of entertainment are also a contributing factor. Children spent less and less time playing and doing physical exercises and spend more time in inactive positions – sitting and lying down.

The human body is a very economical system prone to adapting to a minimal expenditure of energy. According to that mechanism, a long-term lack of movement, on one hand, leads to a weakness of the muscle system, while on the other hand, increased physical activity leads to muscular hypertrophy. In spite of dynamic advertising and the opening of numerous fitness and recreation centers, a very small number of children and adults dedicate their free time to physical exercising. The last refuge for regular systematic health exercising are official educational institutions – pre-schools and schools. In the world, in the recent years, more and more attention is being paid to school and pre-school physical education. The ministries of developed countries earmark large funds for the exercising of children and youth, and funding scientifically based and accredited programs. This paper is involved with one of the forms of exercising for pre-school children. It is about the contents intended towards the prevention of physical deformities, or to be more precise, the prevention of flat feet. Postural disorders in the last few years are increasingly present among school and pre-school children. Newer research has shown that more than 60% of children in Serbia have elements of bad posture which threaten to develop rapidly into physical deformities. Postural disorders not only ruin body esthetics and disrupt normal locomotion, but also impact the proper work of the internal organs.

The human body succumbs to the laws of physics. Gravitation constantly opposes its effect in the endeavor to retain the balance of force. An active force of the muscles enables via the bones (biomechanical lever) a normal upright position of the body and its movement. All the elements are linked with maintaining a normal
upright position marked as postural status. If for any reason (fatigue, weakness, illness and similar) there is a disruption of the muscle and gravitational forces, there is also a disruption of the postural status. Muscle weakness in the pre-school age is its most common cause. Physical exercising is used as the most efficient means of the fight to maintain a normal upright position. It engages the muscle system (postural musculature) responsible for maintaining a proper position of certain body parts and their mutual relationships. This paper has as its subject the specific preventive exercises which impact the strengthening of the muscles responsible for maintaining the arches.

With a normal foot, there is a clear differentiation between two arches: the longitudinal and the transversal. Due to an insufficiency of the muscle system (short foot and calf muscles), the first to slacken is the longitudinal arch, though the possibility of both of them slackening at the same time is not excluded. A child is born with fallen arches, but this is lost as soon as the child starts to actively lean on its legs and engage the appropriate muscle system. Professional literature (Radisavljević, 2001; Ulić, 1997; Ruszkovsky, 1970) describes the statically flat foot which appears as a consequence of a weakness of the muscle system and the ligamentary apparatus, which is typical for certain professions. This manifestation is of course registered only in mature and later years and is not the subject of this research.

Extreme flatfootedness can be very unpleasant and painful. Fallen arches not only disrupt the mechanics of a normal walk, they also cause difficulties in the flow of blood and the nerve impulses through a widely spread net of blood vessels and nerve endings which are found in the area of the feet. There are several stages in the process of forming fallen arches. The majority of authors (Radisavljević, 2001; Ulić, 1997; Koturović and Jeričević, 1996; Mrvaljević, 1985) use the model which differentiates three degrees. The first degree is the least severe and is characterized by a weakening and stretching of the feet muscles, primarily those which maintain the longitudinal arch. This degree is called pes valgus, and is characterized by a very small curve of the Achilles’ tendon, with an inwards convexity (Diagram 1); the foot is placed in a valgus position, with a tendency of weighing down on the inner side of the foot (Diagram 2). In this stage, the longitudinal arch is nevertheless preserved, in spite of the fact that it is somewhat lower than the normal position. The reason for this is that the foot ligaments, as passive stabilizers (tensors) are still unchanged, and the bone elements are also preserved. The changes are a consequence primarily of weakness and the stretching of muscles (active tensors). The test in
which the respondents are requested to stand on one foot only confirms that the first degree of flatfootedness is involved. Then there is a stronger contraction of the calf muscles and the short plantar flexors, so a correction (lifting) of the tranversal arch of the standing foot is achieved.

Diagram 1: The curve of the Achilles’ tendon as an indicator of the collapse of the perpendicular arch

Diagram 2: The first degree of the collapse of the tranversal arch and the position of the Mayer line

The second degree in the development of the flat foot, marked as *pes plano-valgus*, along with a slackening of the muscles as active tensors, and is also characterized by changes on the ligaments. In this stage of the Achilles’ heel, the tendons are still collapsed inwards, and there is more support on the inner part of the foot. In the second stage, not even while standing on one foot will there be a correction of the tranversal arch.

The third (most severe) degree of flatfootedness (*pes transversoplanus*) also implies the initial damage of the bone structures when the tranversal arch is also collapsed, along with the perpendicular. The arches almost cease to exist at all, so support is distributed along the entire area of the foot which causes a duck-like walk, often accompanied by pain.

WORK METHOD

This research paper is a classic experiment with parallel groups. It was realized in several pre-school institutions in the Belgrade municipality of Mladenovac. Prior to the realization of the experiment, a seminar was organized for the teachers who were trained to deal with the problems of flat feet, as well as training for an independent application
of the specific program of preventive games.* After this, the trained teachers organized in their respective pre-schools a standardized 6-month program. The experimental group included all the children from the program (120 respondents). Parallel with the experimental group, there were also two control groups – the first with 70 respondents was submitted to occasional treatments of the feet via standard physiotherapy exercises carried out by physiotherapists from the local clinic, most often as morning exercises or a recreational break, while the second control group was made up of 80 children without systematic preventive treatments. The experiment encompassed a total of 270 boys and girls of older pre-school groups aged from 26 months attending pre-school on a regular basis.

During the collecting of data which concerns the foot status, plantography was used for the central variable of this research. The easiest model to use for analysis of the foot print was the model of Russian authors according to which the plantogram of the front part of the foot (on the level of the first and fifth metatarsal bones) and the heel, is divided into five equal segments (Diagram 3). If the foot print, viewed from the outside, does not exceed 2/5 plantograms, this is a normal foot. When the print covers 3/5 plantograms, it represents the first degree of flatfootedness of the transversal arch, and if it extends to 4/5, it is the second degree. The coverage of all five segments is an indication of the third degree of flatfootedness. For the needs of the research, three assessments of the foot status were carried out: the initial (before the beginning of the experiment), transitive (after three months) and final (following a six-month period of exercising).

* The source of the exercises and games was the accredited program of the Republic Institute for promoting instruction and education entitled “Be straight – you’ll be healthy”. The applied material was published in the handbook of the same name (Perić and Cvetković, 2003).
The collected data was processed by descriptive and comparative statistics along with the application of the SPSS application program. A distribution of frequency was obtained by assessing the foot status from the area of descriptive statistics for all series composed of data obtained by assessment of the foot status, while a contingency analysis ($\chi^2$-test) was applied from the area of comparative statistics, during the testing of differences between empirically obtained frequencies. The foot status of different groups was compared – the experimental and two control, as well as the change of frequency during three time periods – the initial, transitive and final assessment.

RESULTS

The results obtained by assessing the foot status of the complete sample group indicated a large number of children with fallen transversal arches (Table 1 and Diagram 4). The first degree is the most common (59.26%), while there were only 15.56% respondents with a normal foot status. This picture fits in with the results obtained by checking the medical records of children’s clinics which show that over 80% of pre-school children have problems with their feet.

<table>
<thead>
<tr>
<th>Foot status</th>
<th>Absolute frequencies</th>
<th>Relative frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal (0)</td>
<td>42</td>
<td>15.56%</td>
</tr>
<tr>
<td>1. degree of flatfootedness</td>
<td>160</td>
<td>59.26%</td>
</tr>
<tr>
<td>2. degree of flatfootedness</td>
<td>68</td>
<td>25.19%</td>
</tr>
</tbody>
</table>

After comparing the empirical distribution obtained by an initial assessment of the foot status, it has been determined that the three groups (E, $K_1$ and $K_2$) were not significantly different (Table 2). Marked was an
almost identical proportion of the normal foot, and a first, that is, second degree of flatfootedness in all three groups which caused a very high value of the realized level of significance (p=0.57). This kind of relationship of empirical frequencies indicated a high homogeneity of groups and enabled the changes occurring during the following six months to be attributed to the effect of the experimental factor.

Table 2 – Distribution of foot status modality with all three groups of respondents on the initial assessment with $\chi^2$-test parameters.

<table>
<thead>
<tr>
<th>Group</th>
<th>Normal foot (0)</th>
<th>1st degree of flat-footedness</th>
<th>2nd degree of flat-footedness</th>
<th>$\sum$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>17 (14.17%)</td>
<td>71 (59.17%)</td>
<td>32 (26.67%)</td>
<td>120 (100%)</td>
</tr>
<tr>
<td>Control 1</td>
<td>9 (12.86%)</td>
<td>46 (65.71%)</td>
<td>15 (21.43%)</td>
<td>70 (100%)</td>
</tr>
<tr>
<td>Control 2</td>
<td>16 (20.00%)</td>
<td>43 (53.75%)</td>
<td>21 (21.43%)</td>
<td>80 (100%)</td>
</tr>
<tr>
<td>$\sum$</td>
<td>42</td>
<td>160</td>
<td>68</td>
<td>270</td>
</tr>
</tbody>
</table>

$\chi^2 = 2.927 \quad p = .57$

A comparative analysis of the transitive indicators of the foot status has determined that the groups, in spite of certain changes of initial frequency, did not statistically significantly differ among themselves, not even after three months of the experimental factor effect (Table 3). It seems that this period was not long enough to display the more significant effects of various treatments.

Table 3: Distribution of foot status modality with all three groups of respondents on the control assessment with $\chi^2$-test parameter.s

<table>
<thead>
<tr>
<th>Group</th>
<th>Normal foot (0)</th>
<th>1st degree of flat-footedness</th>
<th>2nd degree of flat-footedness</th>
<th>$\sum$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>33 (27.50%)</td>
<td>71 (59.17%)</td>
<td>16 (13.33%)</td>
<td>120 (100%)</td>
</tr>
<tr>
<td>Control 1</td>
<td>12 (17.14%)</td>
<td>45 (64.29%)</td>
<td>13 (18.57%)</td>
<td>70 (100%)</td>
</tr>
<tr>
<td>Control 2</td>
<td>18 (22.50%)</td>
<td>42 (52.50%)</td>
<td>13 (25.00%)</td>
<td>80 (100%)</td>
</tr>
<tr>
<td>$\sum$</td>
<td>63</td>
<td>158</td>
<td>49</td>
<td>270</td>
</tr>
</tbody>
</table>

$\chi^2 = 6.577 \quad p = .16$

The first statistically significant differences between the foot status of the three groups appeared only at the final assessment, after six months. In relation to the results before the start of the experiment, in the experimental and first control group there was a total domination of children with normal foot status, during which the most optimal clinical picture was obtained with the experimental group. Almost two thirds of the respondents of the experimental group had a normal foot status, while in the first control group that number was a little over half. After the effect of the experimental factor, only one fourth of the children with
the first degree of flatfootedness were left in the first group, while there was under one percent in the second group. The second control group continued to have the most children with the first degree of flatfootedness (Table 4).

Table 4 – Distribution of foot status modality with all three groups of respondents at the final assessment with χ²-test parameters.

<table>
<thead>
<tr>
<th>Group</th>
<th>Normal foot (0)</th>
<th>1st degree of flat-footedness</th>
<th>2nd degree of flat-footedness</th>
<th>∑</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>89 (74.17%)</td>
<td>30 (25.00%)</td>
<td>1 (0.83%)</td>
<td>120 (100%)</td>
</tr>
<tr>
<td>Control 1</td>
<td>36 (51.43%)</td>
<td>26 (37.14%)</td>
<td>8 (1.43%)</td>
<td>70 (100%)</td>
</tr>
<tr>
<td>Control 2</td>
<td>24 (30.00%)</td>
<td>34 (42.50%)</td>
<td>22 (27.50%)</td>
<td>80 (100%)</td>
</tr>
<tr>
<td>∑</td>
<td>149</td>
<td>90</td>
<td>31</td>
<td>270</td>
</tr>
</tbody>
</table>

χ² = 51.579  p = .000*

The χ²-test results have shown that the foot status of the experimental group respondents have statistically significantly improved from the beginning to the end of the experiment. The rate of the changes was not the same in the first and second halves of the experimental period, but a significant improvement was realized in both. In the second half of the experiment, there was a speeding up of changes which led to great differences between the results of the initial and final assessment (Table 5 and Diagram 5). This was proof of the great efficiency of the “Be straight – be healthy” program.

In the first control group, changes in the first three months were slower and insufficient to be proclaimed statistically significant, in order for changes to speed up in the second half of the experiment, which finally led to statistically significant differences between the results of the initial and final assessments of the foot status (Table 6 and Diagram 6). This is proof of the effect of therapeutic exercises on improving the foot status, albeit being significantly more slower than the experimental program of preventive games.

Table 5: The foot status of the experimental group in a initial, control and final assessment.

<table>
<thead>
<tr>
<th>Foot status (E)</th>
<th>Initial assessment</th>
<th>Control assessment</th>
<th>Final assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal foot</td>
<td>17</td>
<td>33</td>
<td>89</td>
</tr>
<tr>
<td>1st degree</td>
<td>71</td>
<td>74</td>
<td>30</td>
</tr>
<tr>
<td>2nd degree</td>
<td>32</td>
<td>16</td>
<td>1</td>
</tr>
</tbody>
</table>

χ² = 110.673  p = .000*

52
Cvetković, N. and Perić, D.: The effects of specific games directed at the prevention of flat feet

Diagram 5: Distribution of modality of the foot status expressed in percentage, determined in the experimental group in the initial, control and final assessment.

Table 6: Initial, control and final foot status of the first control group.

<table>
<thead>
<tr>
<th>Foot status (K₁)</th>
<th>Initial assessment</th>
<th>Control assessment</th>
<th>Final assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal foot</td>
<td>9</td>
<td>12</td>
<td>36</td>
</tr>
<tr>
<td>1st degree</td>
<td>46</td>
<td>45</td>
<td>26</td>
</tr>
<tr>
<td>2nd degree</td>
<td>15</td>
<td>13</td>
<td>8</td>
</tr>
</tbody>
</table>

χ² = 31.732  p = .000*

Diagram 6: Distribution of modality of foot status expressed in percentage, determined in the first control group in the initial, control and final assessment.
By comparing the distribution of results from the initial, transitive and final assessment, it has been determined that there was a total absence of positive changes in the second control group (Table 7 and Diagram 7).

**Table 7: Initial, control and final foot status of the second control group.**

<table>
<thead>
<tr>
<th>Foot status (K₂)</th>
<th>Initial assessment</th>
<th>Control assessment</th>
<th>Final assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal foot</td>
<td>16</td>
<td>18</td>
<td>24</td>
</tr>
<tr>
<td>1st degree</td>
<td>43</td>
<td>42</td>
<td>34</td>
</tr>
<tr>
<td>2nd degree</td>
<td>21</td>
<td>20</td>
<td>22</td>
</tr>
</tbody>
</table>

χ² = 3.115  p = .539

**Diagram 7:** Distribution of modality of foot status expressed in percentage, determined in the second control group in the initial, control and final assessment.

**DISCUSSION**

Considering that testing of the significance of the differences between empirical frequencies obtained by the initial assessment of the foot status has established that there were no statistically significant differences between three respondent groups, conditions were created for a subsequent significance of discriminatory relations to be explained as a consequence of the effect of different treatments during the experimental period. The obtained statistical data clearly indicated the significant systematic improvement of the foot status in the experimental and first
control groups during the duration of the experiment, while in the second control group there were a lack of any statistically significant changes in relation to the initial status.

Especially interesting is the fact that the paces of the diagnosed changes in the experimental and first control group were uneven. While significant improvements were determined already at the transitive assessment in the experimental group, realized after three months, in the first control group these changes did not exist. In the group which exercises according to the model of a classical physiotherapist program made up of 2-3 weekly morning activities, significant changes were noted only after the ending of the experiment (after six months of exercising). It is obvious, thus, that the experimental program, made up of specific preventive games, showed itself to be more efficient than the program of the first control group. This efficiency did not only relate to the rate of the changes, but also to their quality. Even though in the first control group, as in the experimental one, there was significant improvement of the foot status after six-month work, these changes were of a smaller volume. While the occurrence of a normal foot in the experimental group - only 14.17%, was almost five-fold (increasing as much as 74.17%), the increase of a normal foot in the first control group was noticeably less. The efficiency of the experimental program was about 20% greater than the efficiency of the first control group.

Partially viewed, it can be concluded that the application of the experimental group program (the program of preventive games) already after three months led to a doubling of the number of children with a normal foot status (from 14.17%, this number grew to 27.5%). At the same time, the program of the first control group (the frontal physiotherapy treatment) brought an improvement somewhat less than 5% (from the initial 12.86% to a transitional 17.14%) which was not statistically significant. In the second half of the experiment (from the third month) the rate of changes in the experimental and first control group was considerably evened out, that is, it led to an almost triple number of children with normal foot status to the end of the experiment.

Considering the obtained results, it can be said with certainty that the working model based on the application of preventive games is very efficient in regards to the prevention of fallen arches in pre-schools. The great progress which was noted after already three months of the program’s application, as well as an almost total elimination of the gravest forms of foot deformities after six-month work, are sure proof that the applied volume and achieved intensity is sufficient to strengthen the used muscles (the dorsal flexors and the plantar extensors of the calf,
as well as the short plantar foot flexors) and that their tonus can lead to an optimal level which secures a normal function of the foot. Even though classical physiotherapy exercises led to progress as well, the absolute impact of preventive games on the quicker pace and a far greater final volume of positive changes has been proven. This is also substantiated by the comments of the teachers who in interviews with the researchers stressed the easy application of all contents, the high motivation of the children, as well as the great interest of parents to conduct the program at home. More than one third of the polled parents stated that at least occasionally they applied parts of the program with the children at home as well.

CONCLUSION

An experiment was conducted with parallel groups on a sample of 270 boys and girls aged between 5.5 and 6.5 regularly attending preschools during a six-month period, divided into three subsamples, with the aim to determine the efficiency of various treatments directed at the improvement of the foot status. A specific model of preventive games was applied in the experimental group. The first control group worked according to the classical physiotherapy program which implied 2-3 morning activities lasting from 15-20 minutes. The third (second control) group was not submitted to systematic work. The foot status was estimated by the application of plantography during three time periods – as an initial, transitive and final assessment. Based on the obtained results, it is possible to conclude the following:

- Before the beginning of the experiment with more than 80% of the respondents, a deviation from the normal foot status was noted. Over half of the respondents had the first degree of flatfootedness, and only 15% had a normal status. At the initial assessment, the three groups did not statistically significantly differ among themselves.

- The program of the experimental group (preventive games) led to a statistically significant improvement of the foot status. The rate of improvement was evened out during the entire experimental period, even though it was realized somewhat more quickly in the second half (after three months).

- The program of classical therapy exercises brought significant positive changes in the first control group, with the significant changes occurring only in the second half of the experiment (after three months). The volume and rate of the changes of the first control group were smaller than those recorded in the experimental one.
In the second control group which was exposed to regular educational treatments in the pre-school, there were no significant changes of the initial status, which means that the usual program of physical education in institutional conditions was insufficient to prevent negative influences of the contemporary way of life on the postural status of pre-school children.

References
STRUCTURE OF PARTICIPANTS IN FITNESS CLUB PROGRAMS IN THE TOWN OF THESSALONIKI

UDK 796.015.132 (495.622); 796.06 (495.622)

Panteleimon Bakirtzoglou1

1Professor of physical education, Thesaloniki, Greece
e-mail: bakirtzoglou@gmail.com

Abstract: In this paper, the results were obtained with the experiences of the test subjects who participated in the survey based on a questionnaire, including a sample of 414 individuals from ten randomly chosen sport centers of the city of Thessaloniki. The questionnaire was divided into seven categories of questions related not only to the sport centers but to social backgrounds as well. The research showed that most of the athletes who used the sport centers for training were women. In these recreation and leisure activities programs, individuals of all ages took part, the majority of them being in their early thirties. It was observed that the elderly did not take part in the programs frequently. The sport centers were used mainly by individuals who had completed secondary school education, less by those with lower education. The majority of the participants were housewives, while workers and pensioners were the minority. A large percentage of individuals took part in programs of low intensity exercises and a small part in the aerobics program. Pilates and yoga took second place according to attendance. It was also observed that the participants showed more interest in lower intensity programs in which relaxation exercises dominated, while there was less interest in aerobics. Gender, age, family status and the level of education played important roles in the choice of the exercise programs.

Key words: fitness, management, services, social structure

THE SUBJECT

The living conditions of modern man have forced him to spend many hours at work and have but a few hours for personal pleasure. The little remaining free time is used by the majority of the urban population
for passive relaxation and not seeking for active forms of relaxation in the form of recreational programs (wellness, fitness). Some of the reasons for this are a lack of information, a deficiency of training space, the distance of gyms or indecisions as to the choice of adequate programs. Despite the constant promoting of a healthy way of life, which except for healthy nutrition also implies physical activity, there are still a small number of people who exercise regularly. Some research (Alexandris, 1998; Alexandris and Paliaala, 1999; Alexandris and Carroll, 1999; Alexandris, Georgiadis and Sdogou, 1999; Howat et al., 1993 and 1996; Stoiljković, 1995; Perić, 2006) shows that a very small number of people in urban areas participate regularly in recreational (health) activities. According to the data from these sources, today only 10-12% of the population in the larger cities occasionally or regularly participate in physical activities. Of this number, only 3-4% exercise regularly in fitness clubs, while the others exercise independently in their homes. The number of regular active people who work out is evenly distributed among private centers (gyms, fitness and aerobics centers) and community-run centers. The reason for this is that all programs of this type have a commercial base, and the fees are on an equal par between the private and public sectors. The active recreationists are citizens aged between 20 and 35 years, with a far less number of women. From the total number of active recreationists only 15-18% are women.

Special attention should be given to the type and quality of programs offered in fitness centers, as well as the profile of their users. Knowledge of the parameters can be of multiple use, for the direct executors of the programs (teachers, personal trainers, fitness instructors, etc.), as well as for the managers of the fitness centers. With the first group, it is necessary to know who participates in the exercises and with which kind of intentions in order to adequately select the methodological model, for the second group the planning of marketing activities (advertising, propaganda, proper investing in the area, in various devices and equipment, forming the fees, etc.) is important.

The subject of this paper are the programs that are currently being offered by sports organizations (fitness centers, gym, spa and leisure centers) of the city of Thessaloniki and the general institutional and social characteristics of their users (according to Saksidi, 1974: with educational, residential, professional and economic status). The research was conducted with the aim to obtain a better insight into some important elements of organizational management and free time.
WORK METHOD

This is a transversal study of an empirical character, which, using a survey, included 414 respondents (athletes, recreationists) from ten randomly selected fitness centers in the municipality of Thessaloniki. The applied survey consisted of seven basic issues related to institutional and social characteristics (Appendix 1). The majority of questions produced answers that formed nominal statistical scales, except for data related to the age of the respondents which was presented in the form of an interval scale. Therefore, from the area of descriptive statistics the most used was frequency distribution, while the greatest part of the comparative analysis was based on the application of the χ²-test as a superior parametric procedure. When processing interval scales, used were central and dispersal parameters along with the appropriate discriminative parametric statistics (analysis of variance).

Appendix 1. Questionnaire for users of sports centers

| 1. Gender: | Male □ | Female □ |
| 2. Age (in years): | | |
| 3. Marital status: | Married □ | Single □ |
| 4. Education: | Primary □ | Secondary □ | University □ | M.A. □ | Ph.D. □ |
| 5. Employment: | Public sector □ | Private sector □ |
| 6. Program in which you are participating: | | |
| 7. How long you have been participating in this program: | 2 months □ | 3 months □ | 4 months □ | 5 months □ | The entire season □ |

RESULTS

Among the surveyed exercise goers, almost 2/3 are female (Table and Figure 1), which shows that they are potentially greater beneficiaries of sports centers. The age of the exercisers goers ranged from 18 to as high as 66 years, which shows that the services of the centers were used by individuals of all ages. The distribution of the exercise goers of different ages, however, was not evened out and is significantly different from the regular schedule. The majority were people younger than 30, while the number of individuals decreased in proportion to age (Table and Figure 2). In relation to the marital status of the respondents, the number of married and single individuals was the same (Table and Figure 3), which shows that marital status did not seem to be a significant factor for using the services of sports centers. Applying the χ²-test, however, showed that users of the fitness centers
were mostly married rather than single women, while with men the ratio was reversed - sports centers were visited far more by single than married men (Table and Figure 4). Among the users of fitness centers there were far more people with secondary school, and least of all those with extremely low and high education (Table and Figure 5). Obviously this corresponds to the distribution criteria established by the age of the respondents. Among the surveyed users were mostly individuals between 18 and 21 years, obviously those with secondary school. The analysis of the structure of the users in relation to their employment has shown that all classes were equally represented, with the exception of pensioners, who were represented by a mere 3.62%. The range in the other social classes varied from 11.59% from the workers class to 22.46% of homemakers (Table and Figure 6).

Table 1. Distribution of users by gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Absolute frequencies</th>
<th>Relative frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>141</td>
<td>34.06%</td>
</tr>
<tr>
<td>Female</td>
<td>273</td>
<td>65.94%</td>
</tr>
</tbody>
</table>

![Figure 1. Distribution of users by gender](image)

Table 2 - Distribution of users according to age

<table>
<thead>
<tr>
<th>Age</th>
<th>Frequency</th>
<th>%</th>
<th>Age</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 – 20</td>
<td>79</td>
<td>19.08 (Mod)</td>
<td>45 – 47</td>
<td>21</td>
<td>5.07</td>
</tr>
<tr>
<td>21 – 23</td>
<td>34</td>
<td>8.21</td>
<td>48 – 50</td>
<td>22</td>
<td>5.31</td>
</tr>
<tr>
<td>24 – 26</td>
<td>37</td>
<td>8.94</td>
<td>51 – 53</td>
<td>8</td>
<td>1.93</td>
</tr>
<tr>
<td>27 – 29</td>
<td>31</td>
<td>7.49</td>
<td>54 – 56</td>
<td>12</td>
<td>2.90</td>
</tr>
<tr>
<td>30 – 32</td>
<td>42</td>
<td>10.14</td>
<td>57 – 59</td>
<td>9</td>
<td>2.17</td>
</tr>
<tr>
<td>33 – 35</td>
<td>28</td>
<td>6.76</td>
<td>60 – 62</td>
<td>20</td>
<td>4.83</td>
</tr>
<tr>
<td>36 – 38</td>
<td>22</td>
<td>5.31</td>
<td>63 – 65</td>
<td>3</td>
<td>0.72</td>
</tr>
<tr>
<td>39 – 41</td>
<td>34</td>
<td>8.21</td>
<td>≥ 66</td>
<td>1</td>
<td>0.24</td>
</tr>
<tr>
<td>42 – 44</td>
<td>11</td>
<td>2.66</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Bakirtzoglou, P.: Structure of participants in fitness club programs in the town of Thessaloniki

**Figure 2:** Distribution of users according to age

**Table 3:** Distribution of users according to marital status

<table>
<thead>
<tr>
<th>Marital status</th>
<th>Absolute frequencies</th>
<th>Relative frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Married</td>
<td>200</td>
<td>48.31%</td>
</tr>
<tr>
<td>Single</td>
<td>214</td>
<td>51.69%</td>
</tr>
</tbody>
</table>

![Pie chart showing marital status distribution](image)

**Figure 3:** Distribution of users according to marital status

**Table 4:** Users of different marital status in relation to gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Marital status</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Married</td>
<td>Single</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>56 (39.7%)</td>
<td>85 (60.3%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>144 (52.7%)</td>
<td>129 (47.3%)</td>
<td></td>
</tr>
</tbody>
</table>

$\chi^2 = 6.323 \quad p = .013^*$
Figure 4: Users of different marital status in relation to gender

Table 5: Distribution of users according to the level of education

<table>
<thead>
<tr>
<th>Education</th>
<th>Absolute frequencies</th>
<th>Relative frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>33</td>
<td>7.97%</td>
</tr>
<tr>
<td>Secondary</td>
<td>179</td>
<td>43.24%</td>
</tr>
<tr>
<td>College</td>
<td>53</td>
<td>12.80%</td>
</tr>
<tr>
<td>University</td>
<td>125</td>
<td>30.19%</td>
</tr>
<tr>
<td>Postgraduate</td>
<td>24</td>
<td>5.80%</td>
</tr>
</tbody>
</table>

Figure 5: Distribution of users according to the level of education

Table 6: Distribution of users according to the type of work they performed

<table>
<thead>
<tr>
<th>Type of work</th>
<th>Absolute frequencies</th>
<th>Relative frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Servant</td>
<td>62</td>
<td>14.98%</td>
</tr>
<tr>
<td>Private sector</td>
<td>58</td>
<td>14.01%</td>
</tr>
<tr>
<td>Worker</td>
<td>48</td>
<td>11.59%</td>
</tr>
<tr>
<td>Student</td>
<td>68</td>
<td>16.43%</td>
</tr>
<tr>
<td>Pensioner</td>
<td>15</td>
<td>3.62%</td>
</tr>
<tr>
<td>Home-maker</td>
<td>93</td>
<td>22.46%</td>
</tr>
<tr>
<td>Unemployed</td>
<td>70</td>
<td>16.91%</td>
</tr>
</tbody>
</table>
Bakirtzoglou, P.: Structure of participants in fitness club programs in the town of Thessaloniki

Figure 6: Distribution of users according to the type of work they performed

Table 7: Distribution of users according to the type of program in which they participated

<table>
<thead>
<tr>
<th>Program</th>
<th>Absolute frequencies</th>
<th>Relative frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerobics</td>
<td>37</td>
<td>8.94%</td>
</tr>
<tr>
<td>Weightlifting</td>
<td>57</td>
<td>13.77%</td>
</tr>
<tr>
<td>Pilates-yoga</td>
<td>64</td>
<td>15.46%</td>
</tr>
<tr>
<td>Tennis</td>
<td>45</td>
<td>10.87%</td>
</tr>
<tr>
<td>Dance</td>
<td>61</td>
<td>14.73%</td>
</tr>
<tr>
<td>Med. Gymnastics</td>
<td>68</td>
<td>16.43%</td>
</tr>
<tr>
<td>Swimming</td>
<td>38</td>
<td>9.18%</td>
</tr>
<tr>
<td>Sports games</td>
<td>44</td>
<td>10.63%</td>
</tr>
</tbody>
</table>

Figure 7: Distribution of users according to the type of program in which they participated

Table 8: Distribution of users of sports services according to duration

<table>
<thead>
<tr>
<th>Duration</th>
<th>Absolute frequencies</th>
<th>Relative frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 months</td>
<td>12</td>
<td>2.90%</td>
</tr>
<tr>
<td>3 months</td>
<td>20</td>
<td>4.83%</td>
</tr>
<tr>
<td>4 months</td>
<td>55</td>
<td>13.29%</td>
</tr>
<tr>
<td>5 months</td>
<td>80</td>
<td>19.32%</td>
</tr>
<tr>
<td>The entire season</td>
<td>247</td>
<td>59.66%</td>
</tr>
</tbody>
</table>
Figure 8: Distribution of users of sports services according to duration

**Tabla 9**: Representation of the program among respondents of different genders

<table>
<thead>
<tr>
<th>Program</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerobics</td>
<td>5</td>
<td>32</td>
</tr>
<tr>
<td>Weightlifting</td>
<td>42</td>
<td>15</td>
</tr>
<tr>
<td>Pilates-yoga</td>
<td>4</td>
<td>60</td>
</tr>
<tr>
<td>Tennis</td>
<td>23</td>
<td>22</td>
</tr>
<tr>
<td>Dance</td>
<td>5</td>
<td>56</td>
</tr>
<tr>
<td>Med. Gymnastics</td>
<td>16</td>
<td>52</td>
</tr>
<tr>
<td>Swimming</td>
<td>15</td>
<td>23</td>
</tr>
<tr>
<td>Sports games</td>
<td>31</td>
<td>13</td>
</tr>
</tbody>
</table>

$\chi^2 = 122.641 \quad p = .000^*$

Figure 9: Representation of the program among respondents of different genders
Table 10: Average age of participants in various exercise programs

<table>
<thead>
<tr>
<th>Program</th>
<th>Average Years</th>
<th>Std. Dev.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerobics</td>
<td>27.62</td>
<td>7.610</td>
<td>19</td>
<td>50</td>
</tr>
<tr>
<td>Weightlifting</td>
<td>30.65</td>
<td>7.811</td>
<td>19</td>
<td>54</td>
</tr>
<tr>
<td>Pilates-yoga</td>
<td>37.78</td>
<td>7.975</td>
<td>21</td>
<td>53</td>
</tr>
<tr>
<td>Tennis</td>
<td>31.89</td>
<td>8.427</td>
<td>18</td>
<td>48</td>
</tr>
<tr>
<td>Dance</td>
<td>27.74</td>
<td>8.191</td>
<td>18</td>
<td>47</td>
</tr>
<tr>
<td>Med. Gymnastics</td>
<td>55.01</td>
<td>6.634</td>
<td>25</td>
<td>66</td>
</tr>
<tr>
<td>Swimming</td>
<td>28.32</td>
<td>9.484</td>
<td>18</td>
<td>47</td>
</tr>
<tr>
<td>Sports games</td>
<td>20.70</td>
<td>2.716</td>
<td>18</td>
<td>29</td>
</tr>
</tbody>
</table>

F = 111.459  \quad p = .000^{*}

Of particular importance was the analysis of the sample structure in relation to the distribution of some recreational programs which are implemented in sports centers. From eight forms of recorded physical activities (Table and Figure 7), the majority of respondents (16.43%) participated in the preventive-therapeutic forms of exercise (medical gymnastics), and the least in classic aerobics (8.94%). The second most frequently represented (15.46%) were relax-activities (Pilates and yoga).

As for the length of the period during which the users participated regularly in the program, by far the most (59.66%) were those who regularly exercised during the whole season, while the shortening of the exercising period dramatically reduced the number of respondents (Table and Figure 8).
Table 11: Presence of different programs among respondents of different marital status

<table>
<thead>
<tr>
<th>Program</th>
<th>Married</th>
<th>Single</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerobics</td>
<td>9</td>
<td>28</td>
</tr>
<tr>
<td>Weightlifting</td>
<td>22</td>
<td>35</td>
</tr>
<tr>
<td>Pilates-yoga</td>
<td>46</td>
<td>18</td>
</tr>
<tr>
<td>Tennis</td>
<td>21</td>
<td>24</td>
</tr>
<tr>
<td>Dance</td>
<td>20</td>
<td>41</td>
</tr>
<tr>
<td>Med. Gymnastics</td>
<td>66</td>
<td>2</td>
</tr>
<tr>
<td>Swimming</td>
<td>13</td>
<td>25</td>
</tr>
<tr>
<td>Sports games</td>
<td>3</td>
<td>41</td>
</tr>
</tbody>
</table>

$\chi^2 = 128.918$  $p = .000^*$

Figure 11: Presence of different programs among respondents of different marital status

Table 12: Presence of different programs among respondents of different education levels

<table>
<thead>
<tr>
<th>Program</th>
<th>Primary</th>
<th>Secondary</th>
<th>College</th>
<th>University</th>
<th>Postgraduate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerobics</td>
<td>0</td>
<td>14</td>
<td>5</td>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td>Weightlifting</td>
<td>0</td>
<td>27</td>
<td>5</td>
<td>21</td>
<td>4</td>
</tr>
<tr>
<td>Pilates-yoga</td>
<td>2</td>
<td>28</td>
<td>8</td>
<td>18</td>
<td>8</td>
</tr>
<tr>
<td>Tennis</td>
<td>2</td>
<td>15</td>
<td>11</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>Dance</td>
<td>2</td>
<td>24</td>
<td>7</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>Med. Gymnastics</td>
<td>26</td>
<td>35</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Swimming</td>
<td>0</td>
<td>12</td>
<td>11</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>Sports games</td>
<td>1</td>
<td>24</td>
<td>5</td>
<td>13</td>
<td>1</td>
</tr>
</tbody>
</table>

$\chi^2 = 148.99$  $p = .000^*$
Table 13: Presence of different programs among respondents with different employment

<table>
<thead>
<tr>
<th>Program</th>
<th>Public servant</th>
<th>Private sector</th>
<th>Worker</th>
<th>Students</th>
<th>Pensioners</th>
<th>Home-makers</th>
<th>Unemployed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerobics</td>
<td>7</td>
<td>7</td>
<td>3</td>
<td>8</td>
<td>0</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Weightlifting</td>
<td>8</td>
<td>16</td>
<td>10</td>
<td>7</td>
<td>0</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Pilates-yoga</td>
<td>14</td>
<td>7</td>
<td>9</td>
<td>2</td>
<td>1</td>
<td>26</td>
<td>5</td>
</tr>
<tr>
<td>Tennis</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>7</td>
<td>0</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Dance</td>
<td>13</td>
<td>4</td>
<td>4</td>
<td>19</td>
<td>0</td>
<td>10</td>
<td>11</td>
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<tr>
<td>Med. Gymnastics</td>
<td>5</td>
<td>3</td>
<td>7</td>
<td>0</td>
<td>14</td>
<td>37</td>
<td>2</td>
</tr>
<tr>
<td>Swimming</td>
<td>6</td>
<td>4</td>
<td>6</td>
<td>9</td>
<td>0</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Sports games</td>
<td>0</td>
<td>9</td>
<td>2</td>
<td>16</td>
<td>0</td>
<td>0</td>
<td>17</td>
</tr>
</tbody>
</table>

$\chi^2 = 230.038 \quad p = .000^*$

The central subject of the comparative analysis was the relatedness of individual characteristics (gender, age, educational level and type of work), and selected recreational programs. Applying the χ2-test proved that between men and women there is a significant statistical difference in the choice of programs. While men preferred weightlifting, as a typical high-intensity activity, the most frequent choice for women were Pilates, yoga and dance, as a relaxing low intensity activity (Table and Figure 9). An analysis of variance revealed that age is also a significant predictor for the selection of preferred activities, given the significant differences in the average number of years among the respondents who participated in different programs (Table and Figure 10). It has been shown that the lowest mean age (20.7) was in the group of respondents who had chosen to participate in sports games and the highest (55.01) in the medical gymnastics group. A similar trend was observed while comparing the representation of each program among respondents who are married and those who are single, considering that a statistically significant difference between married and single individuals was established (Table and Figure 11). While married (and older) individuals preferred low activity exercises, the single (younger) individuals selected higher intensity activities. The educational level also proved to be statistically significant (Table 12) even though by comparing the empirical frequency it was difficult to perceive some regularity in the classifying of the test subjects. It is easy to observe that the respondents with primary education participated in fewer programs.
than others. In some programs such as weightlifting, aerobics and dance, they did not participate at all. Applying the χ²-test, a statistically significant difference between people with diverse occupations in regards to the choosing of a program (Table 13) was found. There is an apparent consistency of a total absence of retired people from any other activities other than medical gymnastics, which is somewhat to be expected, considering their physical form. Also, it was perceived that among the public servants, the favorites were low intensity activities - Pilates, yoga and dance, while among those working in the private sector weightlifting was a favorite, students preferred dance, home-makers opted for medical gymnastics, while the unemployed participated in sports games, and then in weightlifting and dance.

**DISCUSSION**

Of the 414 surveyed respondents, users of services in the fitness center of the city of Thessaloniki, as many as 2/3 were women, with a 65.94% precision. This can be explained in two ways. First, it appears that women are able to find more appropriate programs offered by sports centers. On the other hand, it is realistic to assume that men spend far more time performing various tasks that leave little free time for sports and recreation. In addition, it is probably the influence of habit and tradition that men spend time watching football games, which remains an enjoyable recreation.

As regards the age of the respondents, the range (width variations) was from 18 to 66 years of age, which shows that the services of the sports centers were used by people of all ages. By far, the majority were people younger than 30. In relation to the marital status of the respondents, the number of married and single individuals was fairly homogeneous (48.31% and 51.69% married and single individuals, respectively). Among the surveyed users there were significantly more married than single women, while with men the ratio was reversed - sports centers are far more visited by single than married men. Such a correlation of absolute and relative frequency obviously shows that after marriage, women’s needs for regular recreational activities increases, while in men that need rapidly decreases. This is probably explained by the women’s needs to maintain their esthetic and psychophysical qualities after marriage and giving birth.

When the sub-sample was analyzed according to the criterion of education, it was found that among the most represented were individuals with secondary school education, and the least those with
extremely low or high education. It is important to notice that almost 1/3 of the respondents (30.19%) have university degrees. They, together with respondents from the class with a college degree (12.8%) and those with postgraduate degrees (5.8%) made up almost half of the total user sample. If we add to this the fact that among the respondents with secondary education, the highest number (68 or 16.43%) are future university-educated individuals, presently students, it can be concluded that the number of those who exercise regularly is proportionate to the level of education.

The analysis of the structure of the sample according to the work criterion (or unemployed or retired), showed that all groups were evenly represented, with the exception of pensioners, who make up only 3.62% of this sample. Starting from the empirical frequency values, it can be concluded that home-makers are the most frequent users of sports centers, the least frequent being workers, excluding pensioners, of course.

Of the eight most common forms of physical activity, the largest number of respondents (16.43%) participate in medical exercises, and the least in classic aerobics (8.94%). The second group represented (15.46%) were the group-relaxation activities (Pilates and yoga). The distribution obtained shows that uses of the sports centers were more interested in low-intensity activities with the aim of relaxing the nervous system, while much less participate in classic aerobics, once the most popular form of fitness. There are a high proportion of those who practice swimming as an exercise activity. Sports games are also very popular (football, basketball, volleyball, etc.), as well as tennis and dance. Generally, it can be concluded that the research recorded eight types of activities with a fairly equal number of users. The results unequivocally show that men and women are statistically significantly different when they opt for recreational programs. While men are most likely to choose weightlifting, so far the most frequent choice for women was Pilates, yoga and dance.

The age of the respondents also had a significant influence on the choice of program. It was shown that the lowest average years were obtained in the group of respondents who chose to play sports games, and the highest in the group which chose medical exercises. This was expected since the participation of elderly persons was determined by their health needs and medical limitations, rather than by personal desires and preferences of the concrete type of a particular activity. On the other hand, sports games, as the most dynamic and competitive activities, were better suited for younger people. Substantiating this
conclusion is the fact that the second largest age average was also obtained in the group of relaxing activities such as Pilates and yoga (37.78 years).

Also, marital status was an important factor for the selection of activities. While single, it is logical that young people would select far more dynamic activities such as sports games, weightlifting and tennis, while with married people who are in the majority of cases older, more popular were low intensity activities aimed at relaxation and exercising in the aim of health (medical gymnastics, Pilates, yoga). It is interesting that only three married respondents participated in sports games, while medical gymnastics was practiced (probably by the recommendation of doctors) by only two unwed test subjects.

The main source of variability in the selection of recreational programs for people of different educational levels was the absence of subjects with the lowest education. They were by far the group which participated the most in the medical gymnastics program, which may be associated with their level of awareness of the importance of exercise. This group trained regularly to maintain their health or at the request of a doctor. In other educational groups, all programs were equally represented, that is, in every field there was at least a minimum frequency, provided by cross-tabulation analysis. The only zeroes recorded were in the groups of respondents with primary school education (Table 12).

CONCLUSION

The poll included 414 users of ten randomly selected fitness centers in Thessaloniki in order to quantify the basic social characteristics and participation in certain programs. On the basis of the results obtained, it is possible to conclude the following:

- Fitness center services were by far more used by females.
- The recreational programs included all ages. Among them the majority were individuals younger than 30, as the increasing age of respondents was proportionally reduced.
- The majority of people who participated in fitness center programs have secondary school education, and less those with extremely low and high education.
- The largest number of users of fitness centers’ services are homemakers, and the smallest workers and pensioners.
Most of the respondents participated in medical exercises, and the least in classic aerobics. Following that, the largest number of respondents participated in the group of relaxation activities (Pilates and yoga). The obtained distribution shows that exercise-goers were more interested in low-intensity activities for relaxing the nervous system, while there was less interest in aerobics.

The selection of recreational programs is significantly influenced by gender, age, marital status and level of education.

References

Summary: Hypokinesia and poor nutrition are the most frequent causes of disorders in the physical constitution, followed by an increase in body mass and the amount of fatty tissue. This research followed the effects of a specific model of recreational exercising which was considered, and proved by this study, to have an impact on the correction of the body’s constitution. The research was carried out in the form of an experiment with parallel groups. It was realized in the Miss Fit fitness and wellness center in Novi Sad, and lasted four months. Before the start, in the middle and the end of the experimental treatments for every respondent, the body constitution expressed via the body mass, the fat assessment and the body mass index was determined. Before the start of the experiment, the level of physical work abilities was determined for every respondent by means of the PWC170 test. Based on the results of measuring, the sample was divided into two homogenous groups – the first with strong and the second with weak indicators of physical work abilities. The obtained results showed that these two groups of respondents did not differ in the regards of the volume and rate of changes of body constitution during the experimental period, that is, that the beginner level of physical work abilities did not impact the occurring changes. By comparison, the results of the initial, transitive and final measurements pointed to a significant reduction of body mass and the amount of fatty tissue in both groups of respondents, which speaks in favor of the efficiency of the applied model of exercising in the sense of the correction of body constitution.

Key words: body constitution, fitness, recreation, exercising.
HE SUBJECT

Health, vitality and a long life are what most people wish for. The results of numerous research papers have shown that those who exercise regularly, with properly organized and individually dosed physical activity, are less prone to cardiovascular and psychosomatic illnesses. In spite of the awareness of the positive effect of exercising, there is daily proof of a decrease of physical activities, this also implying a decrease of physical abilities of the average person. Numerous studies have shown that about 80% of the population is insufficiently physically active, and that in most developed countries over 50% of adults are overweight. The main cause of a low level of physical work ability of contemporary man is usually said to be morbogenic trias, and defined as a syndrome of three factors: hypokinesia, obesity and psychological stress. Experts thus increasingly promote the relevance of adopting positive habits, among which dosed recreational exercising take up a central place. Such a model of physical activities, hypothetically directed towards the correction of the body constitution of young women, is also the subject of this paper.

Insufficient movement, poor nutrition and stress are the main causes of body constitution disorders. This primarily involves the increase of body mass, which is also usually followed by an increase of body fat over the allowed limit. Body constitution implies the link between the organic tissues of which the human body is composed. From the aspect of biochemistry, we can talk about a four-component model (fat, water, proteins and minerals), and from the dietetics aspect, a two-component model of body constitution (fat and non-fat residue). In this research paper, however, the four-component model was used, usually used the most in contemporary anthropometry, and defines a proportional representation of the fatty, muscle and bone tissue, as well as the so-called residue (Ostojić, 2005). The determining of body constitution is carried out, primarily, in the aim of assessing the health risk or quality of sports performance, where the most attention is given to determining the contents of the fatty components.

For assessing a body constitution, several different procedures are used today and can be classified into several groups: methods of electrical conductibility, radiological techniques, densitometry and plethysmography. Also used frequently are classical techniques of anthropometric measurements. There is increasing research being carried out which endeavors to determine precisely the physical constitution of man, as well as to check out the impact of various physical activities on
body constitution. Thus Stojiljković (2005) quotes three programs for correcting body constitution. The first relates to a decreased intake of calories in relation to the daily needs of the organism. Even though this is a quick and efficient way, it is damaging for the health. The second approach to correcting body constitution is increasing calorie consumption by introducing additional physical activities, along with an unaltered intake of calories. The third model of the normalizing of body composition is quoted as being a simultaneous reducing of the intake and increase of calorie consumption. The combination of calorie intake, especially a decreased intake of fat with dosed exercising has shown to be the most efficient, considering the appearance of the largest calorie deficit.

Schmidt and associates (2001) compared the effects of several short-term and one long-term sustained carrying out of aerobic exercises on the increase of a maximum consumption of oxygen (VO₂max) and the decrease of body mass. The research involved individuals of both genders divided into three groups. The first group exercised 15 minutes twice, the second 10 minutes 3 times, while the third one had one continued load lasting 30 minutes. The exercises were carried out with an intensity which corresponds to the level of 75% of the maximum heart frequency. The results showed that similar effects were obtained in all groups, those which applied two or three short-term aerobic exercises, as well as those which had one sustained long-term exercise. On the other hand, Chambliss (2003) researched the effects of duration and frequency of exercising on the decreasing of body mass and the improving of physical work abilities. The experimental treatment lasted one year, and included women aged 21 to 45, with a BMI of 27 to 40, while the sample was divided into four groups. The first group had a program which was highly intensive and of a long duration, the third a medium intensity and long duration, while the fourth group had a program of high intensity and medium duration. The results obtained at the end of the experiment showed that the first group decreased its body mass by 8.9 kg in average, the second by 8.2 kg, the third by 6.3, and the fourth by 7.0 kg. The level of physical abilities increased in all the respondents - in the first group by 22% in average, 14.9% in the second, 13.5% in the third and 18.9% in the fourth. Except for a decrease of body mass and an increase of physical abilities, it was also determined that the duration of physical exercising has shown to be a more important parameter for achieving results than its intensity.

A similar research was conducted by Slentz (2004) and associates in which he tested the effects of exercises of a varied duration.
and intensity on the change of body constitution. The experimental treatment lasted eight months and included individuals of both genders with stressed obesity, aged between 40 to 65. The sample was divided into three groups. The first were respondents whose program consisted of longer duration and larger intensity exercises. The program of the second group implied activities of a short duration and high intensity, while in the program of the third group activities of a shorter duration and medium intensity dominated. The respondents of the first group achieved better results in regards to the correction of the body constitution than the remaining two groups whose programs included shorter activities. It was concluded once again that activities of a longer duration and a higher intensity give the best results in regards to the correction of body constitution.

**WORK METHOD**

This research was carried out as an experiment with parallel groups. In the stage of defining theoretical fundaments, the bibliographical-speculative method was used, while the statistical method was used for the processing and interpretation of results. The research was carried out in the Miss Fit fitness and wellness center in Novi Sad, and lasted four months. Before the start, at the middle and the end of the experimental treatment, the body constitution of every respondent was established and expressed via the body mass, fat percentage and Body-Mass-Index. Before the beginning of the experiment, the level of physical test abilities of the respondents was assessed by the PWC170 test. Based on the obtained indicators, the sample was divided into two qualitative groups. The first group was made up of respondents with low physical abilities, and the second with averagely developed physical abilities. The experiment involved 30 women aged between 25 and 30 with extreme obesity and an increased BMI, but without any other health problems.

All the variables applied in the research can, according to their methodological nature, be divided into two groups – the predictor and the criteria groups. The only predictor (independent) variable is the applied model of physical exercising, while in the group of criteria (dependent) variables there were the body mass, the percentage of fat and the BMI.

The experimental program consisted of four weeks of training conceived in the following manner: in the first training session of the week, the muscle system of the caudal part was primarily engaged, in the
second the cranial, in the third training session engaged was the complete muscle system, while in the fourth, work on the strengthening of the stomach and back muscles was carried out on cardio trainers. The exercises were scheduled in 2-3 series, and involved free weights or trainer machines, with weights from 50% to 70% max. The number of repetitions ranged from 12 to 20; the break between the series lasted from 30 to 45 seconds, and between the exercises from one to two minutes. The exception was the breaks after working on the cyclical trainers which were from three to five minutes. At the end of each training session, stretching exercises lasting from ten to fifteen minutes were applied.

The body mass of the respondents was expressed in kilograms with a precision of measuring of 0.5 kg. The percentage of body fat was measured via a bioelectrical impedancence by using the Omron body fat analyzer. The assessment of the physical work capacity was realized with a progressive load on the bicycle ergometer with the PWC170 standardized test (Perić, 2006). Prior to carrying out the test, the respondents warmed up on a treadmill for 10 minutes, with shaping and stretching exercises following. During the test, the respondents had to maintain a constant pace of 70-75 rotations per minute, regardless of the increase of load every three minutes. The test ended when the pulse value reached 170 beats a minute. During the recovery, the pulse was also measured and based on the speed of its dropping, a fitness level for every respondent was established.

RESULTS

A comparative analysis carried out by applying the T-test for independent samples on the results obtained by measuring anthropometric dimensions, showed that the groups among themselves did not statistically significantly differ even within one time period (initial, transitive and final measuring). Namely, in all cases, high values of the realized level of significance were obtained (p) which significantly exceeded the theoretical limit of 0.05 (p > .05). This practically means that there were no significant differences in any of the indicators of the body constitution (the absolute body mass, BMI and the proportional representation of fatty tissue in the total body mass) of average value (an arithmetic mean), determined for the groups of stronger and weaker respondents.

On the other hand, the parameters obtained after the testing of the differences within the groups by applying the analysis of the variants
with repeated measurements, showed that the body constitution of the
respondents of both groups statistically significantly improved from the
beginning to the end of the experiment. In all six cases, namely, the
realized levels of significance (p) were almost equal to zero (p < .001)
and pointed to the possibility of concluding with a high degree of
probability.

The rate of changes in the first two months, even though statistically significant, was somewhat slower than in the last two when
there was a speedy decrease of body mass and fatty tissue. The final F-
value was very high, and the realized level of significance exceptionally
low, which definitely confirms the efficiency of the applied experimental
program (Tables 1, 2 and 3; Diagrams 1, 2 and 3).

Table 1: The values of the body mass of both groups in the initial, control and final assessments.

<table>
<thead>
<tr>
<th>Group</th>
<th>Initial assessment</th>
<th>Control assessment</th>
<th>Final assessment</th>
<th>ANOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaker</td>
<td>78</td>
<td>74.3</td>
<td>69.3</td>
<td>p = .000</td>
</tr>
<tr>
<td>Stronger</td>
<td>75.5</td>
<td>72</td>
<td>67.1</td>
<td>p = .000</td>
</tr>
<tr>
<td>T-test</td>
<td>p = .378</td>
<td>P = .371</td>
<td>p = .384</td>
<td>Level of significance</td>
</tr>
</tbody>
</table>

Diagram 1: Values of body mass in both groups in the initial, control and final assessments.

Table 2: Values of the BMI of both groups in the initial, control and final assessments.

<table>
<thead>
<tr>
<th>Group</th>
<th>Initial assessment</th>
<th>Control assessment</th>
<th>Final assessment</th>
<th>ANOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaker</td>
<td>26.6</td>
<td>25.4</td>
<td>23.6</td>
<td>.001</td>
</tr>
<tr>
<td>Stronger</td>
<td>26.9</td>
<td>25.5</td>
<td>23.8</td>
<td>.001</td>
</tr>
<tr>
<td>T-test</td>
<td>p = .697</td>
<td>p = .888</td>
<td>p = .699</td>
<td>Level of significance</td>
</tr>
</tbody>
</table>
Table 2: Values of BMI of both groups in the initial, control and final assessments.

Table 3: Representation of fatty tissue with both groups in the initial, control and final assessments.

<table>
<thead>
<tr>
<th>Group</th>
<th>Initial assessment</th>
<th>Control assessment</th>
<th>Final assessment</th>
<th>ANOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaker</td>
<td>30.6</td>
<td>28.2</td>
<td>24.9</td>
<td>p = .000</td>
</tr>
<tr>
<td>Stronger</td>
<td>31.2</td>
<td>28.4</td>
<td>25.3</td>
<td>p = .000</td>
</tr>
<tr>
<td>T-test</td>
<td>P = .456</td>
<td>p = .787</td>
<td>p = .391</td>
<td>Level of significance</td>
</tr>
</tbody>
</table>

Diagram 3: Representation of fatty tissue with both groups in the initial, control and final assessments.
DISCUSSION

Considering all the obtained results, it can be said with certainty that the applied model of recreational exercising has shown to be efficient in the regard of the correction of the constitution, and the reduction of body mass and fatty tissue with young women. Exercises based on aerobic sources dominated in the experimental program. Considering that the applied loads, especially in time-related cardio-programs, ranged within the zones of a low and medium intensity, it was logical to expect the engaging of fats (lipolysis) as a dominant energy source. This is indicated by classical textbook information (Perić, 2003; Ostojić, 2007), as well as experimental papers which include respondents of similar characteristics (Donnelly, Hill and Jacobsen, 2003; Marcus, Jakićić and Gallagher, 2003).

The progress which was noted after two months of the program’s application, an almost complete correction of the body constitution after a 4-month application, is certain proof that the applied volume and intensity was enough to incur positive changes of the body constitution, that is, to raise the parameters of the body constitution to normal or acceptable values according to the ones prescribed by the World Health Organization. In comparison with earlier papers and research which encompassed the same or a similar problematic (Anderson and associates 1999; Coyle, 2000; Gallagher, 2000; Đorđević, 2005) this study showed a high concurrence with the earlier results.

It is interesting that the rate of reducing fatty tissue, the implicit body mass and BMI, was not consistent during the entire experimental period. A statistically significant quicker loss of fatty tissue followed in the second half of the experiment, that is, after only two months. This manifestation can be explained by training effects realized during the first half of the experimental period. It is realistic to presume, namely, that in the first eight weeks there was an adaptation of the respondents to effort followed by an increase of aerobic abilities and an increase of the aerobic threshold. In this way, the respondents in the last two months were able to start to use fats earlier as the basic energy fuel during the same work intensity. This leads to the conclusion that every program directed at the reduction of body mass, especially in the case of untrained individuals, should be preceded by a certain preparation period, that is, a period of functional adaptation. It seems that eight weeks is a sufficient period for enlarging the enzymes significant for the calatization of aerobic processes (primarily lypolysis).
CONCLUSION

An experiment was carried out with parallel groups on a sample of 30 young women aged 20 to 25, who were exposed to a specific aerobic training model during four months, with the aim to determine the effects of exercising in relation to changes in body composition, body mass and the amount of fatty tissue. Prior to the experiment, the sample was divided into two homogeneous groups with different levels of physical work abilities. The variables of the body constitution were followed in three time periods (initial, transitive and final measuring). Based on the obtained results, it is possible to conclude the following:

- All the respondents at the beginning of the experiment had an excess of fatty tissue and values of the body constitution index which significantly exceeded normal values.
- The experimental treatment brought positive changes in all the indicators of body constitution, that is, a reduction of body mass, the BMI and fatty tissue.
- The groups among themselves did not statistically significantly differ in the transitive and final measurements, which showed that a different initial level of physical work abilities was not the decisive factor for the volume and rate of the occurring changes.
- A quicker loss of fatty tissue ensued in the second half of the experiment, that is, after two months. This is explained by the development of aerobic powers and the ability of the respondents in the later stages of the experiment to more efficiently use fats as the basic source of energy for muscle work.

References

SUDDEN CARDIAC DEATH – THE MOST COMMON CARDIOVASCULAR CAUSES AND PREVENTION

UDK 616.1:796; 616-036.866:796

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Abstract: The most common cause of death in young athletes is sudden cardiac death (SCD). Cardiovascular diseases are the cause of death in more than 90% of athletes. The causes of SCD in athletes correlate a great deal depending on age. With young athletes (younger than 35), the leading cause are congenital heart diseases, especially hypertrophic cardiomyopathy, and congenital anomalies of the coronary arteries. In the case of athletes older than 35, the majority died due to atherosclerotic changes in the coronary arteries. Even though in competitive sports it is impossible to reduce the risk to zero, the emphatic recommendations of carrying out examinations prior to competitions and counter-indications for participating in sports would reduce the frequency of SCD to a large extent. If specific conditions of the cardiovascular system should be diagnosed, it is necessary to determine the risk from SCD linked with the sustained participation in physical activity and competitive sports activity and define clear disqualifying criteria for every individual athlete.

Key words: sudden cardiac death (SCD), athletes, prevention

INTRODUCTION

The favorable impact of sustained physical activity on the function of the cardiovascular system, as well as on the prevention of primary and secondary cardiovascular diseases, has been studied in depth and confirmed by numerous epidemiological and clinical studies [1, 2]. Those who continuously participate in physical activities – athletes, are considered to be the healthiest members of our society, and
thus their sudden fatality during training or competing can draw great attention. The most common cause of death in athletes is sudden cardiac arrest, or death (SCD) [3, 4, 5].

The first case of SCD in an athlete was noted as far back as 490 B.C., when the Greek soldier and first Marathon runner Pheidippides died suddenly as he brought news on the great victory of the Greeks over the Persians [6]. The significance of SCD has been recognized only in the middle of the last century, and in this country this topic has started to be discussed after the World Basketball Championship held in Ljubljana in 1970 and the sudden death of national team member Trajko Rajković.

SCD is defined as sudden death of a cardiac origin, caused by sudden cardiac arrest [7, 8, 9]. It is characterized as a sudden loss of consciousness one hour after the appearance of acute symptoms. A prior history of heart disease may exist but does not have to be the direct cause of death [6, 8].

All SCD in sports can be divided into three categories [10]: 1) Commotio cordis (disturbance of the heart) which occurs as the result of a blunt impact to the precordial region, causing arrhythmia; 2) SCD in athletes younger than 35 due to structural, congenital heart diseases, which draw the most attention from the medical profession; and 3) SCD due to diseases of the coronary arteries, most common in athletes older than 35 (a predominant risk with marathon runners and half-marathon runners).

ATHLETIC HEART AND THE ADAPTING OF THE CARDIOVASCULAR SYSTEM TO A GREATER PHYSICAL LOAD

The term “athletic heart syndrome” or athlete’s heart, includes all the adaptive changes of the cardio-vascular system which develop with time under the impact of intense and sustained physical activity [11].

It was proven as far back as 1935 that sustained physical activity leads to hemodynamic, electrophysiological and morphological changes in the tissue of the myocardium [12].

Where there is physical loading there occurs an increase of oxygen consumption in the muscle tissue, and a minute volume of the heart must be increased to meet the demands. The minute volume of the heart during the greatest effort can increase seven to eight times in athletes, while the cardiac stroke volume increases two and a half times [11]. The increase of work efficiency during physical activity is also
achieved by an increase of heart frequency during work. A reducing of heart frequency during rest is typical.

The athletic heart is in the morphological sense distinguished by a hypertrophy of the myocardium and an increase of the size of the heart. The “athletic heart” increases until it reaches a critical mass of 350 grams for the left chamber (normal mass 200 grams). The hypertrophy of the left chamber is symmetrical, with an equal increase of the septum and the wall of the left chamber (13 mm maximum) [7, 13, 14].

Ventricular hypertrophy is a useful mechanism of adaptation which increases the functional ability of the heart of young athletes. However, ventricular hypertrophy is rarely a cause of SCD in athletes [10].

**EPIDEMIOLOGY**

In this country there are no statistical facts linked with sudden cardiac death in athletes, and thus data provided by foreign authors was used in this paper. In most studies of American authors, the frequency of SCD in young athletes in high schools and college is 1 in 200,000 athletes per year [4, 10, 15, 20], while studies of European researchers claim that the incidence is greater, amounting to 1-1.6:100,000 [16, 19], with a significantly greater frequency of SCD in the male population (90%).

Maron and associates in their study [4] showed 134 cases of SCD in young athletes who died in the period from 1985 to 1995. The average age of athletes was 17 (the youngest 12 years of age, and the oldest 40). There were a much greater number of boys and men, as much as 90% in relation to the female gender. It is interesting that in this study, 44% of the SCD cases were African-Americans. In relation to the type of sport, 68% of SCD cases were noted in soccer players and basketball players. In 46% of the cases, the cause of death was diagnosed as hypertrophic cardiomyopathy, while in 19% of the cases there were anomalies of coronary blood vessels. Even with hypertrophic cardiomyopathy, as well as in all SCD causes, there was a greater incidence among African-Americans in relation to white athletes.

With female athletes, SCD appears nine times more rarely in relation to male athletes. This difference can be explained by a lower rate of participation of female athletes, less stressogenic demands in competitions, as well as a rarely diagnosed hypertrophic cardiomyopathy in women in the general population [17].
ETIOLOGY

The references show over 20 different causes of SCD (Table 1). Among younger athletes, this is usually a covert cardiac disease. SCD in athletes younger than 35 years of age is the consequence of hypertrophic cardiomyopathy, after which follow anomalies of the coronary arteries and heart stroke, while in those older than 35 years of age the most frequent cause are atherosclerotic changes of coronary arteries.

Table 1: The causes of death in athletes (data obtained based on analysis of works quoted in references under numbers 4, 6, 7 and 8).

<table>
<thead>
<tr>
<th>CAUSE</th>
<th>Younger than 35 years of age (N=387)</th>
<th>Older than 35 years of age (N=74)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertrophic cardiomyopathy</td>
<td>102 (26.4%)</td>
<td>1 (1.4%)</td>
</tr>
<tr>
<td>Anomalies of coronary arteries</td>
<td>77 (19.9%)</td>
<td>0</td>
</tr>
<tr>
<td>Commotio cordis</td>
<td>53 (13.7%)</td>
<td>1 (1.4%)</td>
</tr>
<tr>
<td>Idiopathic hypertrophy of the left chamber</td>
<td>29 (7.5%)</td>
<td>0</td>
</tr>
<tr>
<td>Myocarditis</td>
<td>20 (5.2%)</td>
<td>0</td>
</tr>
<tr>
<td>Rupture of the aneurism of the aorta and Marfan’s syndrome</td>
<td>12 (3.1%)</td>
<td>0</td>
</tr>
<tr>
<td>Arrhythmicogenic cardiomyopathy of the right chamber</td>
<td>11 (2.8%)</td>
<td>1 (1.4%)</td>
</tr>
<tr>
<td>Aortic stenosis</td>
<td>10 (2.6%)</td>
<td>1 (1.4%)</td>
</tr>
<tr>
<td>Atherosclerotic changes coronary arteries</td>
<td>10 (2.6%)</td>
<td>56 (75.4%)</td>
</tr>
<tr>
<td>Idiopathic dilatative cardiomyopathy</td>
<td>9 (2.3%)</td>
<td>0</td>
</tr>
<tr>
<td>Sarcoidosis</td>
<td>3 (0.8%)</td>
<td>0</td>
</tr>
<tr>
<td>Long QT syndrome</td>
<td>3 (0.8%)</td>
<td>1 (1.4%)</td>
</tr>
<tr>
<td>Other causes</td>
<td>45 (11.3%)</td>
<td>13 (17.6%)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>387 (100%)</td>
<td>74 (100%)</td>
</tr>
</tbody>
</table>

It is interesting that there is a great geographic heterogeneity in regards to the most common causes of death. Thus, in North America hypertrophic cardiomyopathy is the leading cause, in Italy the arrhythmicogenic cardiomyopathy of the right chamber, in China Marfan’s syndrome, and in Germany the common cause of SCD is myocarditis [19].

According to available data, SCD occurred in over 80% of younger athletes in the first 30 minutes of physical activity [5]. This might suggest that increased physical activity would be a “trigger” of fatal cardiac arrhythmias [4] in athletes with undiscovered, congenital heart diseases [18]. Nevertheless, physical activity decreases the risk of SCD during longer time periods.
CARDIOVASCULAR CAUSES OF SUDDEN CARDIAC DEATH

A wide scale of cardiovascular disorders represents the most common causes of SCD in athletes. A precise diagnosis accountable for the appearance of SCD differs significantly depending on the age of the respondents. Thus, hypertrophic cardiomyopathy (HCM) is the most common cause of death in young athletes (30-50%). It is inherited based on dominance, and characterized by a high degree of gene penetration [18]. It is distinguished by a stressed genetic heterogeneity [8], with more than 400 different mutations in any one of the 11 different genes which code the synthesis of the sarcomere protein [21]. The consequence of a disrupted synthesis of these proteins is a hypofunctional sarcomere with reduced strength and speed of contraction, which results in a compensatory hypertrophy of the myocardium and a proliferation of the fibroblast [22, 23]. The basic specificity of the disease is a characteristic asymmetry of the hypertrophy of the heart, with a stressed thickening of the wall of the left chamber (15-50 mm, normal to 13 mm) and hypertrophy of the interventricular septum (Diagram 1). Yet there is no compensatory enlarging of the chamber, so the filling of the chamber in the diastole is reduced. As a consequence, hemodynamic disorders occur.

Diagram 1: Hypertrophic cardiomyopathy. The transversal cross section of the heart's chambers shows an asymmetric hypertrophy of the left chamber (LC - left chamber, RC - right chamber).
SCD contained the symptoms which point to heart diseases on a mere 20% of athletes with HCM who died [24]. In the majority of studies, the pre-dominant mechanism of the cause of SCD quoted is persistent ventricular tachycardia and ventricular fibrillation. A disrupted cell structure, an ischemia of the myocardium with the creating of scar tissue, as well as proliferation of the interstitial fibrous tissue are a good arrhythmogenic substrate for an electric instability of the myocardium [22].

Congenital anomalies of coronary arteries are the second cause of SCD in individuals younger than 35. The most common anomalies are in the main left coronary artery which exits from the right Valsalva sinus at a sharp angle (17-19%), and passes between the convergence of the aorta and the lung artery. During physical activity, there is a hypoperfusion of the myocardium due to an impossibility of the coronary arteries to adapt and secure adequate oxygenation of the myocardium [25].

The other causes, such as idiopathic hypertrophy of the left chamber, arrhythmogenic cardiomyopathy of the right chamber, myocarditis, Marfan’s syndrome, the Brugada syndrome, ionic channelopathy (long QT syndrome and Wolff-Parkinson-White syndrome) are rare, with a frequency of less than 5% of the SCD cases.

**RECOMMENDATIONS FOR PREVENTION OF SCD IN SPORTS. THE PRE-COMPETITION EXAMINATION**

Athletes with cardiovascular diseases bear a greater risk from SCD in comparison to healthy individuals. The large number of athletes (only in the USA between 5 and 6 million individuals practice sports professionally) is one of the obstacles for complete screening check-ups and for defining the exact cause of the problem. The worrying fact that the majority of the athletes (some 80%) who died from SCD had no prior history of heart disease nor any prodromal symptoms prior to their death, sets a difficult task for doctors to uncover high-risk individuals.

All athletes with prodromal symptoms, syncopes and palpitations, as well as dyspnea during training and chest pains at rest or during physical activities, should be submitted to detailed testing [10, 18].

A good screening test must be a cheap, valid, secure and generally accepted procedure, which would enable the discovering of illness in the asymptomatic stage [26]. The two basic aims of pre-competition screening are: a) an early identification of athletes with heart disease, b) the assessment of the risk for participating in physical activity in athletes with established cardiovascular changes [18].

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Considering the living standard in the Republic of Serbia, it is hard to determine which screening test is dependable but inexpensive. Nevertheless, all active athletes should by law be required to take pre-competition check-ups in certain licensed clinics and institutions. The exam should be standardized in order to hinder “oversights”. Top athletes need to do an ultrasound cardiac check-up once a year. All participants in sports who were diagnosed with heart disease are submitted to a standard medical diagnostic and therapeutic procedure, and the recommendation for the volume and type of physical activity is given by doctors according to valid world recommendations which were gathered and translated by the Serbian Association for Sports Medicine [27].

The European Association of Cardiologists [28] gave recommendations according to which all young athletes should be included in the screening, according to the Lausanne protocol in two acts. The first step is basic screening, which implies taking a detailed anamnesis by filling out a sports-medical form, followed by a physical check-up. With athletes where there is a justified doubt of heart disease, the check-up is continued (the second step) by using all the available diagnostic procedures.

The American Heart Association (AHA) [29] in 1996 published recommendations for pre-competition screening (Table 2). The recommendations contain 12 items and if any one of them yield a positive response, it is necessary to continue with further testing.

Table 2: The recommendations of AHA for examining the cardiovascular system.

<table>
<thead>
<tr>
<th>PERSONAL ANAMNEsis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Chest pain during effort</td>
</tr>
<tr>
<td>2. A shortage of air during effort</td>
</tr>
<tr>
<td>3. Hypertension</td>
</tr>
<tr>
<td>4. Syncope during effort</td>
</tr>
<tr>
<td>5. Heart murmur</td>
</tr>
<tr>
<td>6. Excessive fatigue</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FAMILY ANAMNEsis</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Cardiac death in the family before 50</td>
</tr>
<tr>
<td>8. The existence of heart disease in close relatives younger than 50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PHYSICAL EXAMINATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Auscultation heart murmur</td>
</tr>
<tr>
<td>10. Palpations of femoral pulses for uncovering coarctation of the aorta</td>
</tr>
<tr>
<td>11. Stigma for Marfan’s syndrome</td>
</tr>
<tr>
<td>12. Measuring of blood pressure</td>
</tr>
</tbody>
</table>
Table 3. Recommendations for participating in sports in individuals with heart diseases which are most often the cause of SCD (Bethesda 2004).

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertrophic cardiomyopathy</td>
<td>Banned from participating in professional sports, with possible exception of sports with small physical loads</td>
</tr>
<tr>
<td>Arrhythmogenic cardiomyopathy of the right chamber</td>
<td>Banned from participating in sports</td>
</tr>
<tr>
<td>Congenital anomalies of the coronary arteries</td>
<td>Banned from participating in sports</td>
</tr>
<tr>
<td>Long QT syndrome</td>
<td>Banned from participating in sports</td>
</tr>
<tr>
<td>Coronary artery diseases</td>
<td>If a low risk from SCD is established, participating in sports of light and moderate intensity is allowed. Mandatory yearly check-ups. If a high risk from SCD is established, only participating in sports of light intensity are allowed. Mandatory 6-month controls.</td>
</tr>
<tr>
<td>Marfan’s syndrome</td>
<td>Athletes without a positive family anamnesis of SCD and without a dilatation of ascending aorta can participate in sports of light and moderate intensity. Mandatory echocardiographic 6-month controls. Athletes with a dilatation of ascending aorta can participate only in sports with small physical loads.</td>
</tr>
<tr>
<td>Myocarditis</td>
<td>Practicing sports not allowed at least 6 months after healing and total recovery. Participating in sports professionally is allowed after the normalizing of the function of the chambers and an absence of heart arrhythmias, with mandatory ECG monitoring.</td>
</tr>
<tr>
<td>Aortal stenosis</td>
<td>Athletes with a mild aortal stenosis (&lt;20 mm Hg) can participate in professional sports without any limits. Athletes with a mild or moderate aortal stenosis (21 do 40 mm Hg) can participate in all sports with small physical loads. Athletes with severe aortal stenosis (&gt;40 mm Hg) are banned from participating in sports. Athletes with bicuspid aortal valves, without stenosis but with aortal dilatation, can participate in all sports with small physical loads. Every 6 months there is mandatory echocardiographic control of ascending aorta and the aortic arch.</td>
</tr>
</tbody>
</table>
At the 36th Bethesda conference in 2004, recommendations for the participation in sport for individuals with diagnosed heart diseases were given [30] (Table 3). According to this panel, the doctor which examines athletes has an ethical, medical and legal commitment to fully inform athletes of the risks in competitive sports, and in the case that a high risk is established, the doctor is responsible for a final judgment in the aim of preventing an undesired event or reducing the risk for the progression of the disease.

References

THE DEVELOPMENT OF ENDURANCE IN SWIMMING

UDK 797.21.015.54

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Abstract: Endurance training is one of the most significant stages in the preparation of top swimmers for competitions and for achieving adequate or desired results. Even very talented swimmers require years of well-planned training to achieve the intended results. Based on the results of prior research, a systematization of the basic principles of endurance training in swimming was done, basic training models were worked out and a procedure for the control of training dosage proposed.

Key words: swimming, endurance, training.

INTRODUCTION

Endurance training is one of the most significant stages in the preparation of top swimmers for competitions and achieving adequate or desired results. Even very talented swimmers require years of well-planned training to achieve the intended results. Their achievements are a consequence of programs made up of a measured working out of those physical qualities which are dominant for achieving the desired or maximum competition achievements in the function of techniques or the discipline of swimming (Olbrecht, 2000; Sweetenham and Atkinson, 2003).

There are three basic training principles in training:
1. The specificity of training, considering the orientation of individual training units: an orientation towards the development of aerobic potentials (VO2max), orientation towards the development of aerobic-anerobic potentials (AP), orientation towards raising the ability of lactate tolerance (LT) and the orientation towards the development of speed (S).
2. Overload. This principle concurs with the previously explained adaptable abilities of the organism and the appearance of supercompensation (Okičić, 2006). Only more significant loads, physiologically and kinesthetically similar to competition loads, contribute to the development of abilities in the desired direction.

3. The progression of loads which has a discontinued character. In accordance with this principle, loading has a progressive character in several consecutive training units after which follows a slackening of loading, and this should contribute to the quality of the activated processes of adaptation (Maglišo, 1983).

Individual pulse values can be used to define certain training zones. The second method for determining training zones is based on the correlation of the speed of swimming, the best personal time and the average time (Okičić, 2007).

The real specific training includes all the metabolic processes, but separates them and subjects them to effort in a way which will lead to a maximum improvement of the total work ability needed for swimming. Processes thus separated in the organism can be overloaded, something not possible with swimming at competitive speed. In this way, every separate process is improved to the degree that it will contribute the most when it is integrated with the other processes before the race itself.

The first level of sports selection and proof of talent begins with scientific methodological and training procedures (Zaciorski, 1982; Dopsaj et al., 2003; Hohmann & Seidel, 2003; Tomkinson et al., 2003).

According to these explanations, there are five forms of training of metabolic processes which must be included into the preparation program of every swimmer competitor and which are relevant for the development of endurance:

1. speed training
2. maximum oxygen consumption training (VO$_{2}$max)
3. aerobic-anaerobic threshold training (AP)
4. lactate tolerance training
5. competition pace training

At the beginning of muscle work (the swim race) from 0 to 6-10 seconds, when the appropriate cardio-respiratory work of the organs had not yet been established, energy is obtained from adenosintriphasphate (ATP). However, since the supplies of ATP are limited, the continuation of activity is possible thanks to the resynthesis of ATP on the part of phosphate creatine (PCr). The available reserves of ATP and PCr are sufficient for muscle activity which does not last longer than 30 seconds.
This reaction of resynthesis is very quick and thus it is possible to realize a maximum speed in the first 30 seconds of the race. The maintaining of a high speed of swimming after 30 seconds is possible on the account of the resynthesizing of ATP by glycogen, a process known as glycolysis. However, a disadvantage of glycolysis is that it ends this process by creating lactic acid whose concentration in the muscles and the blood reaches very high values in a very short time and leads to a disruption of homeostasis. After the energy reserves from the mentioned anaerobic sources are used, work can be continued only on the account of aerobic (oxidative) restoring of energy (ATP). All the energy sources are found in the muscle cells, while glycogen can also be found in the liver, and fats in fatty tissue. ATP is the only source which gives the muscles energy directly. Energy from other sources is used only for restoring ATP. Every muscle fiber has as much ATP that it can be maximally contracted every 2-3 seconds (Nikolić, 1995). After several swim strokes, these supplies disappear, which is why a quick restoring of energy is necessary. The largest difference among these processes is in the speed of releasing energy. With a 25m sprint, the most important energy source is the ATP-PCr reaction, which is so quick that there is no lessening of the speed of swimming.

In the muscles there is so little PCr, that its amount is hardly enough for 5-10 seconds of work. That reaction depends on the amount of PCr in the muscle fiber. Already after 4-5 seconds, PCr supplies are reduced to such an extent that all of ATP cannot be restored in this way, due to which the speed falls for the first time. After 5-10 seconds, anaerobic glycolysis is switched on increasingly, due to which the speed falls again after another 10-15 seconds of a sprint.

During effort which lasts longer than 15 seconds, of the anaerobic processes which are used to resynthesize ATP, it is ATP which has the most important role. Glycolysis occurs from the beginning of muscle activities. Some authors consider that at least 6 seconds are needed for glycolysis to be fully engaged, while others consider it reaches its maximum power in 30 - 40 seconds. The degree of activation of glycolysis depends on the intensity of the process of oxidation, which by supplying larger amounts of ATP causes the impeding of glycolysis. Aerobic processes dominate in covering energy needs for tissue during effort which lasts longer than 1-2 minutes if the inflow of oxygen in the muscles is sufficient (Kozłowski, 1984). This enables the swimmer to maintain almost the same speed for 40-50 seconds, before the products of glycolysis (lactates) cause fatigue. While swimming longer swim
sections, aerobic glycolysis produces energy for muscle work. It in itself (aerobic glycolysis) does not have to be the only energy source, as the processes are too slow to enable the competitive speed of swimming.

Anaerobic and aerobic supplying with energy in man does not continue onto each other - they constantly interlock. During maximum loads in the first minute, anaerobic sources give 80% of energy, while already at the end of the first minute the ratio is 70:30, and 50:50 in the second minute. With children, these ratios are somewhat different. With 10-year-olds in the first half-minute of work, aerobic energy sources cover 47% of needs, 85% at the end of the first minute, and 100% in the second minute. Children have a smaller anaerobic capacity and this is probably the cause of a quicker adaptation to aerobic conditions at the beginning of work (Matković, 1985).

The input of certain types of energy does not depend on the swum distance but on the intensity of swimming (a 100m crawl in beginners equals a 200m crawl with top athletes) (Ahmetović, 1994).

Table 1: The proportionate participation of certain types of energy depending on the loads.

<table>
<thead>
<tr>
<th>Swimming time</th>
<th>Distance</th>
<th>% ATP-PCr</th>
<th>% anaer. glycolysis</th>
<th>% aerobic glycolysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-20 sec</td>
<td>25 - 50m</td>
<td>78</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>40 - 60sec</td>
<td>100m</td>
<td>25</td>
<td>65</td>
<td>10</td>
</tr>
<tr>
<td>1.30 - 2 min</td>
<td>200m</td>
<td>10</td>
<td>65</td>
<td>25</td>
</tr>
<tr>
<td>2 - 3min</td>
<td>200m</td>
<td>10</td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>3 - 5min</td>
<td>400m</td>
<td>7</td>
<td>40</td>
<td>53</td>
</tr>
<tr>
<td>5 - 6min</td>
<td>400m</td>
<td>7</td>
<td>38</td>
<td>55</td>
</tr>
<tr>
<td>7 - 10min</td>
<td>800m</td>
<td>5</td>
<td>30</td>
<td>65</td>
</tr>
<tr>
<td>10 - 12min</td>
<td>1000m</td>
<td>4</td>
<td>26</td>
<td>70</td>
</tr>
<tr>
<td>14 - 18min</td>
<td>1500m</td>
<td>3</td>
<td>20</td>
<td>77</td>
</tr>
<tr>
<td>18 -22min</td>
<td>1500m</td>
<td>2</td>
<td>18</td>
<td>80</td>
</tr>
</tbody>
</table>

The consumption of energy during swimming depends on the following:
The pace of swimming – quicker swimming demands more “quick” energy.
The ability of the swimmer for a larger consumption of oxygen – more capable swimmers have more pyruvates in the mitochondria. Less lactic acid is created.
The economy of the stroke technique – more useful, slower strokes save energy, and slow muscle fibers are used with larger aerobic abilities.
SPEED TRAINING IN SWIMMING

The most appropriate are short repetitions of a high intensity, because all the necessary adaptations occur in the muscles which are overloaded, and thus all repetitions should be swum competitively. It is of great importance that the swimmer swims every time at maximum speed, which must be greater than 95% of the competition speed.

Pulse frequency does not divulge too much, as the duration is too short to achieve maximum heart frequency. The break must be long enough to enable the restoring of greater PCR, or otherwise in the next repetition glycolysis would occur, so the point of training would not be achieved. Pauses of 20 - 30 seconds are recommended in 12.5 and 25m swim styles and 2 - 3 minutes with the 50m style. Sprint training must not cause pain, as it is a sign of anaerobic glycolysis. For the development of the speed of swimming, the following loading regimes are used, shown in Table 2.

Table 2: The intensity of loading for developing speed.

<table>
<thead>
<tr>
<th>Swimming distance</th>
<th>Optimal number of repetitions</th>
<th>Rest</th>
<th>speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.5m</td>
<td>40-60 in series of 10</td>
<td>20-30 s</td>
<td>Quicker than the best 25m result</td>
</tr>
<tr>
<td>25</td>
<td>20-40 in series of 10</td>
<td>20-30 s</td>
<td>At most 1 sec. weaker</td>
</tr>
<tr>
<td>50</td>
<td>6-20 in series of 5</td>
<td>2-3 min</td>
<td>At most 2 sec. weaker</td>
</tr>
<tr>
<td>A divided 50 (2x25)</td>
<td>6-10</td>
<td>10s between 25 1-2 min behind 50m</td>
<td>max 50m</td>
</tr>
<tr>
<td>100 (2x50m)</td>
<td>4-8</td>
<td>10s behind 50 2-3 min behind 100</td>
<td>Max 100</td>
</tr>
<tr>
<td>Training with loads</td>
<td>10-30 in 10-20 sec</td>
<td>30sec-1min</td>
<td>max</td>
</tr>
<tr>
<td>Lifejacket</td>
<td>20-40</td>
<td>30sec-1min</td>
<td>Quicker than the max</td>
</tr>
<tr>
<td>Swimming with brakes or tows</td>
<td>20-40 10-20</td>
<td>30sec-1min</td>
<td>max</td>
</tr>
<tr>
<td>Swimming with flippers</td>
<td>6-40</td>
<td>30sek-2min</td>
<td>Quicker than competition speed</td>
</tr>
</tbody>
</table>

Training of the sprint with loading is not useful, as the number of strokes is reduced, and it is known that the stroke strength is trained.
for a certain swimming speed. Thus the swimmer becomes stronger only for carrying out slower strokes, while the technique of the stroke could also be impaired. Much more useful is training for the sprint with devices (they can cause a disruption of technique and coordination). It is best to use lifejackets and rubber belts or sponges which pull the competitor (brakes or tows), thus forcing him swimmer to swim more quickly.

**MAXIMUM OXYGEN CONSUMPTION TRAINING (MOC)**

MOC (VO₂max) – The ability of the organism to use oxygen from the inhaled air. It is measured during conditions of great loads and represents the difference between the concentration of oxygen in a unit of time in inhaled and exhaled air.

MOC is expressed in liters if the consumption of O₂ is specified for the entire organism, or in milliliters if it is specified by 1 kg of body weight. With non-athletes, MOC vacillates from 2.5- 3.5 L/min, and in athletes it reaches up to 6 L/min, or from 40-90 ml/kg/min (Bai, 1986). With swimming 25 and 50m repetitions, a rest of 5-10 seconds is recommended, and 30 seconds and less with 100m, and under one minute with swimming at 200m. The pace of swimming should be 80-90% of the maximum speed in these sections. It is also recommended that the longer series are divided into several shorter series so there is no accumulation of lactic acid and a decline of the necessary speed. The main aim of this regime is to increase the swimmer’s aerobic abilities. For the increase of aerobic abilities, the following loading regimes shown in Table 3 are used.

**Table 3: Loading intensity for the development of aerobic abilities.**

<table>
<thead>
<tr>
<th>Section</th>
<th>Optimal number of repetitions</th>
<th>Rest</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>40-60 in ser of 10</td>
<td>10sec, I₂= 2-3min</td>
<td>80-85% at 50m</td>
</tr>
<tr>
<td>75-100m</td>
<td>20-30 ser of 5-10</td>
<td>10sec, I₂= 2-3min</td>
<td>80-85% at 100m</td>
</tr>
<tr>
<td>150-200</td>
<td>10-20 in 3-5 ser</td>
<td>30s; 3-5min</td>
<td>85-90% at 200m</td>
</tr>
<tr>
<td>3,4,500</td>
<td>4-8</td>
<td>2-3min</td>
<td>80-90max</td>
</tr>
<tr>
<td>6,7,800</td>
<td>3-4</td>
<td>3-5min</td>
<td>80-90max</td>
</tr>
</tbody>
</table>
TRAINING OF AEROBIC-ANAEROBIC ENDURANCE

The aim of training in this zone of loading is that the concentration of lactates characteristic for the aerobic-anaerobic threshold occurs as late as possible during the same swimming speeds. The point at which lactic acids start suddenly to increase is called the anaerobic threshold (R. Richards 1999; Pyne 1999, Carew and Pyne 1999; Sweetenham 1990). The anaerobic threshold is raised by training. Thus the concentration of lactates at the same speed is lower, which is a consequence of a decreased creating and an increased removing of lactates. With the repeated determining of lactates via tests, the line of maximum ability moves to the right. With the same fatigue, the swimmer swam 400m quicker than in the first test. In this regime, the optimal speed of swimming at the beginning of the season should be 75-85%, and the pulse between 140 and 150. In mid-season, the speed should be 85-90%, and the pulse 150-170. The loading regimes which are used to move the aero-anaerobic threshold are shown in Table 4.

Table 4: The loading intensity for the development of aerobic-anaerobic abilities.

<table>
<thead>
<tr>
<th>Section</th>
<th>Optimal number of repetitions</th>
<th>Rest</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>25, 50, 100m</td>
<td>20-40</td>
<td>5-10sec</td>
<td>65-80% start of season 75-90% later</td>
</tr>
<tr>
<td>150-200m</td>
<td>10-200</td>
<td>10sec</td>
<td>65-80; 75-90</td>
</tr>
<tr>
<td>300-400m</td>
<td>6-10</td>
<td>10-30sec</td>
<td>65-80; 75-90</td>
</tr>
<tr>
<td>500, 600m</td>
<td>6-10</td>
<td>10-30sec</td>
<td>85-90; 90-95</td>
</tr>
<tr>
<td>700, 800m</td>
<td>3-5</td>
<td>30s-1min</td>
<td>90-95; 95</td>
</tr>
<tr>
<td>1000, 1500</td>
<td>1-3</td>
<td>1-2min</td>
<td>90-95</td>
</tr>
<tr>
<td>3000-5000m</td>
<td>1-2</td>
<td>1-2min</td>
<td>95</td>
</tr>
</tbody>
</table>

LACTATE TOLERANCE TRAINING
(ANAEROBIC GLYCOLITIC TRAINING)

The increase of lactate tolerance is especially significant for the 100m and 200m sections, as the short swimming time does not allow oxygen to be spent in a satisfactory amount. With longer sections, this is relevant for the last third of the section. For swimming longer sections
(400, 800 and 1500m) the increase of VO$_2$max is more relevant, as well as the improving of the function for removing lactates. If the principle of specificity and overloading is adhered to, it is recommended that the swimmer swims with an intensity bearing the maximum in lactate tolerance training. The most useful loads to use are those which last 1 minute, the rests between them being 4-5 minutes. The reason for this is the fact that the swimmer reaches a maximum lactate concentration in the muscle only after 40-50 seconds of swimming. A one-minute load guarantees overloading in such a way that the rest must last 4-5 minutes in order to remove the lactates from the active muscles which will enable repeating the maximum load. In case there is insufficient rest, the lactate concentration in the muscles would disable the achieving of sufficient speed. Series of swimming can also be used under the condition that attention is paid to the swimming speed and the time of rest. With swimming the 20x50m series at a high intensity and great speed, a maximum accumulation of lactates will occur only after several repetitions, and if the intensity is not sufficiently high then only after 10 repetitions. Thus it is necessary to swim 16-30x50m if lactate tolerance training is desired. The duration of the rest amounts to 30-60 seconds. This series can be swum in such a way that it can be divided into (6-10x50m) x 3 with 10-30 seconds of rest and a rest of 3-5 minutes between three of these series. Also recommended are 200m high intensity repetitions, especially for 100m. It is enough to swim 3-4x200m with a 3-5 minute rest. Useful are swimming 300-800m sections, under the condition that the speed is sufficiently high. Middle and long distance swimmers should have this kind of training once a week.

**Table 5:** Loading intensity for the development of anaerobic abilities.

<table>
<thead>
<tr>
<th>Distance</th>
<th>Optim. no. repetitions</th>
<th>Rest</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>16-30 in series, 4-10 or together</td>
<td>10-15sec;30-60min</td>
<td>85-90% max.</td>
</tr>
<tr>
<td>75</td>
<td>4-20 in ser., 4-5</td>
<td>10-15min; 3-5min</td>
<td>85-90</td>
</tr>
<tr>
<td>100</td>
<td>8-12 in ser, 3-5</td>
<td>30sec-5min; 3-5min</td>
<td>85-95</td>
</tr>
<tr>
<td>150-200</td>
<td>3-6</td>
<td>30sec-5min</td>
<td>90-95</td>
</tr>
<tr>
<td>300-800</td>
<td>3-5</td>
<td>3-5min</td>
<td>95-99</td>
</tr>
</tbody>
</table>

At the beginning of the season, the intensity of swimming should amount to 85%, and in mid-season it should be as high as 90% of the maximum with swimming of 50 and 100m repetitions (the percentage of
the best swim time for 50 and 100m). Longer repetitions must be swum 90% (at the beginning of the season), that is, with 95% intensity in mid-season. The pulse, after the repetitions, should be close to the maximum. The aim is to train above the pain threshold. This kind of training must not and cannot be repeated every day. This can be done at most 2-4 times a week (if the swimmer trains 9-12 times a week). Loads shown in Table 5 are those used in practice.

**COMPETITION PACE TRAINING**

This training simulates competition conditions, by which it stimulates some integralional metabolic adaptations which are created in other training methods. The separating of the pace in the most economical way decreases the amount of energy which is needed in the first half of the race or in the first 3/4 section, so that strength remains at the end of the race as well. This kind of training also improves the usefulness of the swim stroke which at the same time decreases the need for energy. The repetition series must be swum at a competition pace and competition style. As a warning, it should be mentioned also that this kind of training is exceptionally hard, in a physical as well as psychological sense, and overloading can appear easily if it is used often. Thus it is recommended only 2-4 times a week.

**CONCLUSION**

Recently, special significance has been given to swimming training methods in the sense of an appropriate harmonizing of the general volume of swimming during the year and intensity as a priority stimulant for the development of work abilities. Connected with this, all publications can be divided into three groups: publications whose authors classify loads into several zones based on the frequency of the heart work, authors who classify zones according to the amount of lactates in the blood, and authors who use a combination of the heart frequency and the amount of lactates in the blood to define the loading zones. The increase of endurance, as well as improving the training systems for its development, gives a great contribution to the progress of the swimmer.

Like other sports, swimming has evolved immensely with time. This has especially been felt in the recent years, when records are more and more often broken in many disciplines. This kind of progress can be explained as improving swimming techniques and their perfecting, as
well as the improvement of physical and psychological preparations of swimmers.

Training can be controlled only by team work on the part of the coach and the swimmer. Training loads are individual and depend on the swimmer himself. The coach uses certain swimming parameters (the pulse, endurance and speed) in order to establish the proper training. Contemporary swimming experts classify training loads into five zones, of which each one has its role in the development of endurance. Thus they should not be classified according to importance, as each of them in their own way is important in certain stages of the training process.

References
CHANGING RULES AND THE PLAY OF THE CENTER FORWARD IN WATER POLO

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Abstract: The reason for changing the rules is the desire of top FINA managers to develop the game of water polo and make it more dynamic, especially for the spectators and the media. The role and the play of the center forward have undergone changes with the changing of the rules and referee trends. Although changes in the rules and referee trends have the aim of reducing the impact and influence of the center forward player and favoring their direct guards (backs), the role of the center has had great importance in water polo (primarily in the attack tactics).

Key words: rules, center forward, water polo

THE CENTER FORWARD PLAYER IN WATER POLO

The role of every water polo player, regardless of the position he plays, is immensely important for the success of the team (Rudić, 1988). Practice has shown that top scores in water polo are impossible if the team does not have top players at the three key formation positions - goalkeeper, back and center (Vukanić, 2007).

The center forwards were idols of the nation in this region, an attractive appearance for the spectators, the way to success for a coach and security for teammates. The well-known centers in the history of Yugoslav and Serbian-Montenegrin schools were and still are: Mirko Sandrić, Tomislav Paškvalin, Zoran Petrović, Igor Milanović, Viktor Jelenić, Dušan Popović, Nenad Vukanić, Aleksandar Nikolić, Branko Peković, Boris Zlokozić, Slobodan Nikić, Duško Pjetlović, etc.
The center forward is a key player in the attack and endeavors to take up the most prominent place in front of the opponent’s goal. That place is the most sensitive point in the defense of the opponent. By taking up that position, the center forward greatly helps in his team’s offensive game building. Not only does he become the player who distributes the balls to his teammates and provides them with a favorable opportunity to shoot and score, but he himself also very often has the opportunity to shoot at the goal or to achieve the ejection of his direct defender (driver), and provide his team with a numeric 20-second advantage (man up). In addition to his great importance in the phase of attack, nowadays a center forward player is also required to give exceptional contribution in the defense phase (Lozovina et al. 2004), especially since the last change of the rules in 2005.

However, depending on the rules of the game and the trend of the referee trial, the role of the center forward player in water polo and his impact on the game and the result has undergone changes.

The aim of this paper is to determine how changes in the rules of water polo games have influenced the center forward’s play.

THE CHANGES OF RULES IN WATER POLO

The first rules of water polo (water rugby) were created by a Brit, William Wilson, in 1877, but were often changed. In 1888, the London water polo league shaped these rules in the form of today’s water polo game. Until 1900, several European countries adopted the so-called British rules, and in 1914 the Americans took them on as well. Since 1929, an international water polo committee in FINA (the World Swimming Federation) took charge of the rules of the game of water polo. From 1930, the international water polo rules have been adopted.

Water polo rules were often changed as they often impeded the dynamics and speed of action. An important change in this direction was made in 1949 with the elimination of the prohibition of free movement of players in the dead time (the players had to remain in the place where they were at the moment the game was stopped, i.e. when the referee’s whistle was blown). Since then the game became much faster and more dynamic. Such rules required the players to be more tactically and physically fit. Thus, new tactical solutions appeared.

According to the 1961 rules, the game lasts 4 times 5 min, with a break of 2 minutes between each quarter, and the exchange of players is allowed after a score, or during the break between some quarters of the game.
In 1969, the duration of ball possession is limited, i.e. the attack of a team is limited to 45 seconds and the penalty for major fouls in the duration of 1 minute or until a score of either team, was re-introduced.

At the beginning of the 80s the duration of the exclusion of players was reduced from 1 minute to 35 seconds. In the mid-90s it was again reduced to 20 seconds. These changes accelerate the game further, influencing the progression of new tactical solutions and their effective implementation.

Since 1998, the referees do not use the referee flag, but use hand signals to show the place of the foul and in whose favor it is awarded.

In 2003, a rule permitting a direct shot at the goal from a seven-meter distance after a foul was introduced.

After the World Championship in Montreal in 2005, revolutionary changes in the rules occurred. The ball possession limit (the duration of the attack) is reduced from 35 to 30 seconds, the corner of the defense player is cancelled, the duration of the game is 4 times 8 minutes, a break between the first and the second, i.e. the third and the fourth quarter is 2 minutes, whereas the break between the second and the third quarters lasts 5 minutes. A direct shot from five meters after a foul is allowed (FINA, 2005).

The reason for changing the rules is the desire of top World Swimming Federation (FINA) management to develop the game of water polo and make it more dynamic especially for the spectators and the media (Štirn, 2005). Also, it is believed that during the history of water polo, the rules themselves inhibited the development of the sport, as the quality of the players and the team tactics were, in some periods, more important than the rules of the game. Therefore we suppose that even today’s rules are not final, and that they will change in the near future.

THE EFFECT OF THE CHANGE OF RULES ON THE PLAY OF THE CENTER FORWARD PLAYER IN WATER POLO

From 1950 to 1968, the drivers were allowed to be very rough to the centers, because the game was based on a static (duel) game. Therefore, practically from this period onward, tall, muscular and strong people were selected for the position of the center.

Since 1968, with the introduction of the so-called “pinpinel”, drivers play less roughly for the first time, due to possible exclusion (penalties). In 1969, a rule that after the third ejection the player cannot
return to the game was introduced and the role of the center became more important. The individual tactics of the center forward in the attack and guarding of the center became a part of training preparations. A new type of defense is introduced, the so-called “zone defense”, where all the players are included and cover the area in front of the center and reduce his space for maneuvering and receiving the ball.

Therefore, because of the less aggressive drivers’ play, a short time for the attack and reduced free space for playing with the ball in which they would have more opportunities to provide the defense players’ ejection, the center forwards introduce the so-called “end game” to their play. They perform shots resulting from a direct duel with a driver and the return ball (passing it to those teammates from whom the defense player has moved away and plays the zone).

From 1995 and onwards, we notice a coarser game of the drivers with the centers, i.e. the referees allow a coarser game, with no fouls and ejections.

Parallel with changing the rules and referee trends, the center forward’s play has often changed, and thus also his role in water polo. Although changes in the rules and referee trends have the aim of reducing the impact and influence of the center forward player and favoring their direct defenders (drivers), the role of the center has had great importance in water polo (attack tactics). Such targeted rule changes have their base in the so-called “conflict” of the two approaches to the water polo game. In other words, in Hungarian, American, Soviet (Russian) and Yugoslav (Serbian, Croatian, Montenegrin) teams, the role of the center forward was of a great importance and the positional attack was based on it. On the other hand, Italian and Spanish schools favor water polo with a lot of movement (double hole, crossing...), so the center forward has no great significance. The influence of the second approach generally prevailed in the rules, as the top people in the water polo forums were from those countries.

However, even that did not reduce the importance and role of the center forward in water polo, even in the national teams of those countries. The center adjusted to all the rules changes. It is still one of the pillars of the team, the positional attack is built upon it, and due to it a team can gain advantage by the opponent’s ejection. To fulfill the requirements of the new rules, the training of the center must be more serious, that is, it must be adapted to the new requirements of the game, in order to have a maximum effect in a competition (game) conditioned by the new rules.
CHANGES OF THE RULES IN 2005 AND THE PLAY OF THE MODERN CENTER FORWARD

The rules from 2005 state that the center must be at the same level of technical and tactical training as the players in the field. The times when the centers kept their strength only for the offensive play are long gone. The technique of the center in defense, as the technique of the center in the attack, is no different from the technical preparation of the other players in the field. The center in defense does not differ from the other players.

In defense from a positioned attack, the center attacks not only the opponent's center, but other players in the field as well. Due to a reduction of the attack time to 30 seconds, the old rule that the center in defense guards the wing player in order to rest from/for attacking cannot be valid any more. The reason for this is that he needs more time in transition to get to his place in the positioned attack. Therefore, the center in defense guards the players on the outer line, especially the middle outer attacker.

A rule that was introduced which allows the shot outside 5m after a foul, by the player who was fouled, makes the game of the center in defense more difficult. Therefore, it is necessary for the center to know how to play a press game on the outer attackers.

The cooperation of the center with the goalkeeper is more efficient if the center guards the outer attacker in the press game. After the committed foul play against the attacker, the center slides to block and defend one side of the goal, thus helping the defense players prevent a possible shot. During a zone defense, after foul play against the attacker, the center guarding the outer attackers can “slide” to the zone, and prevent the passing of the ball at 2m, which is a matter of agreement with the driver.

In defense from counterattack, the center usually comes as the last player. If his direct guardian swims off, he attempts to catch up with him, or plays the defense on the nearest attacker. But sometimes it happens that while finishing the action the center finds himself in a formationally different place than the usual. Then the center must follow the agreed line of movement that applies to this formational place and to carry out defense tasks from that position.

In modern water polo, in “man up” situations, when his team has one player less, the center must meet all the principles of the defense and tactical tasks for the position he plays. The center forward’s play in a positioned attack comes down to a battle for position. Each positional
attack is based on finding the way for the ball to reach the center, and for the purpose of threatening the opponent’s goal, center forwards can be: the direct implementers of the attack, the means for ejecting the defense player (his guardian) or they can pass the ball to their teammates.

The center forward’s play in a press game comes down to a duel with his guardian for the position in which he could ensure the smooth reception of the ball. Receiving the ball after the duel while the defense plays a press game, the center forward gains an advantage and potentially threatens the opponent’s goal by a possible ejection or goal shot. Sometimes it is enough for the center to provide a favorable position and thus make the opponent team a play zone, at the same time creating more space and the possibility of coming nearer to the goal for his teammates. The game of the center forward against the zone comes down to getting the driver to the 2m line and placing the center forward in the central area in front of the opponent’s goal. The defense is forced to play a deep zone, and thus a large space for shots from the outer positions is created.

The methods and actions which are allowed to the center forward while fighting for position largely depend on the referee trend at that time. From 1995 it is allowed that the actions of the drivers be coarser than the ones of the center. Nowadays, the center forward is also allowed coarser play while fighting for position. The play of the driver and the center forward in the fight for position would be comparable with the fight of sumo wrestlers. In that fight, each of the fighters (center, driver), seeks to remove his opponent from balance and thus gain space in which they fight, disabling the rival in achieving his intentions.

In the area of psycho-physical determinants of successful outplaying with the drivers in the positioned attack, center forwards should have developed the following capacities: for time and spatial orientation, coordination of body, legs and hands segments, balance, speed of reaction to different sources of stimuli in complex motor activities, psychological processes’ adaptation in different game and swimming pools situations, and hand-eye coordination.

The playing of the center forward in the counterattack is no different from that of the other players. His movement is affected by the defense position which he is in at the time of moving to the counterattack. The center forward must, depending on the current situation, take the position dictated by the development of the counterattack. In case the counterattack doesn’t happen, the positional attack follows where the center forward takes his place in the attack position.
In the cases of “man up”, center forwards usually take the position of “goalpost” because they have a larger number of morphological characteristics, strong legs and feet work and a very high egg-beater kick. Due to tiredness from the duel with the driver and the effectiveness of the attack (because there remains only 17-18 seconds for the implementation of the attack with an extra player from the moment of taking the position), it is irrational to “lose” time for going to the outer or the wing position.

**INSTEAD OF A CONCLUSION**

The play of the center forwards developed parallel with the development of the water polo game, i.e. with the changing of the rules of the game. This caused the center forward’s play to be very complex and to depend on the morphological, technical and physical characteristics, referee trends and the rules of the game (Smith, 1988). With the progression of the game and the applicable 2005 rules, the center must be at the same level of technical training as the other players in the field. Serious requirements are placed before the center forward in defense, equal to other teammates. The times when the center forwards kept their strength only for the game in the attack are long gone.

The center forward must adjust his aggressiveness in the attack to the way the referee judges the game. He depends on the number of personal fouls of the driver, the remaining time and the game score.

We can assume that the development of the center forward’s play, and water polo in general, will be directed to a faster and a more interesting game for the spectators (marketing).

**References**

INSTRUCTIONS FOR THE AUTHORS

The scientific magazine SPORT – SCIENCE AND PRACTICE is an official publication of the College of Sports and Health from Belgrade, published four times a year. It publishes original scientific, professional and review articles and patents from areas congruent with sports and health. All the papers are published in English and submitted to a twofold protected editing (the identities of the reviewers and the authors are unknown until the publication of the papers). The papers submitted to the editorial staff cannot be published in any other publications.

All the authors are responsible for the information given in their papers and are obligated to adhere to the standards regarding the outline of the text and the results interpretation. The papers are prepared and submitted to the editorial staff in English, exclusively in electronic form. It is mandatory to use a MS Word text processor, Times New Roman, 12pt. font. The length of the papers must not exceed 16 pages, including all the tables, diagrams and list of references. In the text, the standard is single spacing, and all four page margins (at the top and bottom and the left and right sides of the page) should be set at 3 cm.

STANDARDS FOR THE OUTLINE OF THE PAPERS

The initial page

The initial page (which is not numbered) contains THE TITLE OF THE PAPER, the first and last names of each author, their academic titles, the institution in which they work, the year of birth, address, telephone number and e-mail address.

The second page

The second page (a separate unnumbered page) contains an ABSTRACT, 150 to 200 words long. The abstract must include a precisely defined subject and the aim of the paper, a brief description of the research procedure and the most relevant results obtained.

The key words are given underneath the abstract. There must be no more than 5 key words.
THE STRUCTURE OF THE TEXT

The text of the paper should start on a new page. All the pages (from 1 to a maximum of 15) are enumerated.

The original scientific papers must contain the following elements: the subject of the paper, the method, research results, discussion, conclusion and references.

* How to write the INTRODUCTION
- Precisely define the research subject and link it with a wider scientific framework in relation to the current relevance and application of the problem.
- Give a short review of the most important hitherto research which is directly or indirectly linked with the research problem. List the mentioned bibliographic sources in the list of references.
- In order for the less knowledgeable readers to follow the text more easily, it is advisable to give a short explanation of the basic concepts.
- All the mentioned elements represent a unique whole (a section).

* How to describe the METHOD
- It is necessary to give a detailed description of the methodological procedure, define the sample of respondents and explain the observed variables.
- Each instrument used (survey or poll, interview, scale, test and similar) should be shown as an integral unit or illustrated in a shortened version. The testing procedure can also be illustrated with appropriate photographs.
- In short, indicate the choice of statistical procedures and applied application program.

* How to interpret the RESEARCH RESULTS
- Present concisely the main results with short and clear explanations.
- It is desirable, for a better review, to use tables and graphs.
- Within this part, it is possible to separate several sections depending on the nature and complexity of data.
- If smaller sections are used, it is necessary to label them precisely.

* What the DISCUSSION should include
- Comment on the results in relation to the expectations and the hitherto research.
- Give an explanation of the results (misconceptions, dilemmas, projections, implications and similar).

* What the CONCLUSION should contain
- In short, describe the research, and then concisely, with a taxative listing, present the main obtained results.
- Point out the eventual possibilities of the practical application of the obtained results.
Instructions for the authors

* How to make up the List of REFERENCES

- Use the APA model of referencing (http://www.apa.org/journals/webref.html)

* * *

If the paper is written as a review, it is allowed to deviate from the structure proposed for the text of the original research papers. The author adapts the structure to the contents of the prepared paper, taking into account a proper marking of the whole entity (sections and subsections). It is necessary to base every claim, new classification or synthesis of the concepts and the results on previous research. The foundation for writing review articles, thus, should be the bibliographical-speculative method.

Designing and marking of the tables

- The tables must be simple and easy to follow.
- The data analyzed in the text should not be repeated in the tables.
- It is necessary to make a reference in the text to correlate with the data in the tables.
- It is necessary to enumerate the tables (for example: Table 1, Table 2…).
- During the marking of the tables, after the enumerating, it is necessary to note which data it contains.
- Numbers and names are written above the tables.
- The tables are literally (and always in the same way) enumerated and marked.
- The tables represent an integral part of the text.

Designing and marking graphs

- It is desirable to equip the text with appropriate pictures, graphs, diagrams and similar.
- In the graph illustrations, data analyzed in the text should not be repeated.
- It is necessary to reference the data given in the graphs in the text.
- It is necessary to enumerate graphs (for example: Diagram 1, Graph 1…).
- In graphs, after enumeration, it is necessary to note which data it contains.
- Numbers and names are written underneath the graphs.
- Graphs are consistently (always in the same way) enumerated and marked.
- Graphs represent an integral part of the text.

The way of referencing bibliographical sourced according to the APA model

- Bibliographical sources are quoted in alphabetical order. The criterion for the order of listing is the last name of the initially named author.
- Each bibliographical source is enumerated.
- In review articles where a greater number of references were used, quotations can also be marked also with the number mentioned in the references.
Example for papers in periodicals (magazines, bulletins...):


Examples for non-periodicals (textbooks, monographs, scripts, books...):


Examples for chapters in non-periodicals (textbooks, monographs...):

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