

**ACTA
UNIVERSITATIS PALACKIANAE OLOMUCENSIS
GYMNICA**

**Vol. 37
No. 3**

Editor in Chief

doc. MUDr. Pavel Stejskal, CSc. Faculty of Physical Culture
Palacký University, Olomouc, Czech Republic

Managing Editor

doc. PhDr. Vlasta Karásková, CSc. Faculty of Physical Culture
Palacký University, Olomouc, Czech Republic

Editorial Board

prof. Dr. João M. S. C. Abrantes Faculty of Human Movement,
Technical University, Lisbon, Portugal

prof. Dr. Herman Van Coppenolle Faculty of Physical Education and Physiotherapy
Katholic University, Leuven, Belgium

prof. PhDr. Karel Frömel, DrSc. Faculty of Physical Culture
Palacký University, Olomouc, Czech Republic

prof. MUDr. Dušan Hamár, CSc. Faculty of Physical Education and Sports
Comenius University, Bratislava, Slovak Republic

prof. Dr. Peter Hirtz Ernst-Moritz-Arndt University, Greifswald, Germany

prof. PhDr. Bohuslav Hodaň, CSc. Faculty of Physical Culture
Palacký University, Olomouc, Czech Republic

doc. RNDr. Miroslav Janura, Dr. Faculty of Physical Culture
Palacký University, Olomouc, Czech Republic

prof. Dr. Bojan Jošt Faculty of Sport, University of Ljubljana, Slovenia

prof. Dr. hab. Stanisław Kowalik University School of Physical Education, Poznan, Poland

Dr. Elisabeth Mattos University of Sao Paulo, Sao Paulo, Brazil

prof. PhDr. Karel Měkota, CSc. Faculty of Physical Culture
Palacký University, Olomouc, Czech Republic

doc. PhDr. Jiří Novosad, CSc. Faculty of Physical Culture
Palacký University, Olomouc, Czech Republic

prof. MUDr. Jaroslav Opavský, CSc. Faculty of Physical Culture
Palacký University, Olomouc, Czech Republic

prof. Dr. hab. Joachim Raczek Academy of Physical Education, Katowice, Poland

prof. RNDr. Jarmila Riegerová, CSc. Faculty of Physical Culture
Palacký University, Olomouc, Czech Republic

prof. James F. Sallis, Ph.D. San Diego State University, San Diego, USA

prof. PhDr. Hana Válková, CSc. Faculty of Physical Culture
Palacký University, Olomouc, Czech Republic

prof. PhDr. František Vaverka, CSc. Faculty of Physical Culture
Palacký University, Olomouc, Czech Republic

**ACTA
UNIVERSITATIS PALACKIANAE OLOMUCENSIS
GYMNICA**

**Vol. 37
No. 3**

PALACKÝ UNIVERSITY OLOMOUC

2007

All contributions were reviewed anonymously.

Všechny příspěvky byly recenzovány anonymně.

The authors take response for contents and correctness of their texts.

Autoři odpovídají za obsah a jazykovou správnost prací.

Electronic form available on address: <http://www.gymnica.upol.cz>

Elektronická podoba (časopisu) je k dispozici na adrese: <http://www.gymnica.upol.cz>

© Vlasta Karásková, 2007

ISBN 978-80-244-1850-6

ISSN 1212-1185

CONTENTS

The Olympic Games as a cultural event <i>Zvezdan Savić</i>	7
Subsidization policy in sports and physical training in the Czech Republic <i>Vladimír Hobza, Radek Cíkl</i>	15
Attitudes of students in sport education to the sport activity of blind people in Hungary and possible reasons for them <i>Peter Osvath, Katalin Kälbli, Gabor Ramocsa</i>	21
The rhythm of movement during aquarobic classes <i>Alicja Nowaczyk Chatupka, Dorota Róžańska, Elżbieta Rostkowska</i>	27
Somatometric characteristics of high jumpers <i>František Langer</i>	37
A test of manipulation functions using the constructional set “Ministav” in physiotherapy and the verification of its reliability <i>Jana Vyskotová, František Vaverka</i>	49
The impairments of sensorimotor hand functions in stroke patients – the comparison of the results of a clinical assessment and the assessment utilizing the standard tests (a case study) <i>Kateřina Macháčková, Jana Vyskotová, Jaroslav Opavský, Hana Sochorová</i>	57
Physiological anaerobic characteristics of Slovenian elite table tennis players <i>Miran Kondrič, Radoje Milić, Gordana Furjan-Mandić</i>	69

OBSAH

Olympijské hry jako kulturní událost <i>Zvezdan Savić</i>	7
Subvenční politika ve sportu a tělovýchově v České republice <i>Vladimír Hobza, Radek Cíkl</i>	15
Postoje studentů sportovní výchovy ke sportovní aktivitě nevidomých v Maďarsku a jejich možné příčiny <i>Peter Osvath, Katalin Kälbli, Gabor Ramocsa</i>	21
Pohybový rytmus při lekcích aquaaerobiku <i>Alicja Nowaczyk Chatupka, Dorota Róžańska, Elżbieta Rostkowska</i>	27
Somatometrické charakteristiky skokanů do výšky <i>František Langer</i>	37
Test manipulačních funkcí ve fyzioterapii pomocí stavebnice Ministav a ověření jeho reliability <i>Jana Vyskotová, František Vaverka</i>	49

Poruchy senzomotorických funkcí ruky pacientů po ischemické cévní mozkové příhodě – srovnání výsledků obvyklého klinického vyšetření a vyšetření pomocí standardizovaných testů (případová studie) <i>Kateřina Macháčková, Jana Vyskotová, Jaroslav Opavský, Hana Sochorová</i>	57
Fyziologické anaerobní charakteristiky slovinských elitních hráčů stolního tenisu <i>Miran Kondrič, Radoje Milić, Gordana Furjan-Mandić</i>	69

THE OLYMPIC GAMES AS A CULTURAL EVENT

Zvezdan Savić

Faculty of Sport and Physical Education, University of Niš, Niš, Serbia

Submitted in April, 2007

The Olympic Games have become a multi sport event, which entertains not only athletes from different countries, but a world wide audience numbering millions. They therefore exceed any other sports or cultural event when it comes to matters of public interest. Deriving from the initiative of a few countries and a small number of athletes, a historically significant phenomenon of the civilization of today has developed, each time with a designated location, its own competitors, propositions and rules. The Olympic Games represent the ideology of different peoples in one place, the ideology of religions, customs, traditions, languages, or cultures in general. They make mass communication between the contestants and the rest of the world possible. Social, scientific, sports-technical and political evolution has opened up great horizons for sport as a socio-cultural phenomenon, and it has become a common good. Over one hundred and ninety countries take part in the Olympic Games today. Athletes and judges come from various social settings, something which was unimaginable in the day and age from which the Games originate. Yet, what constitutes a landmark of today's Olympic Games is the social communication among the youth of the world within a grandiose event.

There we can see athletic mastery and a coming together of young people without regard to ideology, race and religion. This is what makes the Games the most beautiful and most significant event. The authors of this research paper have tried to give a more detailed explanation of the most important cultural aspects of the Olympic Games and to describe their social context.

Keywords: Game, culture, tradition, religion, customs, the Olympic Games.

INTRODUCTION

The second half of the 20th century was significant for the development of physical education and sport in general. During this time, systematic archaeological studies were widely published not only in Greece, but in other countries of the Mediterranean as well. Many significant monuments of the culture of ancient Greece were discovered. The study of these monuments enabled one to look upon the entire significance and role of physical education in the life of the society of that time. Having recognized this role and its significance, modern society has come to feel the need that physical education take its well deserved place in the life of the community, that is, that physical education be included in the general education and upbringing of youth (according to Kragujević, 1984, 6).

The most perfect creation of the Greek civilization was, no doubt, the Olympic Games (776 BC). In ancient times they succeeded in uniting the Greek polises. The Greeks admired and loved the beautiful appearance of the body, its health and strength. To be healthy is the greatest human value thing to a man – this is what the ancient Greeks thought. The second best thing was to be beautifully in shape, and the third is to enjoy the

wealth one has acquired in an honest fashion (Durant, 1996, 229). The perfection of physical abilities was of great importance for the defense of the country. War in ancient times depended not only on the physical strength and skills of the individual, but also on those of a group of warriors. The ancient Greeks were interested in sport and their favorite athletes were their earthly gods. Therefore, the first organized participation in a sports event as a social event, the onset and early beginnings of professional sport are to be found in ancient Greece, 15 centuries before the Christian era.

The Olympic Games, on a world wide scale, were brought back to life 15 centuries later. When they were resurrected for the first time since ancient times, the Games became an international event playing its role and having its place in the civilization of the 20th century. Today these games represent the greatest celebration of humanity, they are a joyful event, one filled with optimism and peaceful contests, in which the entire world participates. Each fourth year, the human race celebrates and glorifies sport, and the world recognizes the Olympic ideals of culture and peace.

The Olympic Games have become an extraordinary multi sports event, which entertains not only athletes from different countries, but a global audience num-

bering millions. In this manner, they exceed any other sports or cultural event when it comes to public interest. Deriving from the initiative of a few countries and a small number of athletes, a historically significant phenomenon of the civilization of today has developed, each time with its designated location, its own competitors, and with its propositions and rules. The Olympic Games are an event which is of great social importance. They represent the integration of different peoples in one place, a tolerance between various religions, customs, traditions, languages, or cultures in general.

The Games make mass communication between the contestants and the rest of the world possible. Social, scientific, sports-technical and political evolution has opened up wide horizons for sport as a socio-cultural phenomenon, which has become a part of everyday life. Over one hundred and ninety countries take part in the Olympic Games today. Athletes and judges come from various social settings, which was unimaginable in the day and age from which the Games originate. Yet, what is a landmark of today's Olympic Games is the social communication among the youth of the world within a grandiose event. There we can see athletic mastery, a coming together of young people regardless of bad influences (such as politics, marketing, drugs, etc.), and without regard to race and religion. This is what makes the Games the most beautiful and most significant event.

Historical roots

The naked, sculpted bodies of the contestants, the twitching of muscles, the sweat, the excitement and uncertainty, superhuman efforts, strength and sacrifice, and in the end, the entrance into the arena before 30–40,000 viewers who had walked for days in order to cheer for the contestants, were all part of the games which originated from before the start of the Christian era. It was a time when the gods roamed the earth. The winners of the Games would then become immortal, and during their lifetime they would be referred to as divine beings and their bodies sculpted in stone. For each winner, the height of the games would be the moment they placed the laurel of olive branches on his head. The winner's laurel in Olympia was woven out of the branches of a sacred olive which grew in Altise, west of the temple of Zeus.

In ancient times, at the end of the competition, the name of the winner would be spoken out loud, along with the name of his father and the country he was from. Today, the national flags of the winners flutter from the winners' pedestal, national anthems are played and medals awarded along with cash prizes or other privileges. There is a legend which tells the story of a Greek called Hillon who died at the moment his son's name

was spoken and the winner's laurel placed on his head. Today, no one is indifferent or calm when watching the announcement of "their winners". It is precisely that feeling which has kept the spirit of the Olympic Games going for thousands of years (Douskou, 1982).

The first historical evidence that we have of the Olympic Games having taken place dates from 776 BC and the location was Olympia. It was the time of Homer and of constant disputes and wars which ceased every four years in honor of the great Games. The first Games were held in honor of the god Zeus. Olympia at that time was not able to accommodate the thousands of people who would come every four years to see the competition. The Games were the greatest sports event of that time. The ancient Olympic Games were held in mid summer and lasted only 5 days. Among the philosophers who came regularly to see the games we come across the names of Aristotle and Plato. Plato is claimed to have participated and won in the Isthmian games and to have gotten his name based on his involvement in athletics (Plato – the wide). These games had come to life for political reasons. The story closest to the truth is one that speaks of the Spartan king of Licurg and the Elidic king Iffit as their founders. In the desire to prevent frequent wars and destruction in Greece, and at the recommendation of the prophetess Pythias, they dedicated the games to Zeus – the god of gods and ruler of nature (Bart, 1970).

The official history of the Olympic Games started with a race at a distance of one "stadium" (192.27 meters). Running was the dominant discipline at the games. Later, a discipline of five events was introduced (wrestling, running, jumping, discus and javelin), wrestling was introduced as a separate discipline, fist fighting – boxing, the pankration (a combination of wrestling and boxing), running with a weapon, a carriage race and a horse race with racing foals (Vuković, 2001, 16). The beginning of the competition would be declared by messengers and trumpeters. According to legend, they were enormous men whose voices and trumpets could be heard all the way to the sea. Perseverance and stamina, the strength and beauty of each movement were what characterized the competitors in ancient times. The Greeks were well known for their celebration of the beauty and strength of the human body. Great attention was paid to the physical education of their youth. All men, before they became soldiers, had to practice and prepare for battle. The state made arrangements for their physical education. It was practiced in their high schools and Palestras.

The Olympic Games were terminated by the roman emperor Theodosius the first (346–395). He was the one who united the Roman empire but is also remembered for his termination of the Games in 394. The town of Olympia disappeared soon after that as it was destroyed by the Goths. The Olympic Games were brought

back to life 15 centuries later in 1896, thanks to the French baron Pierre de Coubertin.

The game as culture

Within the context of all the happenings related to the Olympic Games, it is clear that they are an integral part of modern sport and of course play a part in a large number of modern day civilizations. This is why they should be viewed also as a social occasion. This is because sport, athletes and all those who are in any way connected to sport, are a part of certain social events and movements. The Olympic Games are an opportunity for athletes from various cultures to gather together every 4 years and to show off their fitness, but also the extent to which they have adjusted to the general movements and sports, economic, cultural and political demands.

The Olympic Games have, no matter whether it's a case of those which had been organized by the ancient Greeks, or those from the new age, always caught the attention of experts from various areas. The **subject matter** of this research is part of the scope of the research conducted by experts from the areas of the social sciences, physical education and sociology. The context of the research is made up of the cultural aspects of the Olympic Games.

The **problem to be resolved** by this research can also be determined based on this kind of assumption; it would refer to the Olympic Games as a historical phenomenon of the civilization of today. The Olympic Games have: an arranged time and place when and where they occur, as well as contestants, propositions and rules. They have been characterized as an event with a strong social context. They are a multicultural event, or rather, a gathering of different people in one place, an integration of religion, customs, traditions, languages, behavior, and therefore an integration of culture in general. The Olympic Games are a cultural phenomenon of our day and age. They are of global proportions, so their multiculturalism can clearly be seen. It is at these Olympic Games that Western and Eastern culture can be seen to merge. Countries with various modes of behavior, countries of different cultural beliefs, different ethnic and language backgrounds, accept the forms and rules of conduct of life and work in the Olympic settlement, in the stadiums and bleachers. At European championships, a smaller number of competing countries and contestants participate, so there are fewer cultures involved there.

Over a longer period of time, during which the new Olympic Games have been taking place with their inevitable ups and downs, they have progressed. This progress has to do with certain social, economic, and political events in the world. Alongside the general development of the Games, sports results have also been improved,

along with the social relations among the groups of contestants in the Olympic Games. These relations are to be viewed within the general cultural and social context of the Games. The results of this research can be used in further multidisciplinary research on a similar topic. Of course, this theoretical analysis can be of great importance even for sport historians, or historians specializing in physical education, as it offers a new perspective on the sociological study of the Olympic Games.

A magnificent multicultural challenge

In ancient Greece, games and various sports competitions were very popular, and the occasions for which to organize them were various: in honor of a king who had died, in honor of someone's return, as part of a festivity, in honor of some divinity, in honor of an alliance, in honor of a military victory or for political reasons. The ancient Greeks wanted, and achieved, the following: to motivate their youth to exercise by means of these games, to entertain people during them, to allow for the growth of philosophical ideas at these gatherings, to let people become familiar with certain agreements existing between states and to achieve a closeness among people (Živanović, 2002, 112, 113).

Sport is a complex social occurrence. Its place in and role it plays in the life of a community are conditioned by material and social development, as much as by the character of the dominant social relations in the spheres of production and division, politics, education, culture, recreation and entertainment. Sport, in its top and mass form, is considered to be an indicator of the material and social development of a community as well as of the development of their ideas. "Sport is a domain of everyday human life offering great possibilities for human essence to emerge and to realize that basic characteristic of its nature. Sport can be the arena of the most magnificent human victories, but also of human defeat and of degradation and dehumanization." (Koković, 1986, 155). That is why today we approach sport in different ways. These include: recreational, educational, mass, amateur, and professional approaches. What characterizes sport at the Olympic Games is the fact that the relations among the contestants and the other participants are at a higher level and are very often put before any victories.

The first few lines of the "ode to sport" by Pierre de Coubertin indicate the significance and glorification of sport: "*Oh, sport, the joy of the Gods, the essence of life*" (Manojlović, 1996, 7). It was still in ancient times that it was determined that sport was much more than a game, entertainment, pastime or recreation. Unlike the ancient games, which were based on religious inspiration and were strictly discriminatory (neither women, nor slaves, nor foreigners, even though only in origin, could partici-

pate), the aim of Pierre de Coubertin with their renewal included a humanist inspiration and pedagogical intent: free access to all men and all women (with a limitation dating from 1908), an explanation of the educational value of sport, and an incentive for good international understanding. Sport today is a significant means of influencing human behavior. It belongs human creations and expresses our primeval need not only to compete with one other, but also to win. He also came up with rules which are adhered to more meticulously on an international level than the rules of any other activity. This kind of sport was the vision of the founder of the new Olympic Games, of the baron Pierre de Coubertin. The Olympic Games as a combination of several sports in one location are the most massive sports spectacle making up an important socio-cultural occurrence in the modern world. They affect our modern way of life, the behavior of people which participate in sport but also those who only watch the Olympic spectacle. The Olympic Games have significantly contributed to the mass popularity of sport and competition on the one hand, and on the other, have contributed to the presence of sport in the mass media, especially when it comes to TV. This has enabled people of all races, classes, ideologies and political views to directly be granted equal rights to participate in sport, to compete, to win, and especially, to be the audience and watch.

“The competition is primarily connected to the game and to culture, but it reaches further than the game” (Božović, 2003, 67). The contestants and the viewers who come from various corners of the world pour into one city in one state, getting to know its culture, customs and way of life. At the same time they bring with them the national characteristics and cultural habits and customs of their country. The meeting of various countries, cultures, languages, customs, religions, and traditions in one place is a clear indicator of the multicultural nature of the Olympic Games. Everyone comes there with the same aim: to compete as champions, honestly, for the glory of sport and for the honor of their teams (these words are taken from the Olympic pledge), to win, to support their athletes, to get to know the sports achievements of other people and the customs and culture of their host country. This unity on a global scale is characteristic only of the Olympic Games.

At the Olympic Games both Western and Eastern cultures coexist, even though there are theorists who consider it impossible to create multiculturalism in our modern society. Countries with different forms of human behavior, cultural beliefs, and ethnic and language backgrounds accept the forms and rules of conduct of life and work in the Olympic settlement, its stadiums and bleachers. In some western countries we find examples of communal living involving several peoples in one country, that is, a cultural mix but not in the form

of life and work as is the case with the participants of the Olympic Games. Every culture has its own unique patterns of behavior, which seem foreign to people of other cultural milieus (Giddens, 2003, 27). This is not the case with the Olympic Games. The collective performance at the opening is a true form of multicultural life. In their national uniforms, together, they strive to a united goal, victory and fame at the Games. All the participants, by means of the competitions, take part in the life of the Olympic settlement, and spontaneously get to know each other and other cultures.

The Olympic Games represent an irreplaceable moment in which the unity of thought and emotion of people is achieved. Today they rely on democratic ideals and internationalism, which in fact represent the foundations of a new social system, which cannot be said about everyday life. The international Olympic Committee is without a doubt the first international organization of modern times.

No other sports event, be it even the World Championship in soccer, creates such strong feelings in the viewers. Enthralled by the results, the audience stands up and shouts, prays, cries, the viewers contradict one another and clash (Bulogn, 1984, 5).

To be a participant in the modern Olympic Games means to belong to an international elite – a sports elite of the best. Each athlete in the Olympic Games is influenced by the culture of the country he comes from and whose national colors he is defending. It is still the case today that the Games represent a call to establish peace among all peoples by means of sports challenges, competitions at which racial, religious and cultural differences will be respected and tolerated, along with the differences in the political regimes of the countries that the contestants come from. Olympianism still leans towards establishing a global community (even if it lasts for only half a month), during which time the rules of honest competition and life will dominate.

Even though it is often thought of in a negative way, having been both historically and socially degraded, the Olympics have withstood the test of time. While they could never be torn from the roots of social and political events, what makes them lasting and faithful to civilization are their cultural aspirations. One of the principles of the Olympiad speaks of the attempt of Olympianism to create a way of life by uniting sport and culture and education.

This method is based on the pleasure which can be found in physical strain and the educational value of a good example and the respect of basic principles. The aim of Olympianism is for sport to exist everywhere, so that it can serve the harmonious development of individuals and society.

The cultural framework of the Olympic Games is obvious. In that way we can define culture as the total-

ity of our existence and manifestation. Culture refers to the way of life of the members of a society, or groups within a society.

It includes the manner in which people dress, their marriage customs, family life, the way they work and create, their religious services, free time, etc. "The culture of a society encompasses both non material aspects – beliefs, ideas and values which make the content of a culture, as well as material aspects – objects, symbols or technology by means of which the cultural content is expressed" (Giddens, 2003, 24). Multiculturalism as the combination of cultures of equal status, achieves its full realization precisely at the Olympic Games. The contemporary thinking of anthropologists of sport speaks in favor of sport being viewed as a social phenomenon in contemporary science, and of the human being being viewed as a bio-psycho-socio-cultural phenomenon (Koković, 2000).

CONCLUSION

Sport is part of the social structure and should not be seen as an isolated phenomenon. It is closely connected to culture, art, politics and also religion. Sport today meets the demands of various cultures, and itself enriches the cultural image of the world. It carries in itself some of the characteristics of a game. Of a game itself we primarily say that it is a freely and a voluntarily chosen activity, which is at the same time pleasant entertainment, and has its rules just like the Olympic Games. Games, including the Olympic ones, have been an integral part of culture and all human activities throughout history. The game as such has in fact been an integral part of all civilizations up to date, as well as an important factor in the lives of people, it has been the subject of thought and study of some of the wisest people. It is not only important for us, it is unavoidably our essential need. "Empires and kingdoms were made, lasted and disappeared and games have always existed and have remained the only lasting occurrence, as an inseparable part of human life" (Pavlović, 2002, 5).

The Olympic Games in a way represent the foundation of human existence, as they are not isolated occurrences, but are open and in constant development. The Olympic Games have the following cultural characteristics: they were chosen freely and within them there are certain rules which guide the game and which must be respected. They have a cultural norm because they have their own place, time, rules and propositions, and no game can last indefinitely. Only certain examples from the history of Rome are known where the games, in the interest of the emperor Marcus Aurelius, lasted for 135 days a year. These Games were a very important political device for gaining the approval of a large

number of people. This was not only the case with the Olympic Games.

The tradition of the Olympic Games for the winner to be rewarded has been kept alive to this day, but in a somewhat altered form. Today those prizes are much greater, along with the acclaims and privileges awarded to Olympic winners. It is for those awards and acclaims that during the course of training some people turn to illegal stimulants in order to achieve these aims, which is a negative side effect of today's games. The Olympic Games today are connected to large amounts of money and large transactions, which has caused the involvement and interest of an increasingly larger number of people outside the sport area (politicians, managers) in this lucrative and profitable cultural branch, as sport has turned into big business today. "Sport events and competitions are becoming 'richer' in ideas (*idée fixe*) originating from people who are outside the sport arena" (Božilović, 2003, 98).

To be a participant in the Olympic Games means to belong to an international elite – *the sports elite consisting of the best*. Each contestant comes from a certain social group, becoming a star which attracts the public. Having the appearance of an idol thanks to marketing and the media, he/she becomes a promoter of world fashion lines. In that way athletes become popular figures in videos, advertisements, various humanitarian activities, and promotions. Thus, they create an image of unreachable authority. Athletes from Serbia who take part in the Olympics have so far been more successful in collective sports (basketball, handball, volleyball and water polo) than in individual events, even though we have had an Olympic winner in one of these events (archery). They represent the culture of the society they come from, including ethnic characteristics and the idiosyncrasies of their mentality. The feature they have in common is that they are young people with positive attitudes toward sport, they spend a lot of their time in training, they are ready for great victories, and for these they give to the maximum of their abilities. Their social backgrounds differ. Mostly they come from urban sports areas, which are at the same time the centers of sports in which they participate either as individuals or on a group basis. These settings allow them to achieve top results. They come from families of various educational profiles, where one of the parents or close relatives actively participated in sport. Their family functions as a factor motivating them to achieve the best results they can (Savić, 1994, 84).

But today, there is a whole other side to participating in the Olympics. It is an ugly and difficult one, it chastises and warns of the possibility that these Games that involve the human body and spirit can turn into a means of bullying and demeaning. This is due to the fact that besides the economic, there is a strong pres-

ence of political and ideological aspects. It seems that the Olympic Games of today have somewhat changed their original ethic guidelines (*Mens sana in corpore sano*), which was promoted by their founder Pierre de Coubertin. It is obviously a case of "stepping in the wrong direction", as sport is gaining the tendency to turn into a cult characteristic of only one form of culture (Božilović, 2002, 97). The cited conclusions speak in favor of the necessity for suggesting new criteria for the organization of the Olympic Games. One of them is for the Games to constantly be held in their homeland of Olympia. It would be a new step towards possible peace in the ever increasingly divided world.

In the context of faith and religion it is necessary to point out the religious practices of the ancient Greeks, who held the ancient Olympic Games in honor of Zeus, the God of all Gods. The games were originally dominated by religious contents, but over time the sports competitions became increasingly popular, so that more days were set aside for them during the games. The ancient Greeks made human beings - athletes mystical by assigning them divine significance. The best athletes were given a religious, mythological character. Thanks to the Olympic Games, the culture of ancient Greece rose to unimaginable heights, rose to that extent that it was built into the foundations of modern European culture (Živanović, 1992, 103).

Pierre de Coubertin was convinced that to bring people together necessitated a greater familiarity among them (Manojlović, 1996, 41). One such opportunity was offered by the Olympic Games. As the greatest event of today, they have been characterized as a gathering of several nations of different languages in one place at one specific time. Language represents the basic means of communication among people. It is the cultural heritage of each nation. The Olympic Games are a combination of various people and their languages. During the Games, at one time ancient Greek was used, and today we use English as the official language of all the athletes, judges, coaches, the press and all the other people involved. It is only the audience that uses its own language and in that way points out its nation and culture. Between the audience and the competitors a relation exists which is full of tension, but of expectation as well. The audience, by cheering, fulfills its ancient need to belong to its own nation. The audience out there in the stands forgets for a moment the real world, the world full of crises, wars, floods, violence, illnesses and poverty. Together they represent a single unit which is characteristic of large cities, large sports events, and therefore the Olympic Games. This specific group of people in one place can serve to help us understand our modern society. That mass of people at the Olympic Games represents a large number of common interests which mutually affect each other; they have

a sense of belonging to each other and of participating in a common activity. The voluntary gathering of large groups of people where a direct contact among individuals lead to a sense of identification and community, is the characteristics of various sports events, including the Olympic Games (Adorno et al, 1980, 62).

Today, over one hundred and ninety countries take part in the Olympic Games. Athletes and judges come from various social settings, something which was unimaginable in the day and age from which the Games originate. Yet, the social communication among the youth of the world within a grandiose event constitutes a landmark of today's Olympic Games. There we can see athletic mastery and a coming together of young people without regards to ideology, race and religion. After such a long period of time, they now serve to spread the idea of peace among men and nations. Yet, this humane idea is often neglected in this day and age, and the Games serve some other ideas of greater or smaller ethnic groups.

An important characteristic of both ancient and modern Olympianism is the fact that athletes celebrate their nation, their race, their flag and anthem. The Olympic Games in relation to their traditional and contemporary nature have been and will continue to be a challenge to all the nations of the world. There is enough dynamics and faith in them to let us join those who claim: "If there were no games, they should be invented" (Žvan, 1983, 116). All our modern day athletes should participate in the Olympic Games, like in ancient times, without weapons, in order to use "the weapons of sport" to fight for world peace. The idea of the human race elevating itself by means of sports competitions and the glory in honor of the human race still needs more work. Because, people and their needs to compete and prove themselves in sport surpass state borders, and the idea of peace and harmony among people exceeds all the meridians of the world.

REFERENCES

- Adorno, T., & Horkheimer, M. (1980). *Sociological studies*. Belgrade: The School Book.
- Bart, V. (1970). *Life in the ancient world*. Ljubljana: Mladinska knjiga.
- Božilović, N. (1998). *The sociology of culture - prolegomena*. Niš: Prosveta.
- Božilović, N. (2002). *Kitch: A study of the human being and pseudoculture*. Niš: Zoograph.
- Božović, P. (2003). U traganju za dokolicom. In *Pursuit of leisure*. Podgorica: NPP "Victory" Podgorica.
- Bulogn, P. I. (1984). *The Olympic spirit of Pierre de Coubertin*. Belgrade: The People's Book.
- Douskou, I. (1982). *The Olympic Games in ancient Greece*. Athena: Ekdotike Athenon S. A.

- Durant, V. (1996). *The life of Greece*. Belgrade: The People's Book.
- Giddens, E. (2003). *Sociology*. Belgrade: The Faculty of Economics in Belgrade.
- Koković, D. (1986). *Sport without games*. Belgrade: PPO Titograd.
- Koković, D. (2000). *Social anthropology*. Belgrade: The High School of Basketball.
- Kragujević, B. (1984). *From the Olympic battle fields*. Belgrade.
- Manojlović, P. (1996). *Pierre de Coubertin: His ideas, work, and life*. Belgrade: The Yugoslav Pierre de Coubertin Committee.
- Pavlović, P. (2002). *Prilog egzegezi igre*. Serbian Sarajevo: The Knightly Organization the Serbian Hawk.
- Savić, Z. (1994). *A comparative study of some socio-psychological characteristics of female volleyball players of the First Federation League and the United Serbian League*. Novi Sad: The Faculty of Physical Education.
- Vuković, R. (2001). *Forerunners, organizers, contestants and guests at the Olympic Games in Athens in 1896*. Belgrade: "Logos" Totovo village.
- Živanović, N. (1992). *The ups and downs of sport*. Paraćin: Vuk Karadžić.
- Živanović, N. (2002). *Prilog epistemologiji fizičke culture* (2nd ed.). Niš: Panopticum.
- Žvan, M. (1983). *Olympianism and Olympic ideas*. Belgrade: Ideas.

**OLYMPIJSKÉ HRY
JAKO KULTURNÍ UDÁLOST**
(Souhrn anglického textu)

Olympijské hry se staly událostí zahrnující mnoho sportů, která zaměstnává nejen sportovce z různých zemí, ale také milióny diváků z celého světa. Z hlediska veřejného zájmu tedy převyšují jakoukoliv jinou sportovní nebo kulturní událost. Z iniciativy několika málo zemí a malého počtu sportovců se vyvinul historický fenomén dnešní civilizace, odehrávající se na určeném

místě, s vlastními soutěžícími, nabídkou a pravidly. Olympijské hry vyjadřují ideologii různých národů na jediném místě, ideologii náboženství, zvyků, tradic, jazyků nebo obecně kultur. Probíhá při nich masová komunikace mezi soutěžícími a zbytkem celého světa. Sociální, vědecký, sportovně-technický a politický vývoj otevřel sportu jako sociálně-kulturnímu jevu široké obzory a sport se stal obecně prospěšným. Olympijských her se dnes účastní více než sto devadesát zemí. Sportovci a rozhodčí pocházejí z různých sociálních prostředí, což bylo v době, ve které hry vznikly, něco nepředstavitelného. Přesto je sociální komunikace mezi mladými lidmi celého světa v rámci této grandiózní události významným prvkem dnešních olympijských her. Můžeme při nich sledovat mistrovské sportovní výkony i setkávání mladých lidí bez ohledu na ideologii, rasu a náboženství. Právě to činí hry mimořádně krásnými a významnými. Autoři výzkumu se snažili podat podrobnější vysvětlení důležitých kulturních aspektů olympijských her a ukázat jejich sociální kontext.

Klíčová slova: hra, kultura, tradice, náboženství, zvyky, olympijské hry.

Ph.D. Zvezdan Savić



University of Niš
Faculty of Sport
and Physical Education
Univerzitski trg. 2
18 000 Niš
Serbia

Education and previous work experience

Professor of the history of sport at the Faculty of Sport and Physical Education, University of Niš; coach in the volleyball club "AS" Niš.

Scientific orientation

Research activities are focused on the history of sport and PE.

SUBSIDIZATION POLICY IN SPORTS AND PHYSICAL TRAINING IN THE CZECH REPUBLIC

Vladimír Hobza, Radek Cíkl*

Faculty of Physical Culture, Palacký University, Olomouc, Czech Republic

**Ministry of Education, Youth and Sports, Prague, Czech Republic*

Submitted in March, 2007

Considering the positive externalities and classical meaning of the term physical culture, sports belong among the spheres of life traditionally supported in the Czech Republic.

Conceptual issues of the differentiated support of sports and physical training at various state administrative and municipal government levels are, at the present time, connected with a change in the state's allocation policy, i. e. from a centralized to a decentralized one. The activities of these important institutions, represented by the state, regional authorities and municipalities, should be coordinated in the area of subsidization policy in order to avoid social cost ineffectiveness and, in the final stage, negative impacts on sports and physical training.

Keywords: Subsidies in sports, coordination of allocation policy, state programmes, public activities.

INTRODUCTION

The policy of the financial support of a certain activity, also referred to as subsidization policy, is not only an economic issue, but especially a legislative as well as a political issue in every country. Our present subsidization policy (if we don't mention grants from private funds which are not subject to this analysis) in the field of sports and physical training is realized at several levels in the Czech Republic:

- at the state level (especially by means of the Ministry of Education, Youth and Sports),
- at the regional level,
- at the municipal level.

Allocation of grants earlier centralized thus follows the application of reform measures in the field of the public administration, the principle of subsidiarity and a follow up system of social funds allocation.

Subsidies of the state and municipal governments oriented to sports and physical training

Besides subsidies¹ provided at the state level, which are managed within the purvue of specialized programmes, public convenience is one of the basic stimuli as well as guides to subsidization policy at regional and municipal levels. By virtue of public convenience not

only sports and physical training are subsidized, but also culture, the social sphere, charity, science, education, etc.

In the Czech Republic no law exists which would define public activities more exactly. The definition of public convenience has been discussed in the Czech Republic for many years, nevertheless, the meaning of the concept public convenience is still ambiguous. Unfortunately, it can be one of the reasons why a part of the subsidies from public budgets does not get to those for whom they should be designated from an ethical point of view. Various Czech legislative laws state and at best define public convenience by listing activities in terms such as "public activities", "welfare purposes", "socially beneficial targets", etc. – e. g. an allusion in Act No. 586/1992 Coll., on income taxes, where tax exemption is guaranteed by virtue of the vaguely defined term "public convenience". Since 2000, the allocation of subsidies to support sports and physical training has progressed significantly in favour of the regional authorities, as it is stated in TABLE 1 and illustrated in Fig. 1.

This trend not only corresponds to the development in advanced countries, but it especially evens up previous extreme centralism applied within the framework of socialist planning in sports and physical training. In general terms it is thus possible to expect that this qualitative trend is right and will continue for some time.

¹ In economical terms, subsidy means support provided by the state or another entity, serving to ensure activities exactly defined or the purpose, in which the entity providing the subsidy is interested. "Subsidy" differs from "grant" in regards to the exact definition and determination of the purpose.

TABLE 1

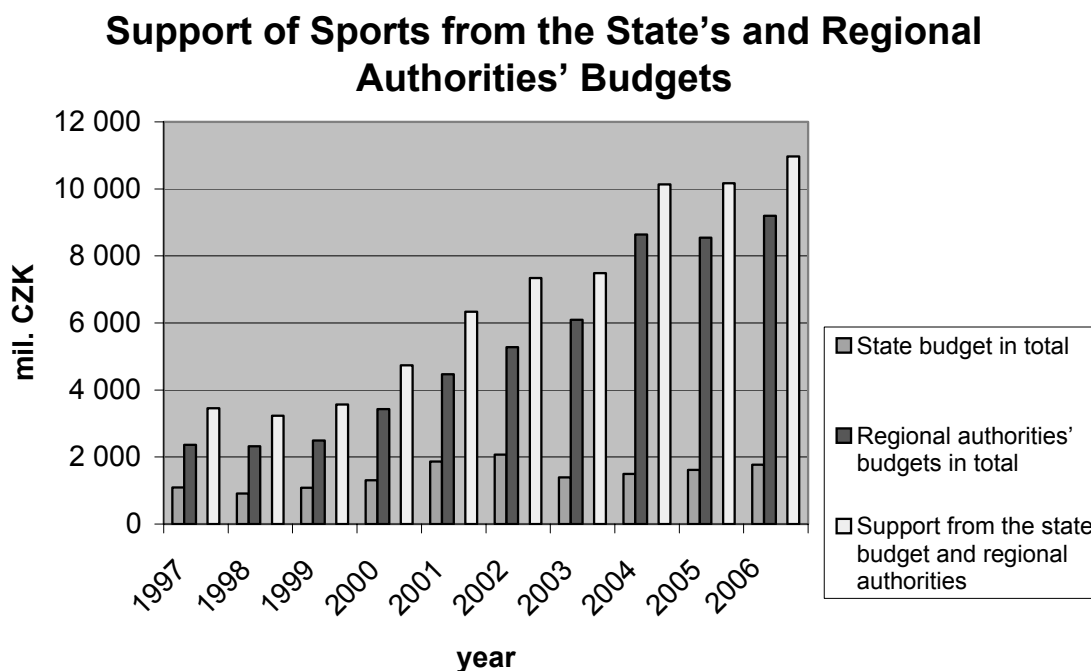
Support of sports and physical training from the state's and regional authorities' budgets (in millions of CZK)

Grants (millions of CZK)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006 ²
State budget (SB) in total	1089	915	1079	1308	1865	2069	1394	1497	1619	1770
Regional authorities' budgets in total	2364	2319	2490	3431	4471	5276	6097	8641	8548	9200
Support from the SB and regional authorities in total	3453	3234	3567	4739	6336	7345	7491	10138	10167	10970

Source: Ministry of Education, Youth and Sports, Ministry of Finance, Prague, 2006

Fig. 1

Graphic presentation of support of sports and physical training from public budgets



For more exact consideration of the trends in amounts of grants and subsidies relating to sports and physical training the relation to gross domestic product development in relevant years was given as the basic comparison measure. This development is illustrated by the following Fig. 2.

Regional authorities' budgets, budgets of regions, municipalities

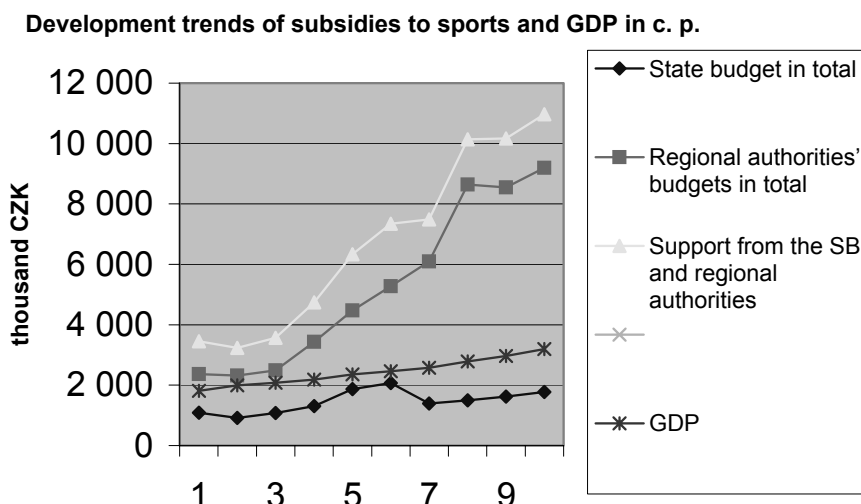
As it is obvious from Fig. 2, in the subsidization policy of public budgets the focal point of supporting physical culture thus changes gradually from the state level to the level of regional authorities in accordance with the proclaimed statement on the subsidiarity of public funds allocation (Nemec & Wright, 1998). The

crucial support of sports is already proceeding out of a coordinated state centre line and at the expense of regional authorities, municipalities and the sports movement. In parallel with decentralized sources, especially in municipalities, changes are made in the institutional organization of sports, physical training and communal recreation, as these changes are supported by significant trends in the increase of grants to this sphere.

Although it is possible to get a summary of the basic development trends on the basis of the total amount of financial means allocated to this sector from public budgets, only very little information can be found out about the internal structure of the utilization of these means. However, it is especially a structure appropriately set with necessary financial amounts that can fulfil effectively a socially beneficial function.

² The figures correspond to data planned for 2006.

Fig. 2

Development of subsidies to sports and trends in GDP³ growth in 1997–2006

GDP in c. p. – gross domestic product in common prices

Differentiation of grants and subsidization programme in sports and physical training

The present system of supportive financing of sports and physical training has been applied in the Czech Republic for a long time, however, individual entities' interests are significantly differentiated step by step in connection with the targets and priorities of these entities. In subsidization policy, while the state keeps the role of a supporter of the representation, the support of top level sports and also the role of a maintainer of a material and technical base of sports and physical training, budgets of regional authorities, which are new entities in the chain of economic relations, especially municipalities, support development of their own local sports activities, their own representation, fitness recreation and sports for everybody (Hobza, Reškořík et al., 2006). Strengthening of municipalities' influence on the renewal and construction of sports facilities will probably continue. The reason for this influence will be property – i. e. the transfer of a further part of their facilities from the physical training unions and sports clubs to municipalities, as well as for organizational and technical reasons.

Present trends towards citizens' common sports activities or both planned and spontaneous single events result especially from the local requirements of the inhabitants, and they are well founded even in terms of "just" funds allocation.

Physical training code as a factor of responsibility for provision of subsidies

The Ministry of Education, Youth and Sports is fully entrusted with coordination and subsidization policy in the sphere of sports and physical training, complying with laws and the government's decrees in the field of subsidization policy. Other government departments solve subsidization policy in the field of public convenience analogically, based on partial standards, too (there is no law in this field which would regulate general principles as well as the rules of clear grants definition, allocation and utilization).

The necessity of the continuous objectification of a mutual role of the state central organs and regional authorities has not been sufficiently comprehended yet. It would be appropriate to codify the distribution of the roles and tasks of individual "territorial players" providing subsidies from common funds in a mandatory document, by which those who act in the sphere of sports and physical training could be guided when making decisions. Due to a large number and variety of user entities it is not probably possible to expect a coherent view and a leading role of municipalities. However, they participate significantly in the development of sports and physical training by their own funds too, as has been already proved. The task of setting and putting into practice a package of certain rules entitled the **Physical Training Code** will still evidently remain a task of the

³ The GDP is reduced by three digit places (GDP/1000) in the graphic chart with regard to the commensurability of trends in individual figures and the graphic chart's intelligibility.

central organs in the Czech Republic. An ideal solution could be the inclusion of the code into the act on sports support. At the present time, in the second term of our regional authorities (whose administration and position in sports and physical training has been already more or less stabilized, as have the budgets of municipalities), we have the most suitable chance to do it.

If we pass over the issue of school physical training which is regulated by standards in connection with education laws, codifying the position of sports and fitness recreation in the Czech society has left us.

What should the proposed **Physical Training Code** contain? Above all, a certain distribution of responsibilities for various spheres of sports, physical training and fitness recreation ensured from the level of the state, regions and municipalities. Task of particular levels can be summarized in the following decisive sections:

- a) The task of the central organs of the state administration is to care about:
 - national representation, especially in the case of the Olympics, and then of other selected sports branches,
 - training of youth with a talent for sports towards sport representation,
 - campaigns for the support of the improvement of citizens' physical condition and thus their health,
 - equalization of regional differences and deficits in the sports and physical training infrastructure,
 - the physical culture of handicapped sportspeople,
 - the support of special sports and physical training events organized on the territory of the Czech Republic.
- b) The task of regional authorities is to care about:
 - the support of sports and physical training events of international, supra regional and regional importance organized on the territory of regional authorities,
 - the support of the sports and physical training of youth, especially by means of secondary and vocational schools.

- c) The task of municipalities is to care about:
 - fitness recreation of citizens,
 - support of physical training unions/sports clubs ensuring physical training of youth,
 - support of sports units which contribute by their importance to municipality promotion,
 - support of sports and physical training events of international, regional and local importance organized on the territory of the municipal authority.

Subsidization and grants policy in sports and physical training is not complete without the inclusion of umbrella sports and physical training organizations which solve their own development priorities. An additional and more general economic view of the proposed grants policy complete with umbrella sports organizations is given in TABLE 2. They are **especially defined programmes and activities**, and not predetermined institutions, which are preferentially supported by subsidies and grants, in terms of economic theories, in the proposed decisive table. In accordance with this principle, subsidies and grants are obtained by those institutions (organizations) that fulfil succinctly defined rules of individual initiation grant levels. A schematic and preliminary proposal of power distribution is submitted in the following table.

However, it cannot be expected in a practical realization subsidization policy that an exact delimitation of responsibilities can be achieved. Specific interests from various levels will often overlap and follow one another. However, powers at individual levels of the public budgets administer in connection with a structure of tasks resulting from the **Physical Training Code**, which should be always dominant.

It is desirable that the fulfilment of dominant and associated partial tasks including financial provision should be continuously objectified in accordance with new knowledge and development trends. They are described in professional studies dealing with physical culture and its closely associated sociological, health and economic aspects (Hodaň, 1997; Novotný, 2000; Weber

TABLE 2
Distribution of grant powers

	Priority 1	Priority 2	Interest
State	Representation	Top level sport and its sport infrastructure	PA ⁴
Region	PA	Sport infrastructure	Regional representation
Municipality	Sports infrastructure	PA	Society activities
Umbrella sports organizations	Top level, efficiency sport	Society activities	PA

⁴ PA – public activities

et al., 1995; etc.). It can be illustrated by both passportization in the field of support on a material and technical basis, which arises gradually by regions, and a newly applied regional conception of the development of sports and physical training with modern principles of grant policy. It would be useful to deal with conceptions and passportization from a central level, the tasks of which, these days, include, besides others, the equalization of regional differences and deficits in sports and physical training infrastructure. The danger of unbalanced states of infrastructural facilities otherwise arises within the frame of the Czech Republic, with the real danger that the difference already existing will disproportionately deepen itself still more. Nevertheless, as mentioned above, one of the important tasks of the tax policy and public budgets is to even up infrastructural differences and objectify initial property conditions. Therefore, the primary task of the state cannot be to create social and property inequalities and further disproportions for state and municipal financial means. In European terms such a policy is absolutely unacceptable so much the more in that a structural policy of the EU strives for equalization of regional differences in the economic and social fields. On this occasion, the Physical Training Code as an organizational and maybe even ethical document can be a good basis in specific fields of Czech sports and physical training.

CONCLUSION

Possibilities of subsidies designated for sports and physical training are limited by the budget even in highly advanced countries. In the Czech Republic it is the same – although the amount of financial means for this field of development continuously grows, the share of grants and subsidies relating to the state budget is considerably lower than in western countries (Felderer, Halmenstein, Kleissner, Moser, Schindler, & Treitler, 2006). So much the more is it necessary to be particular in coordination of subsidies and grants to sports and physical training from all levels providing this support. At the present time, new documents of the government will be probably elaborated in addition to others concerning sports development. In our opinion it is necessary to include new views in these documents, such as the differentiation of grants, the Physical Training Code, sports coordination from the level of the state and municipal governments, sports for everybody, a conception of the development of sports organizations, etc. Besides these fields, the enforcement of higher financial shares for sports and physical training from the state budget and the reallocation of financial limits of individual programmes in favour of updated Czech sports priorities are very important, too. Sports and physical training

in more complex national economic terms (including follow up industrial branches, the travel trade, health and multiplication effects) bring up to 7% into the gross domestic product in advanced countries, their support thus pays off even from an economic point of view (Howard & Crompton, 2004).

REFERENCES

- Felderer, B., Halmenstein, A., Kleissner, A., Moser, B., Schindler, J., & Treitler, R. (2006). *Sport und Oekonomie in EU*. Wien: SportsEconAustria.
- Hodaň, B. (1997). *Úvod do teorie tělesné kultury*. Olomouc: Univerzita Palackého.
- Hobza, V., Rektořík, J. et al. (2006). *Základy ekonomie sportu*. Praha: Ekopress.
- Howard, D. R., & Crompton, J. L. (2004). *Financing Sport* (2nd ed.). Morgantown: Fitness Information Technology Inc.
- Nemec, J., & Wright, G. (1998). *Verejné financie*. Bratislava: NISPACEE.
- Novotný, J. (2000). *Ekonomika sportu*. Praha: ISV.
- Směry státní politiky v tělovýchově a sportu* (2003). Praha: MŠMT.
- Směry státní politiky ve sportu na léta 2004–2006* (2003). Praha: Úřad vlády České republiky.
- Sport a EU - Evropská unie a její vliv na sportovní prostředí v České republice*. (2004). Praha: MŠMT. Odbor sportu a tělovýchovy.
- Weber, W., Schneider, C., Kortlueke, N., & Horak, B. (1995). *Die wirtschaftliche Bedeutung des Sports*. Schorndorf: Verlag Hofmann.
- Evropská charta sportu* (2002). Praha: MŠMT.
- Usnesení vlády č. 718/1999 k zásadám komplexního zabezpečení státní sportovní reprezentace*.
- Usnesení vlády č. 17/2000 k Národnímu programu rozvoje sportu pro všechny*.
- Usnesení vlády č. 114/2001 o zásadách vlády pro poskytování dotací ze státního rozpočtu ČR nestátním neziskovým organizacím ústředními orgány státní správy*.
- Usnesení vlády č. 673/2003 ke směrům státní politiky ve sportu na roky 2004–2006*.
- Zákon č. 586/1992 Sb., o daních z příjmů*.
- Zákon č. 115/2001 Sb., o podpoře sportu*.
- <http://www.Sazka.cz>

SUBVENČNÍ POLITIKA VE SPORTU A TĚLOVÝCHOVĚ V ČESKÉ REPUBLICĚ (Souhrn anglického textu)

Vzhledem k pozitivním externalitám a všeobecně uznávanému významu tělesné kultury patří sport a tělovýchova k tradičně podporovaným oblastem života v České republice.

Se změnou alokační politiky státu, tj. z centralizované na decentralizovanou alokační politiku, jsou v současnosti spojeny koncepční otázky diferencované podpory sportu a tělovýchovy z různých úrovní státní správy a samosprávy. Tyto významné instituce, představované státem, vyššími územními celky a municipalitami, by měly postupovat v oblasti subvenční politiky koordinovaně, aby nedocházelo k celospolečenské neefektivnosti vynakládaných prostředků a v konečné fázi negativním dopadům na sport a tělovýchovu.

Klíčová slova: subvence ve sportu, koordinace dotační politiky, státní programy, veřejně prospěšná činnost.

Ing. Vladimír Hobza, Ph.D.



Palacký University
Faculty of Physical Culture
tř. Míru 115
771 11 Olomouc
Czech Republic

Education and previous work experience

1970–1975 – University VŠB Ostrava, Economics and management (Ing.).

1983–1985 – VUT Brno – External postgraduate study – Management.

2001–2005 – Masaryk University Brno, External postgraduate study (Ph.D.).

1975–1991 – Deputy director economist, Sigma UP Olomouc.

1991–1995 – Deputy director at ČSOB, branch in Olomouc.

1995–2000 – Director of HypoBank, branch in Olomouc.

Since 2000 – Lecturer at the Department of Recreology, Faculty of Physical Culture, Olomouc.

Placement abroad: KPMG – Aachen (1992), Bundesbank Zentrale Nordrhein-Westfalen (1992), Marburg Universität (2005).

Scientific orientation

Economics and economics of sport, financing sport, subsidies and subsidy policy in sport.

First-line publications

Hobza, V., Rejzler, J. et al. (2006). *Základy ekonomie sportu*. Praha: Ekopress.

Hobza, V. (2007). Tělesná kultura. In *Ekonomika a řízení odvětví veřejného sektoru* (pp. 153–168). Praha: Ekopress.

Author of 3 university textbooks, 5 textbooks for distance learning in the field of management, financing and economics; co-author of 17 projects for municipal sphere; 35 contributions, articles and reviews.

ATTITUDES OF STUDENTS IN SPORT EDUCATION TO THE SPORT ACTIVITY OF BLIND PEOPLE IN HUNGARY AND POSSIBLE REASONS FOR THEM

Peter Osvath, Katalin Kälbli, Gabor Ramocsa

Faculty of Physical Education and Sports Sciences, Semmelweis University, Budapest, Hungary

Submitted in January, 2007

The very low participation of blind people in sport is fundamentally caused by the inappropriate knowledge of experts on disabled – specific areas of sport. Sport coaches and 582 students learning to be PE teachers were asked about their knowledge and ideas of sport for individuals with disabilities, mainly for blind people. Research has proved that good intentions of PE teachers and coaches taking part in disabled sport are basically not missing, thus the main barrier is the lack of topics regarding sport for handicapped people in the curriculum of their studies. Janečka, Kudláček and Válková (2003) have emphasized the basic need of specially prepared PE teachers, mainly in the elementary schools. Personal experience and direct contact with blind athletes cannot be replaced by audiovisual methods of education. Blind people cannot be trained to be coaches by the nature of their disability, so blind sport must be developed through the active support and cooperation of sighted sport experts. Sport for the disabled has to be taught as a separate subject, or at least as a separate and stressed section of an already existing, regular subject, such as theory of training. Methodically, personal contact with blind people as well as practical sessions in the course of their education is essential and irreplaceable (Asjborn & Tonjum, 1986). Students should not be allowed to graduate without specific knowledge about sport for the handicapped, and about the possible ways for participation in sport for blind athletes. Such a many sided approach of education is the future and the modern way of teaching.

Keywords: Involvement of PE teachers in sport for the blind, coaching training for adapted sport, counter emotion against sport for the blind.

INTRODUCTION

In previous studies (Osvath, 2004; Osvath & Ramocsa, 2006) it has been found that the underdevelopment of sport for blind people, and the unbelievably low number of blind athletes in Hungary has been caused mainly by the lack of sport experts responsible for organizing and conducting training and competition for them. Janečka, Kudláček and Válková (2003) has emphasized the basic need for specially prepared PE teachers, mainly in the elementary schools. Personal experience and direct contact with blind athletes cannot be replaced by audiovisual methods of education. Blind people cannot be trained to be coaches by the nature of their disability, so blind sport must be developed through the active support, and cooperation of sighted sport experts. Intentions of the individuals to perform regular physical activity is strongly related to the type of disability (Longmuir & Bar-Or, 2000; Sit, Lindner, & Sherrill, 2002). Knowing this and being familiar with the shyness and inactivity of blind people (Ponchillia, Staruse, & Ponchillia, 2003), it is not surprising that only 2–3% of the approximately 10000 blind individuals and people with visual impairment do sport on a regular basis in Hungary. This data, as compared to the 25–27% participation of the regular population in

sport, seems boring. Even fewer blind athletes are registered officially in local sport clubs, which fact urges the society to do something in order to mobilize them in the direction of sports. Females with disabilities, including those of them who are visually impaired, are significantly underrepresented in sport (Sherrill, 1993). The optimal socialization of disabled people is a very complex process (Coakley, 1998). It is uniquely true for people with sensory disability (Klapwijk, 1986). Sport, led by highly qualified sport experts can support it efficiently.

Tanaka (Tanaka et al., 1998) found in his study that media was a good tool for generating interest in sport among sighted people, but not among individuals with disabilities.

We thought that an insufficient personal background was the main reason for the immature sport activity of blind people, which could be treated by adequate education, pedagogy, and special courses for sport experts.

Disability – specific topics should be integrated into sport education courses on how the students could get focused on handicapped sport.

It was thought that the knowledge and experience of students in sports education on sports for individuals with disabilities was not enough to get a realistic overview about their special needs.

Answers were searched for regarding the following topics

Is there any counter emotion against practising with blind sporters, or are non handicapped sportspeople open to be involved in work with the disabled? E. g. would you take part in sport for the blind? If yes, why? I would like to help them; I pity them; It is easier to make a career with them; Because of the higher income; I am interested in difficult tasks and challenges; It is easier to work with them.

Why are sport experts keeping a distance from individuals with disabilities and especially from blind athletes? E. g. why would you not take part in sport for the blind? I do not feel well prepared; I am not interested in it; I am afraid of this special job; I feel pity towards blind athletes; It is not well paid enough; It makes no sense to be bothered with them.

What kind of ideas, knowledge do they have about this special area? E. g. have you ever seen any sport event for people with disabilities: yes-no?

Do you know any special sport for athletes with disabilities? List them! Did they get any handicap - specific information during their studies, in relation with their particular sport? E. g. did you have classes on sport for people with disabilities: yes-no?

SAMPLES AND METHODS

By means of questionnaires developed by the authors, 582 students were asked, about the attitude, the knowledge, and the plans of the students in relation to sport for the blind. The study was approved by the ethical committee at the National institute for sports medicine. Written informed consent was obtained from all subjects before the investigations. The questionnaire was composed of open and closed questions. A pilot study was made first, in which 50 collected questions were used (Renwick et al., 2003). The pilot study was participated in by 402 randomly selected students. As the final version of the questionnaire, 25 questions were selected from the pilot study. A pretest was performed first with 582 students. None of them took part in the pilot study. The same participants were tested 5 weeks later (Kerkley, Alvarez, & Griffin, 2003; Stelmack & Od, 2001) with the same questionnaire.

The answers had no intensity values, thus they could not be expressed on any scale. Instead of correlation analysis, indirectly, the differences of the received answers were used to verify the reliability of the questionnaire.

There were no significant differences between the frequencies of the received answers: $\chi^2 = 1.17$, $p > 0.05$.

The study was participated in by 378 female and 204 male students. All of them study at the Semele University at the Faculty of Physical Education and Sport Sciences or at the Fitness Academy courses for coaches. The students of these institutions were asked, because the points of view of the PE teachers and sport coaches are equally important for the improvement of blind sport in the future. Well organized and well conducted PE classes held at an early age for blind individuals can provide the essential basis necessary to direct them toward specialized sport activities, and to increase the number of athletes involved in regular sport. The samples were taken randomly.

RESULTS

The age distribution and the average age of the students (it was 23.8 years) were in accordance with the most common values of the students at the universities or in special adult education in general.

TABLE 1
Age and gender proportion of students

Age (years)	Males	Females
18-20	50	106
21-25	84	202
26-30	38	42
31-45	32	28

Almost half of them (49.5%) declared having a disabled individual among their relatives or friends, but very few of these relations were blind (10.1%). This fact explains why they have hardly any direct connection or experience with blind individuals. Furthermore, only one student had any experience of blind athletes.

A very high number of the students have already seen sport events organized for individuals with a disability (74.2%), mainly on TV (52.7%). Personal experience with such a kind of event was even more rare (24.7%). A very few students mentioned film as a possible information source about sport for the handicapped.

Most of the students have already seen competitions (63.9%), some of them (15.4%) demonstrations, and only a small minority has taken part in really interesting training sessions, which is the most important activity from the professional point of view (10.3%).

The majority of the students (89.6%) had no practical experience in organizing such a kind of event, but the rest (10.4%) had already seen competitions on site, or worked with disabled athletes as volunteers. Unfortunately, only 21% of them had participated in such a kind of event more than once, the majority had only one occasion to do so. There were no students who had already

worked with athletes with a disability as a referee, as an event organizer, or as a coach.

A much smaller number of students could answer the questions focused on sport for the blind on a personal experience basis. Only 2% of them had participated in sport events organized specially for blind people and then only once. They were spectators. It is interesting that none of them had any blind relative or friend, so they attended because of their own interest.

The students had to list sports appropriate for blind individuals as a task to test their general knowledge about the nature of blindness. Although 52.5% of them thought that they are familiar with the special requirements of blind athletes, the results clarified their wrong ideas about the relation of blindness to physical activity. There were students who offered body building to blind people, which is a special sport based on visual, esthetic requirements. Blind individuals cannot be motivated on a visual basis (Sherrill, 1981). Goal ball was the best known sport for blind people, mentioned in 36% of the questionnaires, but only 52.1% of them had seen it played on television.

Most of the students (89.1%) have never heard about the aspects and forms of sport for the disabled during their studies. The topics and explanation of the possible ways of integration of individuals with disabilities into sport is absolutely missing from the curriculum of these courses. Only a small part of the students of Semeľweis University have already met with these topics, but it is understandable, as they studied in the Adapted PE program.

Only 17.5% of the students have refused definitely the idea of dealing with blind athletes in the future. Of the rest, 39% have intentions of working in this field, depending on the task, and 61% were ready to do any job together with blind people. This result strengthens our hopes of increasing the number of experts in sport for athletes with disabilities.

Among the reasons, wishing to help got 64.8%, attraction to challenges got 29.8%, and pity was mentioned in 4.1% of the answers. Of the students 1.3% thought that better income perspectives could be possible if they worked in this special field of profession. None of them thought that dealing with handicapped people, mainly with blind athletes, was easier.

TABLE 2

Reasons for participating in sports for blind people

Intention to help	64.8%
Attraction to hard professional work	29.8%
Pity for blind people	4.1%
Opportunity for better income	1.3%
Opportunity for faster career building	0.0%

Nobody believed in a faster career in sport for the disabled as compared to able bodied sports, although the observably small number of rather uneducated experts in sport for the disabled could allow faster career building for the highly educated experts.

Those students who completely refused to work with blind athletes have given the following reasons: they are not well prepared for this special area of their profession (44.3%), have no attraction to the disabled, including blind people (28.2%), have a fear of them (22%), or are not able to work with them, because of the pity they feel for them (5.5%).

TABLE 3

Reasons for refusing participation in sport for blind people

Do not feel well prepared	44.3%
Are not interested in	28.2%
Are afraid of this special job	22.0%
Feel pity for blind athletes	5.5%

The following answers were given to the questions concerning the possible advantages of sport for blind people. Sport strengthens both their self confidence, and can give them a new aim in their life received equally 94.8%. The health protective effect of sport received 89.6%. Most of the students (83.5%) thought, that blind people could build close relationships with sighted people through sport. It is in absolute contrast with the opinion of the blind athletes, who did not see this role of sport at all. Many of them (72.9%) believed that sport was an efficient tool to recognize the performance of blind people, even on a governmental level. In our previous study (Osvath & Ramocsa, 2006) it was found that financial, or governmental recognition was very rare and improbable, and then possible exclusively only for the elite athletes who are members of the national team. That sport could help the blind athletes in orienteering in traffic or make it easier for them was the opinion of 43.3% of the students. A small minority (6.2%) believed that sport could be a tool for improving the quality of existence of blind people, thus professional sport in not a real option for them.

It was particularly interesting that the students did not find the opportunity for travelling abroad important for blind people, whereas the athletes themselves found it to be a very useful "side effect" of sport.

TABLE 4
Advantages of sport for blind athletes

Improvement of self-confidence	94.8%
New goals, perspectives in life	94.8%
Health protection	89.6%
Opportunity for creating relationships with sighted people	83.5%
Opportunity for recognition of achievement	72.9%
Improvement of abilities for travelling	43.3%
Financial recognition of athletes	6.2%
Opportunity for travelling abroad	0.0%

No ideas about the challenges the blind face in relation to sport were had by 14.5% of the students. Most of them (77.3%) believed that the most important difficulty for them was access to the venues; they could not use the facilities because they could not approach them physically. It is an obvious mistake, because it is valid only for people physically disabled in other ways. This is supported by the next answer, that in 74.3% of cases they believed that blind athletes need special venues or sport facilities.

The insufficient financial support and the lack of sport experts involved in sport for handicapped people were also mentioned (72.6%) as main barriers to the development of blind sport.

Very few students (8.2%) believe that blind people are basically inactive, and that it is very difficult to motivate them. This is also in contrast with the point of view of the blind athletes.

That there were no real differences in organizing sport events for blind as opposed for sighted athletes was thought by 7.2% of the asked people.

They thought that the transportation of the athletes is not challenging, which is also a misconception.

TABLE 5
Challenges of sport for blind people

No idea	14.5%
Lack of accessible venues, sport facilities	77.3%
Lack of special facilities	74.3%
Insufficient financial background	72.6%
Inactivity of blind people	8.2%
There are no more challenges than in the sport for able athletes	7.2%
Small number of blind athletes	3.0%

The most important finding was that the majority of the students (74.5%) could not imagine that the integration of sighted people into blind sport could be a possible, favourable solution in order to strengthen the activity of blind athletes. It could be a really strong barrier to the improvement of sport for people with visual

impairment. Only the traditional, reverse direction of integration is known and acceptable for them.

CONCLUSION

It is important to state that the results of this study are declarative.

Most of the students had no precise idea about the professional tasks necessary in order to work with individuals with disabilities. They hadn't access to appropriate information about sport practise, and theory of sport for handicapped people. All of these facts can be the cause of them keeping their distance from sport for people with disabilities. It is very good news that only the minority of the students refused to work with the blind definitely. This attitude can also have been changed by educational modifications, which are supposed to have started in secondary grammar schools. There is a general refusal of the idea of the integration of sighted people into the sport of blind people, although it is strongly believed that this way of integration could be a very efficient route to the expansion of blind sport, and for the increase of the numbers of athletes among those with visual impairments. Goal ball could be a perfect sport for starters.

The direct personal experience of the students with people with disabilities seems to be few and far between, although the main characteristics of sport for the handicapped are known more or less from television, a rather superficial information source that cannot provide a wide range of knowledge about this topic. Many students considered sports to be appropriate for the blind, which however are, in reality, absolutely not suitable for them to do. It shows that they are not familiar with the nature of blindness itself, and the impact of it on the daily life of blind people. This misconception can be treated with disability specific classes, education at an early age, beginning in the grammar or high schools. The health and environment subject could give the frame to these topics. Answers received to the questions focusing on the advantages and disadvantages of sport for the blind have proven that the point of view of students about the use and goals of sport was in contrast with that of the blind themselves. Some of the advantages were over esteemed, and many of them were underestimated. These misconceptions could be caused to disappear by the integration of disability specific subjects and by systematic education based on personal, practical cooperation with individuals with disabilities.

From the answers received, it seems to be obvious that most of the students in sports education declare themselves to be open to work with blind athletes, but they have no direct personal experience in this field, so their intentions should be considered as a theoretical

wish. Counter emotions against practising with the blind was not found.

Disability specific topics have to be integrated into the curriculum of their studies, and more special teachers and experts should be involved in these subjects. Due to the small number of special professors, familiar with sport for the blinds or other handicapped individuals at the above mentioned institutions, closer cooperation must be established or strengthened with universities or academies specializing in adapted sport or education. Training a new generation of sport experts cannot be done without the contribution of special professors and without the creation of special, disability focused subjects. This lack of sport experts can be considered to be one of the main challenges faced by sport for the blind.

In summary, it can be stated that the main challenges of sport for the blind are based on personal and educational reasons. Access to sport facilities and venues do not cause real limitations for blind athletes, but the lack of sighted experts responsible for organizing and conducting their sport activities are what make their opportunities almost hopeless. A centrally organized and directed new educational approach is the solution. The blind face many barriers in their daily life, so their possible life quality improvement cannot be dependent on the inattentiveness of sighted people, and the unadvised concept of education in the schools at different levels.

REFERENCES

- Asbjorn, M., & Tonjum, V. (1986). Sports for the blind, sports for the disabled. In *Sports for disabled: International congress on recreation, sports and leisure* (pp. 79-81).
- Coakley, J. (1998). Sport and socialization. *Exercise and sport science review*, 21, 169-200.
- Janečka, Z., Kudláček, M., & Válková, H. (2003). Sport specialization with visual impairment in prepubescent and pubescent age. *Acta Universitatis Palackianae Olomucensis. Gymnica*, 33(2), 7-10.
- Kerkley, A., Alvarez, C., & Griffin, S. (2003). The development and evaluation of a disease - specific quality of life questionnaire for disorders of the rotator cuff. *Clinical Journal of Sport Medicine*, 13, 84-92.
- Klapwijk, A. (1986). Persons with a disability and sports. In *Sports for the disabled: International congress on recreation, sports and leisure* (pp. 1-14).
- Longmuir, P. E., & Bar-Or, O. (2000). Factors influencing the physical activity levels of youths with physical and sensory disabilities. *Adapted Physical Activity Quarterly*, 17, 40-53.
- Osvath, P. (2004). A fogyatékoság ügyének megjelenése a sporttudományban. *Sporttudományi szemle*, 4, 44-46.
- Osvath, P., & Ramocsa, G. (2006). Sport hatása a vakok életminőségére: Magyarországon. *Kalokagathia*, 44, 170-175.
- Ponchillia, P. E., Strause, B., & Ponchillia, S. V. (2003). Characteristics of athletes with visual impairment. *Adapted Physical Activity Quarterly*, 20, 206.
- Renwick, R., Nourhaghghi, N., Manns, P., & Rudman, D. L. (2003). Quality of life for people with physical disabilities: A new instrument. *International Journal of Rehabilitation Research*, 26, 279-287.
- Sherrill, C. (1981). *Adapted physical education and recreation*. Iowa: Wm. C. Brown Company Publishers Dubuque.
- Sherrill, C. (1993). Women with disability, Paralympics, and the reasoned action contact theory. *Women in Sport and Physical Activity Journal*, 2, 51-60.
- Sit, C. H. P., Lindner, K. J., & Sherrill, C. (2002). Sport participation of Hong Kong Chinese children with disabilities in special schools. *Adapted Physical Activity Quarterly*, 19, 453-471.
- Stelmack, J., & Od, F. (2001). Quality of life of low vision patients and outcomes of low vision rehabilitation. *Optometry and Vision Sciences*, 78, 335-342.
- Tanaka, T., Yoshida, Y., Shiraishi, T., & Horiguchi, S. (1998). Survey of disabled persons concerning their opinions on winter sports and recreational activities. In K. Yabe (Ed.), *Trends and issues in winter and paralympic sport* (pp. 29-33). Nagano: Paralympics Committee.

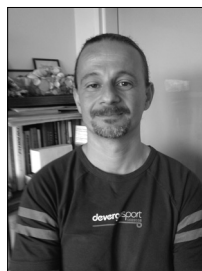
POSTOJE STUDENTŮ SPORTOVNÍ VÝCHOVY KE SPORTOVNÍ AKTIVITĚ NEVIDOMÝCH V MAĎARSKU A JEJICH MOŽNÉ PŘÍČINY (Souhrn anglického textu)

Velmi nízká účast nevidomých na sportovních aktivitách je způsobena především nedostatečnými znalostmi odborníků v oblasti sportu pro postižené osoby. Sportovní trenéři a 582 budoucí učitelé tělesné výchovy byli dotazováni na znalosti a představy o sportovních aktivitách osob s postižením, především nevidomých. Průzkum prokázal, že učitelům tělesné výchovy a trenérům, kteří se účastní sportovních aktivit určených pro postižené, dobré úmysly v zásadě neschází a že hlavní překážkou je nedostatek témat týkajících se sportu pro postižené v osnovách studijních oborů. Janečka, Kudláček a Válková (2003) zdůraznili zásadní potřebu speciálně připravených učitelů tělesné výchovy, a to především na základních školách. Osobní zkušenosti a přímý kontakt s nevidomými sportovci nemohou být nahrazeny audiovizuálními vzdělávacími metodami. Nevidomí se

nemohou v důsledku svého postižení stát trenéry, takže sport pro nevidomé musí být rozvíjen s aktivní podporou a spoluprací se sportovními odborníky bez zrakového postižení. Sport pro postižené musí být vyučován jako samostatný předmět nebo alespoň jako samostatný a zdůrazňovaný úsek již stávajícího běžného předmětu, jako je teorie tréninku. Z metodického hlediska je zásadní a nenahraditelný osobní kontakt s nevidomými a také praktická setkání v průběhu výchovy (Asjborn & Tonjum, 1986). Studenti by neměli školu opouštět bez specifických znalostí o sportu pro postižené a o možných způsobech zapojení nevidomých do sportovních aktivit. Takový mnohostranný přístup ke vzdělávání je budoucí a moderní metodou výuky.

Klíčová slova: zapojení učitelů tělesné výchovy do sportovních aktivit pro nevidomé, výuka tréninku pro adaptovaný sport, negativní emoce proti sportu pro nevidomé.

Ass. prof. Peter Osvath, MD



Semmelweis University
Faculty of Physical Education
and Sports Sciences
Alkotas ut. 44
1123 Budapest
Hungary

National director of Special Olympics Hungary.

First-line publications

- Pavlik, G., Olexo, Z., Osvath, P., Sido, Z., & Frenkl, R. (2001). Echocardiographic characteristics of male athletes of different age. *British Journal of Sports Medicine*, 35, 95-99.
- Osvath, P., & Ramocsa, G. (2006). A sport hatása a vakok életminőségére: Magyarországon. *Kalokagathia*, 44(1), 170-175.
-

THE RHYTHM OF MOVEMENT DURING AQUAROBIC CLASSES

Alicja Nowaczyk Chalupka, Dorota Różańska*, Elżbieta Rostkowska

The Eugeniusz Piasecki University School of Physical Education, Poznań, Poland

**The Józef Piłsudski Academy of Physical Education, Warsaw, Poland*

Submitted in December, 2006

The rhythm of movement which is a component of co-ordination motor abilities, present in practically every movement, is a little researched property. Previous studies on the rhythm of movement in humans have always focused on the abilities of motor performance of rhythm by the subjects. They did not explain the mechanism of this performance.

The aim of this study is to present a wide, parametric description of behaviour related to the rhythm of movement, with changes to this behaviour taking place during rhythmic exercise classes. The rhythm of movement of 35 women in aquarobic classes was studied. The classes consisted of 52 exercises the performance of which was analysed in terms of rhythm. The subjects performed also three tests for rhythmic skills.

It was noted that the properties of an exercising person such as rhythmic skills and age, only partially determine maintaining of the rhythm during the exercise. The duration of an exercise has a great effect on the rhythm of movement. A faster pace of an exercise favours maintaining the rhythm. Exercises in which the movement is in the frontal plane are easier to maintain in rhythm than exercises in the median plane. Exercises with alternating sides movement are easier to maintain in rhythm than symmetrical exercises. Similarly, running exercises are easier to maintain in rhythm than jumping exercises. Using equipment during exercises lowers the possibilities of maintaining the rhythm. An interesting phenomenon of "going into rhythm" and "losing rhythm" at various stages of exercises was noted.

The results obtained in this study indicate the complexity of the property called the rhythm of movement. They partly explain the phenomena accompanying the performance of rhythmic exercises by women. The results of the study may be helpful for instructors in preparation of synopses of rhythmic exercise classes.

Keywords: Rhythm of movement, aquarobic, motor exercises in water.

INTRODUCTION

The sense of rhythm of movement is one of the fundamental co-ordination abilities of people (Raczek, 1992).

In spite of the significance of rhythmic skills for efficient motor activities, so far there have been no extensive studies of this phenomenon. There are however many fragmentary studies of the ability of rhythmisation in children, students or athletes.

The studies of Zachopoulou et al. (2000) may be an example. The authors carried out observations the aim of which was to compare the level of rhythmical abilities of children trained in differing sports: tennis, basketball, swimming, and a control group. Children in the swimming group showed the best results in maintaining the rhythm during exercises at a slow and fast pace. Children doing tennis showed a greater rhythmic precision. No statistically significant difference was noted between rhythmical precision and maintaining the rhythm by both sexes.

Phillips-Silver (2005) studied the relations between motor reactions to rhythm and the development of the

sense of rhythm in babies. He found that the sense of rhythm in babies may be developed. Babies clearly react with movement to rhythmic features of the music they listen to.

On the basis of the studies carried out by Młodzikowska and Tukiendorf (1991) it may be assumed that success in sport is determined by a high level of the ability of rhythmisation of movements. Motor sense of rhythm in young people develops with age and with specialist training which allows for achieving significant sports results.

The results of the study by Iskra (1999) are quite different. He looked for the significance of rhythmic skills in hurdle races assuming that these skills determine the ability of achieving the rhythm of race characteristic for the hurdlers. His studies did not show statistically significant relations between the results of the rhythmisation test and the results of selected motor fitness tests in the groups of the best Polish hurdlers. The author states however that for testing of rhythmical talents in sport a test with a characteristics of rhythm similar to the rhythm in a given sports event should be prepared.

Stronczyński and Stula (2003) were interested in the issue of the importance of abilities of movement rhythmisation and sense of musical rhythm in teaching and mastering sports technique based on the example of football. It turned out that players with a better ability of the sense of musical rhythm are more economical in effort and better adapt to set motor structures.

Also, laboratory studies on the sense of rhythm in girls were carried out. They show that there is a tendency toward improvement of results with age and that girls present a higher level of sense of rhythm compared to the population of boys (Gorgól, 1995). Similar studies were carried out by Czabański and Świadek (1995). In the results a significant difference in motor talents in terms of rhythm were noted in the tested female students. Maciantowicz (2002) states that rhythmic movement causes smaller energy loss. Smaller energy loss during movement means more economical movements. In coaching work one should strive to achieve a correct rhythm of the given movements.

However, no one in Poland nor in the world has undertaken the observation and scientific analysis of motor behaviour related to the rhythm of movement in mature women, engaging in physical activity for recreation. The authors of this study were interested not only in the issue of the rhythm of movement, but also in aquarobics becoming more and more popular in the world.

Moving aerobics from a gym to the water environment has made classes more attractive and found many fans. The research so far has confirmed the decrease of fat tissue as an effect of aquarobics (Hoeger et al., 1993). Similar results in subjects exercising on land and in water were obtained by Sanders (1993). The above authors did not however assess the diets of the studied women.

The effect of aqua aerobics on the motor fitness of 18–19 year old girls in Poland was studied by Eider (2004). He used the international test of physical fitness for his study. He found that two months of doing aquarobics affected in a statistically significant way the time of the short and long run, the length of the two-legged jump and the length of time spent in hanging from bent arms. Weiss and Jamieson (1995) as well as Bailey et al. (1997) showed a beneficial effect of aquarobics in the form of an improvement in one's overall sense of well-being, an increase in energy levels and better self-assessment. Piotrowska-Calka (2003) studied also reasons for participating in the classes. The most frequent reason was willingness to improve physical fitness, the need to be active, and also the need for mental relaxation and shaping the figure.

In terms of rhythmic predisposition and abilities to recreate rhythm women are more talented than men. It also results from women's greater inclination and passion for those types of physical activity which are characterised by greater rhythmisation and may be connected with musical accompaniment (Meinel, 1967).

The above discussion leads to the presentation of the aim of the study, which is creating a wide, parametric (measurable) description of behaviour related to the rhythm of movement (rhythmical behaviour) with changes in this behaviour taking place during rhythmical exercise classes.

METHODS

The authors studied the rhythm of movement in women during aquarobics classes. The participants in the classes were 35 women aged 25 to 64. The women exercised in five separate groups with 6, 10, 8, 5 and 6 participants, respectively. In each of the groups 52 exercises were carried out and their performance in terms of rhythm was analysed later. The number of exercises multiplied by the number of women is 1820. This is the number of exercises analysed.

The classes were carried out in a swimming pool 10 by 5 metres wide and 1.20 to 1.40 m deep. The classes took place once a week. The part which was studied took 35 minutes. The remaining time was taken by organisational activities and stretching at the end of the class.

The study involved filming the classes of aquarobics. The camera recorded the instructor's work (the demonstration and the verbal part), performing exercises by the participants and the music. The rhythm of movement recorded on the film was processed into both quality and quantity results using the Pinnacle studio computer programme and subjected to statistical and descriptive analysis. Performance of exercises in terms of rhythm was analysed. The authors were most interested in those properties of rhythmic exercises which in the water environment are the drive behind better or worse rhythmic performance by women.

Additionally the participants of the classes were subject to testing of rhythmisation. It involved three tests.

The first one is a special test of the motor sense of rhythm of Bednarzowa and Młodzikowska (1982), modified by the authors for the needs of the studies on the rhythm of movement in women doing aquarobics. The task involved remembering and recreating with body movements (stamping) of the previously observed rhythm of movement at the pace given by the metronome. The results of the test allow for the assessment of the observation skill during observation of movement and of the ability to immediately imitate. The rhythmic motive used in the task included a pattern with rhythmic values of quavers and crotchets in triple time. The task was performed by each person individually. A correctly performed rhythmic motive was awarded with one point.

Also a test of motoricity to assess the rhythmisation ability devised by Raczek, Mynarski and Ljach (1998) and modified for the purpose of the study was used. The test included two tasks. The first task, "rhythmic tapping with hands", involved mastering an observed cycle of movement and repeating it quickly within 20 seconds on the table top. The second task required placing a subject in a corner of a room, so that her hands adhered to two neighbouring walls. A special cycle of movements made with upper and lower limbs was to be remembered and repeated within 20 seconds. The results of each test was a number of correctly performed cycles within the set time.

The first test of rhythmisation focused on the lower limbs, the second (the first task) on the upper limbs and the third one (the second task) on both the upper and lower limbs.

RESULTS

The research assumption was that the most difficult task was maintaining one's own movement at the correct rhythm dictated by the music and the instructor. Failing to do so results in the appearance of an individual rhythm, the maintainance of which is easier than in the case of correct rhythm. A participant experiencing the greatest difficulties in rhythmisation cannot maintain either the correct nor the individual rhythm.

Results of rhythmisation tests and subjects' age

The results of three rhythmisation tests have been presented in TABLE 1.

The results of the rhythmisation tests focused respectively on the upper and lower limbs and did not show any relation with the women's age. The third test, focused on the lower and the upper limbs together showed a statistically significant relation to age - R. Spearman's $-.38$ with $p = .026$. This means that the older the woman, the lower the result of the test.

Maintaining the correct or individual rhythm

Fig. 1 presents the percentage of exercises maintained in the correct or individual rhythm and not maintained in the rhythm separately for each participating woman. And so subjects 8 and 15 maintained most exercises in correct rhythm. Subject 7 exercised in her own individual rhythm for most of the time. Subjects 3, 10, 17 and 18 had the largest difficulties with maintaining any rhythm - they were characterised by the highest percentage of exercises out of rhythm.

The results of the above comparison (Fig. 1) make us believe that maintaining the rhythm or not depends

on the individual rhythmisation skills of an exercising person. This is confirmed by the statistically significant relation between the number of exercises maintained in rhythm and the age of the subjects. The older the woman, the fewer exercises she maintained in the correct rhythm ($R = -.40$, $p = .016$) and the more in individual rhythm ($R = .37$, $p = .030$). The number of exercises completely not maintained in rhythm did not correlate with age.

Studying the relations between the results of rhythmisation tests and the number of exercises maintained in rhythm during classes indicates the usefulness of the second test (focused on the lower limbs) and the third test (upper and lower limbs together) in the assessment of rhythmic abilities. The better the results of these tests, the more exercises the subject maintained in the correct rhythm.

Such a result of comparative and statistical analysis would suggest that other features of an exercise, its duration, pace, type of movement and other properties, do not have such an effect on maintaining rhythm. The following research activities were aimed towards potentially verifying this observation.

Duration of an exercise and maintaining it in the correct rhythm

On the basis of recorded films the duration of each exercise was calculated. The shortest exercise took 6 seconds and the longest one - 165 seconds. For each subject in each exercise the time for which the person maintained her movements in the correct rhythm was calculated.

The exercises were divided according to their duration into long, medium and short lengths, not mechanically, but in accordance with the women's capabilities of maintaining the rhythm. It was found that in exercises lasting for up to 25 seconds the subjects maintained the correct rhythms for at least 40% of the duration of the exercises. These exercises were classified as being short, due to their duration and coping with the rhythm by the subjects (Fig. 2).

Exercises lasting from 26 to 48 seconds were classified as medium-length exercises, as here the subjects went below the threshold of 40% (they maintained the rhythm for less than 40% of the duration of an exercise). A group rhythm appeared. In some exercises of this group all subjects, for 100% of the duration of an exercise, maintained the rhythm, so that there was a group rhythm (Fig. 3). The notion of a group rhythm is another term introduced by the authors, in addition to the correct rhythm and the individual rhythm

Exercises lasting 49 seconds and more were classified as long. In this group there were exercises in which the mean percentage of maintaining the correct rhythm

was equal or close to zero. There was however group rhythm in these exercises (Fig. 4).

The result of the analysis of the relation between the duration of exercises and maintaining the rhythm, separately for each time category confirms the correctness of the above criteria of division of exercises into short, medium and long ones. This relation analysis using Spearman's rank correlation test is statistically insignificant which means a similarity of properties within the group.

The same relation for all exercises in total, shows a statistically characteristic significance ($R = -.26$ with $p = .027$), although not a strong one. This means that the longer the duration of an exercise, the more difficult it is to maintain the rhythm.

A small typicality of this relation indicates that other properties, apart from exercise duration, affect the maintainance of rhythm. A further study aims to find these properties.

The pace of exercising and maintaining the rhythm

Another task was dividing exercises by their pace. Pace determines the specific duration of individual rhythmic units, and thus it specifies the speed of performance of the piece. The pace can be slow, moderate or fast. In music for aerobics the term BPM (beat per minute) is used. In exercises with a moderate pace there is one move per each beat. In slow exercises there is a move every second beat and in fast exercises one beat means two moves.

It was calculated that in the whole of the analysed material there were 30 exercises at a slow pace, 184 exercises at a moderate pace and 46 exercises at a fast pace. In TABLE 2 the number of these exercises was multiplied by the number of exercising women.

The highest percentage of exercises maintained in the correct rhythm was for exercises at a fast pace – 52.9 percent, followed by exercises at a normal pace. However, fast exercises were most frequently short exercises, hence the smaller possibility of “losing” the rhythm. A statistical comparison of groups in terms of the rhythm (correct, individual, none) using the U-Mann-Whitney's test, by pace, showed what follows:

- slow and normal exercises – a statistically significant difference $Z = 2.8$, $p = .001$,
- slow and fast exercises – a statistically significant difference $Z = 2.9$, $p = .0016$,
- normal and fast exercises – a statistically insignificant difference.

The result shows that the subjects maintain the rhythm mainly for fast and normal exercises.

Motor properties of exercises and maintaining the rhythm

Exercises were classified by their qualitative properties related to the type of movement. The following groups of exercises were distinguished:

- exercises where the movement is in the frontal or median planes,
- jumping or running exercises,
- exercises with or without equipment,
- exercises with alternating sides or symmetrical movement,
- exercises on the spot or with moving about.

In this analysis exercises which did not qualify without reservations for any of the groups were rejected.

The analysis using the U-Mann-Whitney test indicates that the rate of performance with the correct, individual and/or no rhythm, with exercises divided into the frontal plane and the median plane, are more favourable for exercises in the frontal plane ($Z = -2.03$ with $p = .042$). More exercises in the frontal plane (in a statistically significant way) are performed in the correct rhythm.

With the division of exercises into jumping and running, the difference is distinct in a statistically significant way. Many more running exercises were maintained in the correct rhythm ($Z = 6.61$ with $p = .000$).

In exercises without equipment the rhythm was statistically significantly better maintained than in exercises with equipment ($Z = 8.18$, $p = .000$).

The participants better maintained rhythm in exercises with alternating sides movement than in exercises with symmetrical movement ($Z = 5.76$ with $p = .000$).

No statistically significant difference was found between maintaining the rhythm in exercises performed on the spot and exercises with moving about.

Duration of classes and group rhythm

An observation was carried out in order to determine whether duration of the classes, and hence fatigue, is related to errors in group rhythm. It turned out that it is not related as the number of errors did not correlate with the passing of time of the class.

An abrupt changeability in the frequency of errors during the classes was noted. In the separate analysis of each minute of the class it was noted that most errors occur in the 4th, 14th, 21st, and 26-27th minutes of the classes. When the class was divided into 2 minute units most errors were found in minutes 3-4, 13-14, 21-22, 27-28. The picture of the number of errors with the division of the class into one and two minute units is similar and shows the lack of randomness of the number of er-

rors in time fragments of the classes. Therefore, there is no need to look for further regularities in the relation of the duration of classes and number of errors.

Time intervals between these crisis periods of the class are similar – approximately 10 minutes (Fig. 5). The 7th, 20th, 23–24th minutes and the period towards the end of the class – the four minutes after the 30th minute of the class, are the periods of significant lowering of the number of errors.

A small number of errors occurred in the first three minutes of the class. This is understandable because of the nature of the first exercises. They are warm-up exercises, easy to perform, adapting to water, without the equipment. These exercises occurred at previous classes and are known to the participants. Observation of the exercises in the minutes when the number of errors was the largest and the smallest does not indicate any qualitative properties of exercises at these times.

The phenomenon requires a further analysis, however it indicates the existence of a peculiarity popularly known as “coming into rhythm” or “losing the rhythm”.

DISCUSSION

The rhythm of movement which is a component of co-ordination motor abilities, present basically in every movement, is a little researched property. Exercise classes with rhythmic character are getting more and more popular. Most often they are recreational or health classes. In the vast majority of cases they are attended by women. The age of the participants ranges from very young to elderly. Thus researching of the phenomena related to the rhythm of movement is very interesting and becomes more and more needed.

The results of the study presented above turned out to be very interesting. Previous studies on the rhythm of movement in people focused mainly on the abilities connected with motor performance of rhythm in a subject. They did not explain the mechanism of this performance. The reason for a better or worse rhythmic performance was seen only in terms of the motor or psychomotor abilities of a person. The results of the current study show the complexity of the phenomenon of the rhythm of movement. So far no one has indicated types of movement, in terms of motorics and time, which are easier or more difficult to perform rhythm wise. The results of the study such as for example the relation between the rhythm of movement and the duration of a class, indicate the direction for further research.

The results of the study have a great applicable significance not only because of the popularisation of rhythmic exercise classes, but also due to the usefulness of rhythmic abilities in sports, professional and everyday motoricity.

CONCLUSION

The results of the study are a help for instructors in the preparation of class synopses. They partly explain the phenomena which accompany the performance of rhythmic exercises by women. An instructor, when preparing the classes, that is making up the class on the basis of a selection of exercises, may use the results presented in the work as a guide. He or she knows what is the percentage of chance of a correct performance of an exercise depending on its motor and time properties. He or she may predict the difficulties experienced by the participants. By knowing the properties of an exercise which affect the chances of its correct performance an instructor is able to make up exercises appropriate for a given group of exercisers. He or she may use the principle of grading the difficulty – prepare easier exercises for the first class and more difficult later on, as the results of the study show the degree of difficulty of an exercise.

REFERENCES

- Bailey, C., Finch, S., Hallan, S., & Stiff, P. (1997). *A study to investigate the effects of a 10 week: Aquarobics programme on cardiorespiratory fitness, flexibility and general well being*. AKWA.
- Bednarzowa, B., & Młodzikowska, M. (1982). Ruchowe poczucie rytmu u młodzieży. *Sport wyczynowy*, 20(6), 17–22.
- Czabański, B., & Świadek, R. (1995). Pomiar uzdolnień ruchowych w zakresie odtwarzania rytmu. *Antropomotoryka*, 12(13), 3–12.
- Eider, J. (2004). Motor fitness of young women participating in aquarobics. *Journal of Human Kinetics*, 11, 47–52.
- Gorgól, A. (1995). Z badań nad poczuciem rytmu dziewcząt – metoda pomiarowa. In *Gimnastyka w wychowaniu fizycznym dziewcząt* (pp. 79–83). Wrocław: AWF.
- Hoeger, W., Gibson, T., Moore, J., & Hopkins, D. (1993). A comparison of selected training responses to water aerobics and low impact aerobic dance. *National Aquatic Journal*, 13–16.
- Iskra, J. (1999). Zdolność odtwarzania rytmu a wyniki wybranych testów sprawności motorycznej w grupie najlepszych polskich płotkarzy. *Trening*, 11, 59–64.
- Maciantowicz, C. (2002). Kinematyczne parametry ruchu określają cykliczne zadania ruchowe podejmowane przez człowieka. *Medycyna sportowa*, 18, 466–472.
- Meinel, K. (1967). *Motoryczność ludzka: Zarys teorii czynności sportowych i działań ruchowych z punktu widzenia pedagogicznego*. Warszawa: Sport i Turystyka.

- Młodzikowska, M., & Tukiendorf, C. (1991). Ruchowe poczucie rytmu na różnych etapach rozwoju sportowego w wybranych dyscyplinach sportu. *Wychowanie Fizyczne i Sport*, 35(1), 73–89.
- Phillips-Silver, J. (2005). Feeling the beat: Movement influences infant rhythm perception. *Science*, 6(3), 1430–1430.
- Piotrkowska-Całka, E. (2003). *Motywacje i korzyści wynikające z uczestnictwa w zajęciach aqua aerobica: Uczestnictwo Polaków w rekreacji ruchowej i jego uwarunkowania*. Warszawa.
- Raczek, J., & Mynarski, W. (1992). *Koordynacyjne zdolności motoryczne dzieci i młodzieży: Struktura wewnętrzna zmienność osobnicza*. Katowice: AWF.
- Raczek, J., Mynarski, W., & Ljach, W. (1998). *Teoretyczno-empiryczne podstawy kształtowania i diagnozowania KZM: Studia nad motorycznością ludzką*. Katowice: AWF.
- Sanders, M. E. (1993). *Selected physiological training adaptations during a water fitness program called "wave aerobics"*. Thesis, University of Nevada, Reno.
- Stronczyński, W., & Stuła, A. (2003). Znaczenie zdolności rytmizacji ruchów i poczucia rytmu muzycznego dla rozwoju techniki piłkarskiej. Dyspozycje osobowościowe do gier sportowych. *Wrocławskie towarzystwo naukowe*, 61–65.
- Weiss, C. R., & Jamieson, N. B. (1995). *Woman, subjective depression, and water exercises*. *AKWA*.
- Zachopoulou, E., Mantis, K., Serbezis, V., Teodosiou, A., & Papadimitriou, K. (2000). Differentiation of parameters for rhythmic ability among young tennis players, basketball players and swimmers. *European Journal of Physical Education*, 5(2), 220–230.

TABLE 1

Subjects' age and results of rhythmisation tests

	min-max	\bar{x}	SD
Age (years)	25-64	44.3	11.3
Rhythmisation test - lower limbs	1-2	1.4	0.5
Rhythmisation test - upper limbs	2-11	5.4	2.5
Rhythmisation test - lower and upper limbs	0-7	3.4	1.8

TABLE 2

Maintaining the rhythm in exercises by their pace

Rhythm	Pace					
	Slow number	%	Normal number	%	Fast number	%
Correct	74	40.4	679	52.9	181	52.9
Individual	65	33.5	333	25.9	89	26.0
No rhythm	55	28.4	272	21.2	72	21.1
Total	194	100	1284	100	342	100

TABLE 3

Maintaining the rhythm in exercises classified by the plane of the movement

Rhythm	Frontal plane number	%	Median plane number	%
Correct	304	53.3	614	47.9
Individual	152	26.7	382	29.8
No rhythm	114	20.0	286	22.3
Total	570	100	1282	100

TABLE 4

Maintaining the rhythm in exercises classified into jumping and running exercises

Rhythm	Jumping exercises number	%	Running exercises number	%
Correct	183	38.3	362	65.6
Individual	189	39.5	91	16.5
No rhythm	106	22.2	99	17.9
Total	478	100	552	100

TABLE 5

Maintaining the rhythm in exercises with or without equipment

Rhythm	Exercises with the equipment number	%	Exercises without the equipment number	%
Correct	587	45.6	347	66.9
Individual	347	27.0	117	22.6
No rhythm	353	24.4	55	10.5
Total	1287	100	519	100

TABLE 6

Maintaining the rhythm in exercises with alternating sides and symmetrical movement

Rhythm	Alternating sides exercises number	%	Symmetrical exercises number	%
Correct	768	57.1	178	41.4
Individual	310	23.0	108	25.1
No rhythm	267	19.9	144	33.5
Total	1345	100	430	100

TABLE 7

Maintaining the rhythm in exercises performed on the spot or with moving about

Rhythm	Exercises on the spot number	%	Exercises with moving about number	%
Correct	864	52.5	74	43.0
Individual	395	24.0	80	46.5
No rhythm	388	23.5	18	10.5
Total	1647	100	172	100

Fig. 1

Percentage of exercises maintained in the correct rhythm, individual rhythm or not maintained in rhythm

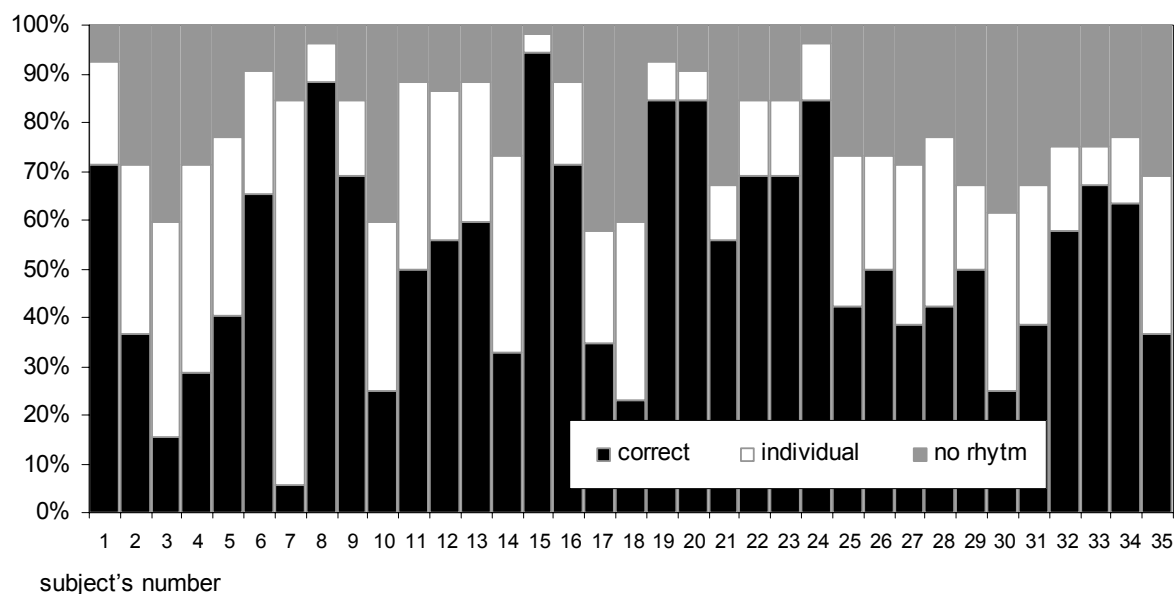


Fig. 2

The group of short exercises – duration and exercises and the mean percentage time of maintaining the correct rhythm

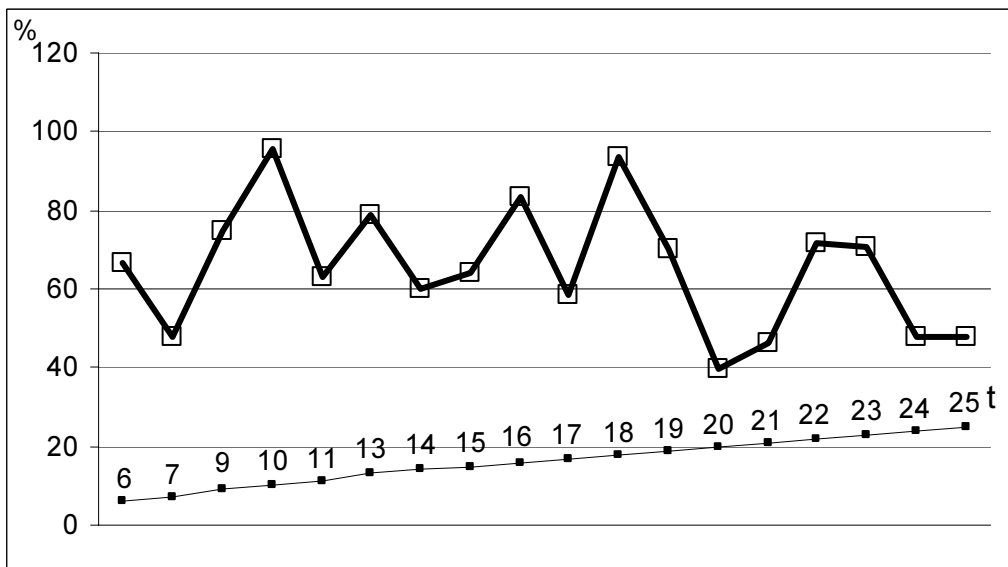


Fig. 3

The group of medium exercises – duration of exercises and the mean percentage time of maintaining the correct rhythm

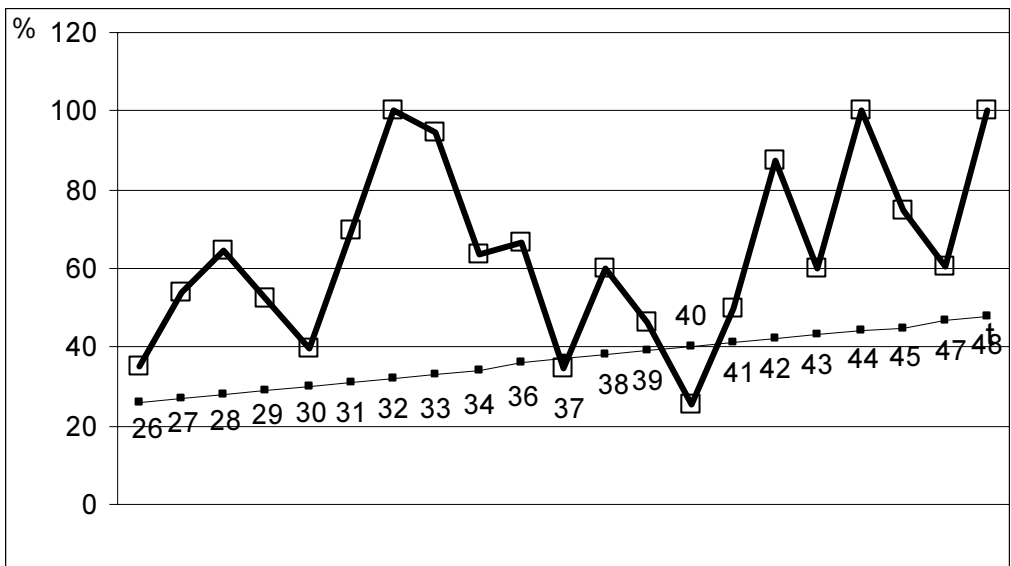


Fig. 4

The group of long exercises – duration of exercises and the mean percentage time of maintaining the correct rhythm

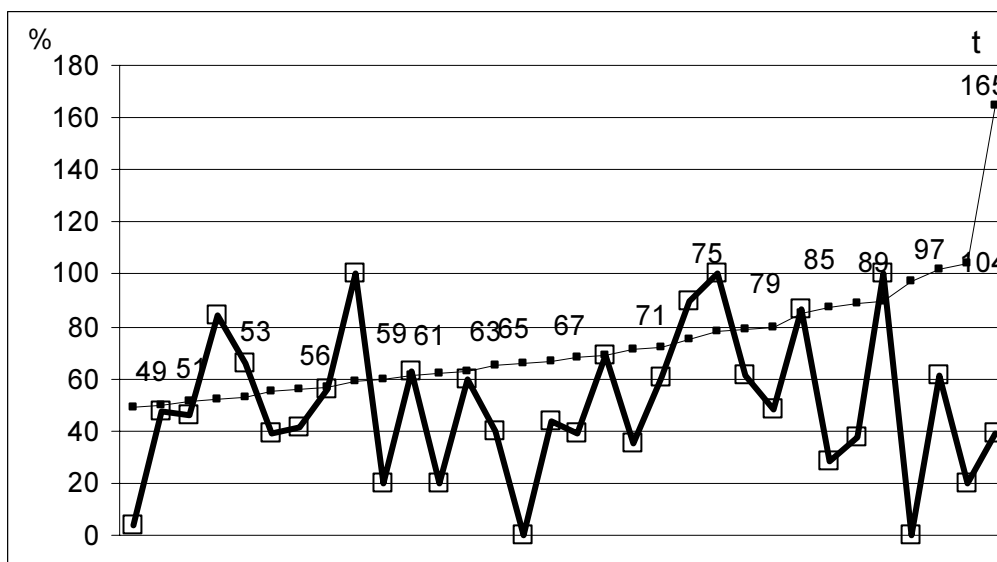
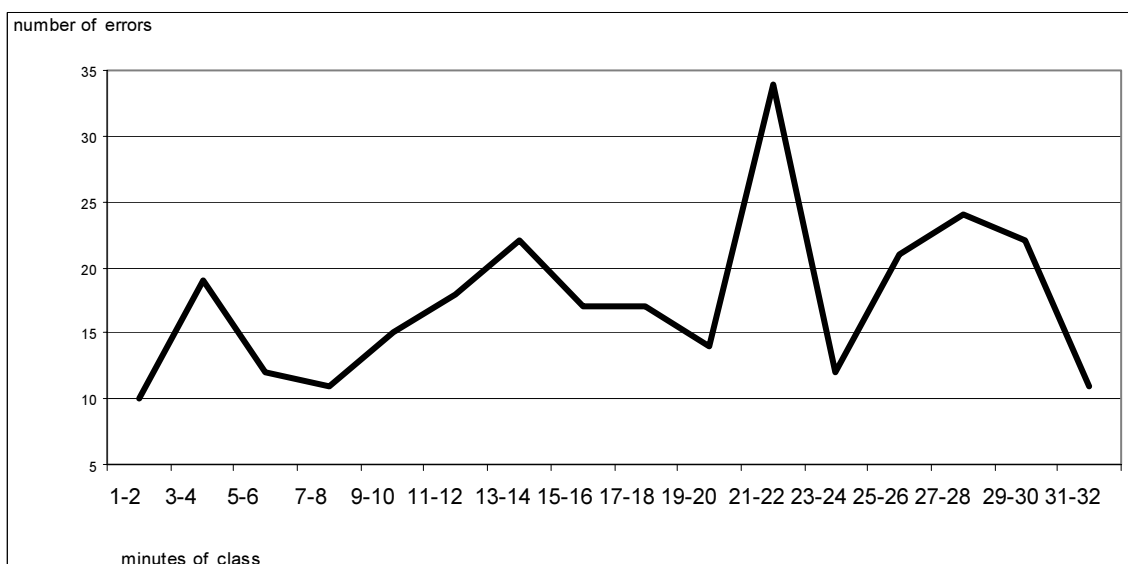


Fig. 5

Number of errors and the duration of the class



POHYBOVÝ RYTMUS PŘI LEKCÍCH AQUAEROBIKU

(Souhrn anglického textu)

Pohybový rytmus, který je složkou koordinace motorických schopností a který se vyskytuje prakticky u každého pohybu, je málo zkoumanou vlastností. Předchozí studie o pohybovém rytmu u člověka se vždy soustřeďovaly na schopnosti motorického provádění rytmu u subjektů. Nevysvětlovaly však mechanismus jeho provádění.

Cílem této studie je představit rozsáhlý parametrický popis chování souvisejícího s pohybovým rytmem a změny, kterým toto chování během lekcí rytmického cvičení podléhá. Byl zkoumán pohybový rytmus 35 žen při lekcích aquaerobiku. Lekce sestávaly z 52 cvičení, jejichž provádění jsme studovali s ohledem na rytmus. Subjekty prováděly rovněž tři testy rytmických dovedností.

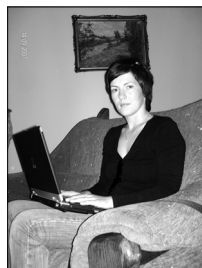
Zaznamenali jsme, že vlastnosti cvičící osoby, jako jsou rytmické dovednosti a věk, pouze částečně určují schopnost udržet rytmus během cvičení. Na pohybový rytmus měla velký vliv doba trvání cvičení. Rychlejší tempo cvičení podporuje udržení rytmu. Rytmus se udržuje snáze během cvičení, při kterém dochází k pohybu ve frontální rovině, než během cvičení ve středové rovině. Rytmus se udržuje snáze během cvičení se střídáním stran pohybu než během cvičení symetrických. Podobně se rytmus udržuje snáze při cvičení s během než při cvičení se skákáním. Použití vybavení při cvičení snižuje možnost udržet rytmus. V různých etapách

byly zaznamenány zajímavé jevy „vstoupení do rytmu“ a „ztrácení rytmu“.

Výsledky získané v rámci této studie naznačují složitost vlastnosti nazývané pohybový rytmus. Částečně vysvětlují jevy provázející provádění rytmických cvičení u žen. Výsledky studie mohou být užitečné pro instruktory při přípravě obsahu lekcí rytmického cvičení.

Klíčová slova: pohybový rytmus, aquaerobik, motorické cvičení ve vodě.

Alicja Nowaczyk Chalupka, MA



The Eugeniusz Piasecki
University School of PE
Ul. Królowej Jadwigi 27/39
61-871 Poznań
Poland

Education and previous work experience

2002–2006 – school teacher.

2002 – fitness and aqua fitness instructor.

2003 – University School of Physical Education, studies on doctor degree.

Scientific orientation

Motor coordination in aquarobic.

SOMATOMETRIC CHARACTERISTICS OF HIGH JUMPERS

František Langer

Faculty of Physical Culture, Palacký University, Olomouc, Czech Republic

Submitted in June, 2007

The significance of somatic prerequisites for the high jump is evident. In the course of our evaluation, a significant dependence of the physique on performance was confirmed with all the groups of female and male high jumpers having high average performances, which were measured over the period from 1983 to 2005. All these groups were characterized by relatively large homogeneity in most somatic indicators.

The measurements we use as a base in the following parts of this paper were carried out over the course of more than two decades. They include single cross-section examinations of the groups of female and male high jumpers ($n = 117$) as well as longitudinal monitoring of selected individuals.

In accordance with the physical development of female and male high jumpers, it is obvious that the groups measured were chosen intentionally and can be designated as “partially selected groups” with respect to both performance and physique. In the course of our examination, changes in the physique, caused by selection and consequently by a specific training load as well as the demanding athletic event itself, can be observed with all the groups.

Keywords: Somatic prerequisites, anthropometric examination, typology, somatotype, predication, sporting performance.

INTRODUCTION

Performance demands in present day peak sports increase continuously and only individuals, with whom factors influencing performance are on a high level, can expect to succeed. Gualdi-Russo and Graziani (1993), Rienzi (2000), Kopecký, Přidalová et al. (2001) state that sports performance is determined in a differentiated way by somatic, functional, psychological and motor characteristics and capabilities. Therefore, the physique becomes a limiting factor of performance, i. e. a direct reflection of the level of movement activities. This knowledge is of great importance when suitable types for various sports branches or events are sought.

To measure somatic characters and to relate them to performance is necessary not only in ontogenic observation, but also within groups of, e. g. first rate sportspeople. The somatotype is a holistic expression of somatic character, on the basis of which, and some other somatic qualities, we can deduce morphological prerequisites for a selected sports event (Štěpnička et al., 1979).

Ulbrichová (1988) emphasized the significance of these studies: “...beside body height, weight and fat there are a number of other characteristics typical for individual kinds of sports – some parameters may be affected by specific loading even if they need not play a significant role in the structure of performance – e. g. the girth and shape of the chest, the ratio of shoulder width to pelvis width, etc.... The main goal of research work in the morphology of sportspeople is to clarify

the significance of these characteristics for performance itself, to study the possibilities of selecting suitable somatic types and the possibilities for influencing them using specific training loading.”

We note a certain similarity in the somatotypes of sporters in one branch of sport and, as a rule, an exclusion of types which are too different. Riegerová and Vodička (1992) state this as follows: “It is a well known fact that, based on the morphological state of an individual – morphophenotype we are able to predict, to some extent, his/her physical performance.” And Tanner (1964) stated quite simply earlier on: “A deficiency in the physique may nearly prevent a sporter from achieving success.”

Basic somatometric data can be found in various papers dealing with the general or special performance of sporters – often as an illustration of the complex characterization of the group concerned. It is indicative of the fact that most authors consider the physique to be one of the important characters affecting motor performance (Langer, 1989, 2004; Chytráčková, 1990; Riegerová & Vodička, 1992; Pavlík, 1999; Riegerová et al., 1995; Krawczyk, Sklad, & Jackiewicz, 1997; Susane et al., 1998; Carter & Ackland, 1998; Vařeková & Vařeka, 2005; Riegerová, Přidalová, & Ulbrichová, 2006; etc.).

Štěpnička (1972 and 1974) carried out the typological classification of an overwhelming majority of the Czechoslovak first rate sporters.

The research results are noteworthy – the research, aimed at the relationship of morphological character

and performance in the high jump with a group of persons ($n = 100$) was carried out by Stawczyk (1965) and Moravec and Slamka (1983) who, analogous to Langer (1989), described first rate female and male high jumpers. Langer (1989, 2004) kept under review age regularities of the development of biomechanical parameters in the run up and the take off technique in the context of changes of anthropometric character.

Our long term observation of first rate female and male high jumpers in the course of more than 20 years is unique in the technical literature.

OBJECTIVE OF THE WORK

The long term objective of our work is to attempt to apply systematically the results of our research to the professional practice of physical education.

The main objective is to analyze the development of somatic prerequisites in the high jump globally, to describe the morphological character of high jumpers and to demonstrate the relationship between sports performance in this event and mutual interactions.

The summary of experimentally verified results should serve as a foundation for the optimization of training methods, forms and instruments as well as for the elimination of undesirable phenomena.

CHARACTERIZATION OF THE SET

The sets will be characterized in detail in the results part. Here, we will focus on the listing of the measured sets, the results of which are included in this paper:

1983-1984 a set of male high jumpers ($n = 19$) and female high jumpers ($n = 14$),

1985-1986 a set of male high jumpers ($n = 21$) and female high jumpers ($n = 14$),

1989-1991 a set of male high jumpers ($n = 8$) and female high jumpers ($n = 8$),

1995-1996 a set of male high jumpers ($n = 11$) and female high jumpers ($n = 6$),

2002-2005 a set of male high jumpers ($n = 7$) and female high jumpers ($n = 9$).

We carried out the basic anthropometry with the best Czech, Slovak and Danish female and male high jumpers in training camps in Nymburk, Prague, Otrokovice, Brno and Olomouc at the time of major races in Czechoslovakia and later in the Czech Republic. In the course of the athletic season of 1995-1996 we surveyed somatotypes within a group of French first rate male and female high jumpers in Rheims and in training camps at Dijon, Tours and Le Touquet.

METHODS

The effort to establish objective criteria for typological classification needs led to some attempts at creating adequate measuring methods. Determination of the somatotype according to the Heath and Carter method (Heath & Carter, 1967; Carter & Heath, 1990) fits the anthropometric research in sport best. It was advantageous to use the method for the possibility of comparison as well as for the evaluation of the somatotypes of high jumpers.

According to Štěpnička (1983) and Chytráčková (1990), somatotypes can be matched to various categories based on the methodology we have followed. We divided the somatotypes based on the dominance of individual components and based on their mutual relationships.

The somatic parameters were measured by classic anthropometric instruments under standard conditions and the particular points were defined precisely (Martin & Saller, 1961; Fetter, Prokopec, Suchý, & Titelbachová, 1967). The selected anthropometric techniques were unified so that the findings are comparable with other published results.

All the measurements were carried out before the athletic racing season (April-May), mostly in the morning hours in warm, well-lit rooms or in sports halls.

The high jumpers were dressed in athletic trunks and T-shirts and were barefoot. They expressed assent to the measurements. In the course of the measurements we respected ethical rules.

The method for the assessment of individual component levels in reports is published by, e.g. Carter (1980), in the Czech Republic by Štěpnička (1972), etc. The somatometric data - the body height and weight, the girth of each contracted arm and the girth of the calf - were required. Further, we measured two bone measurements and four skin folds. Based on the measured parameters, the somatotype was defined according to Heath and Carter (Riegerová & Ulbrichová, 1993).

The admissible margin of error of measurements for the determination of body height was ± 1 cm and for the assessment of width circumferential measurements it was ± 1 cm. When defining the body weight we worked with an accuracy of 0.1 kg. We recorded the thickness of skin folds with an accuracy of 0.1 mm.

We recorded the measurements for defining the somatotype (body height, body weight, width of skin fold, bone measures, and the girths of arm and calf) in pre-prepared forms. The reports were completed with a preprinting to record the age, nationality and three components of the somatotype. After calculating the individual coordinates we assessed the somatotype using our own computer programs and recorded it in the somatograph. We have put all the values found into summary sheets and graphs.

RESULTS

We must first say that all the anthropometric measurements were performed by us with the sets of notable Czech as well as foreign male high jumpers ($n = 66$) and female high jumpers ($n = 51$) and were of an informative character. In the text part we aim mostly at the assessment and interpretation of results from an objective viewpoint.

The data on age and the measurements of the body height and body weight in the observed groups are presented in TABLE 1. The number of the measured athletes (n), the arithmetic mean (AM), the standard deviation (SD), the measured minimum and maximum values, i. e. the range of the age, body height and body weight (x_{min} ; x_{max}), were recorded with every set.

For comparison the data on the age, body height and weight of the best male and female high jumpers in the world tables in the athletic seasons of 1989–1990 and 2002–2003 are presented in TABLE 2.

TABLE 1

Basic data on the age, body height and body weight with the measured sets of notable Czech as well as foreign male and female high jumpers in the period from 1983 to 2005

1983-1984	n	Age [years]				Body height [m]				Body weight [kg]			
		AM	SD	MIN	MAX	AM	SD	MIN	MAX	AM	SD	MIN	MAX
Males	19	23.1	3220	19.0	29.0	1.924	4.460	1.85	2.02	80.5	4.770	70.0	86.5
Females	14	22.0	2.710	16.0	27.0	1.758	4.320	1.67	1.84	62.1	6.410	52.0	74.0

1985-1986	n	Age [years]				Body height [m]				Body weight [kg]			
		AM	SD	MIN	MAX	AM	SD	MIN	MAX	AM	SD	MIN	MAX
Males	21	23.8	3.504	18.0	32.0	1.914	5.266	1.83	2.02	80.7	5.126	72.5	92.5
Females	14	21.7	2.491	19.0	27.0	1.784	2.887	1.74	1.84	66.1	4.194	61.0	75.0

1989-1991	n	Age [years]				Body height [m]				Body weight [kg]			
		AM	SD	MIN	MAX	AM	SD	MIN	MAX	AM	SD	MIN	MAX
Males	8	22.5	2.646	18.0	26.0	1.939	4.729	1.86	2.02	80.4	4.601	72.5	86.5
Females	8	22.3	2.332	19.0	27.0	1.789	2.976	1.84	1.75	67.1	4.106	75.0	62.0

1995-1996	n	Age [years]				Body height [m]				Body weight [kg]			
		AM	SD	MIN	MAX	AM	SD	MIN	MAX	AM	SD	MIN	MAX
Males	11	21.1	3.486	17.0	28.0	1.907	4.956	1.81	1.98	78.8	6.726	62.0	85.0
Females	6	20.7	2.545	17.0	25.0	1.775	2.435	1.72	1.80	64.7	8.065	50.0	74.0

2002-2005	n	Age [years]				Body height [m]				Body weight [kg]			
		AM	SD	MIN	MAX	AM	SD	MIN	MAX	AM	SD	MIN	MAX
Males	7	23.6	1.990	21.0	27.0	1.910	7.764	1.83	2.05	80.1	3.932	73.0	86.0
Females	9	23.1	4.120	19.0	31.0	1.766	4.470	1.70	1.86	57.9	3.110	63.0	53.0

TABLE 2

Basic data on the age, body height and body weight with the sets of notable world male and female high jumpers in the athletic seasons of 1989 and 2002

WORLD	n	Age [years]				Body height [m]				Body weight [kg]			
		AM	SD	x_{min}	x_{max}	AM	SD	x_{min}	x_{max}	AM	SD	x_{min}	x_{max}
1989 (males)	9	24.0	3.032	19.0	30.0	1.92	0.208	1.82	2.02	81.0	4.812	71.0	86.5
1989 (females)	9	23.5	0.901	19.0	27.0	1.78	0.187	1.69	1.86	63.2	4.756	56.0	74.0
2002 (males)	10	24.1	2.807	20.0	28.0	1.93	0.049	1.83	2.02	79.7	5.715	67.0	85.0
2002 (females)	10	22.4	0.831	21.0	24.0	1.81	0.054	1.73	1.92	61.6	4.991	55.0	73.0

Our entire set was younger than the best world high jumpers (on average by 1.3 years with men and 1.5 years with women). The highest recorded age data with our groups of men were in 1986 (J. V., age 32, born in 1954; personal record 2.12 m), the lowest age data in 1996 (S. C., age 17, born in 1979; personal record 2.04 m and L. S., age 17, born in 1979; personal record 2.01 m). As for women there are extreme age values from 2002 (L. D., age 31, born in 1971; personal record 1.92 m) or from 1984 (I. V., age 16, born in 1968; personal record 1.84 m).

As for the data on average body height the high jumpers tested ($h = 1.92$ m) do not differ from world standards too much and are shorter only by 0.02 m. The body height range of the variation of our best high jumpers is, however, sizable ($R_{min-max} = 0.17$ m). When we compare our set with the set of high jumpers measured in 1967 by Štěpnička (1972), then the difference in the average body height is, for our groups, +0.08 m.

Note: In general, the trend of increasing body height is well known with the normal population as well as with sporters (Matiegka, 1927; Novotný, 1964; Fetter & Suchý, 1966; Linz & Fleischman, 1965; Linz, 1971; Žára, 1968; Štěpnička, 1979; Bláha, 1986; Langer, 1989, etc.).

With women the body height range of variation is almost the same as with men ($R_{min-max} = 0.16$ m). The female high jumpers we have measured are shorter than the set of the ten best female high jumpers in the world, on average by less than 0.03 m.

Note: According to Ballreich and Kuhlow (1986) a body height increase of a high jumper by 0.1 m results in augmentation of the vertical jump height +0.07 m.

We measured the highest body height 2.05 m with men (D. H., year of measurement 2002, age 27, body weight 79.0 kg; personal record 2.21 m) and 1.86 m with women - female high jumpers (I. S., year of measurement 2002, age 25, body weight 63 kg; personal record 1.96 m). We found the lowest value of the body height 1.81 m with the French junior (S. C., year of measurement 1996, age 17, body weight 62 kg; personal record 2.09 m) and 1.70 m among women (K. K., year of measurement 2002, age 29, body weight 58 kg; personal record 1.87 cm).

The dependence of absolute sports performance on body height was not substantiated with the tested female and male high jumpers having high average performances ($x_{males} = 2.20$ m; $x_{females} = 1.82$ m). The correlation coefficient is very low ($r_M = 0.101$) with men, with women it even has a negative value ($r_F = -0.407$).

The body weight range of variation is relatively large in our groups ($RM_{min-max} = 16.5$ kg; $RF_{min-max} = 22.0$ kg). The highest and the lowest body heights always correspond to the highest and the lowest body weights with men and women. As for men - 86.5 kg and 2.02 m

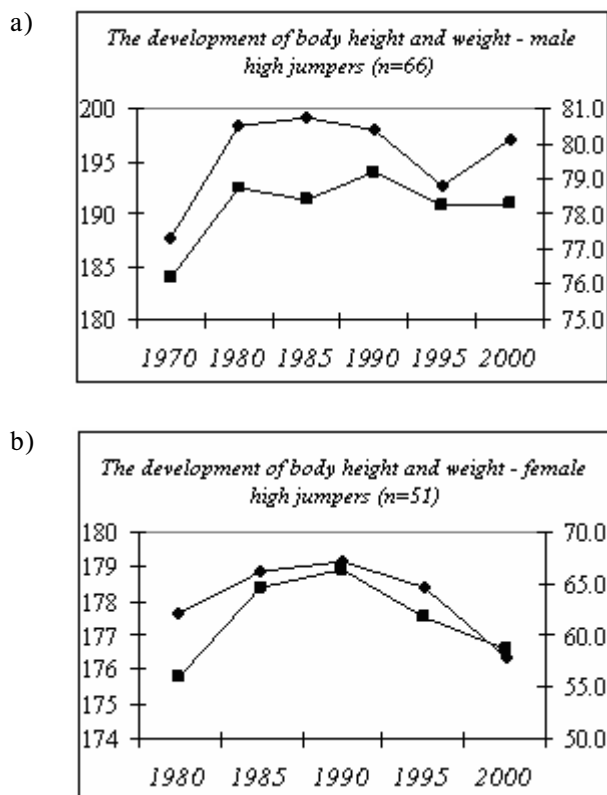
(M. M., born in 1963, year of measurement 1989; personal record 2.20 m) and 62 kg and 1.81 m (C. S., 1979, 1996; 2.19 m). As for women - 75 kg and 1.84 m (K. J., 1962; 1986; 1.82 m) and 50 kg and 1.72 m (L. E., 1976, 1996; 1.84 m). An extremely tall male high jumper having a very low body weight (D. H., body height 2.05 m, year of measurement 2002, age 27, body weight 79.0 kg; personal record 2.21 m) and a female high jumper having identical parameters (I. S., body height 1.86 m, year of measurement 2002, age 25, body weight 63 kg, personal record 1.96 m) are exceptions.

Average values of body weight with all the measured male and female high jumpers in the particular research stages are approximately the same. Our set differs from the best world male and female high jumpers on average by +2.5 kg with men and by +1 kg with women.

Note: In his research Štěpnička (1972) specifies the average weight of our best high jumpers as 77.3 kg ($n = 15$).

Fig. 1

The development of average body height (◆) and body weight (■) values in stages measured with male (a) and female (b) high jumpers in the CR



The summary findings of anthropometric measurements for determining a somatotype of male and female high jumpers have been processed using our own computer program and recorded together with the average values and standard deviations in TABLE 2.

TABLE 3

Average components of the male and female high jumpers' somatotypes in particular research stages

1983-1984	n	Components of somatotype														
		ENDOMORPH				MESOMORPH				ECTOMORPH				AM		
		AM	SD	MIN	MAX	AM	SD	MIN	MAX	AM	SD	MIN	MAX	ENDO	MESO	ECTO
Males	19	2.84	0.727	3.66	4.49	4.21	0.694	2.49	5.10	4.32	0.415	2.96	4.52	2.8	4.2	4.3
Females	14	3.43	0.829	2.61	4.88	4.96	0.458	2.38	3.22	4.04	0.603	3.91	4.48	3.5	5.0	4.0

1985-1986	n	Components of somatotype														
		ENDOMORPH				MESOMORPH				ECTOMORPH				AM		
		AM	SD	MIN	MAX	AM	SD	MIN	MAX	AM	SD	MIN	MAX	ENDO	MESO	ECTO
Males	21	3.94	0.381	3.47	4.56	3.64	1.033	1.15	5.12	4.04	0.552	2.96	5.19	3.9	3.6	4.0
Females	14	3.60	0.650	2.61	4.88	3.40	0.568	2.38	4.29	3.86	0.331	3.32	4.50	3.6	3.4	3.9

1989-1991	n	Components of somatotype														
		ENDOMORPH				MESOMORPH				ECTOMORPH				AM		
		AM	SD	MIN	MAX	AM	SD	MIN	MAX	AM	SD	MIN	MAX	ENDO	MESO	ECTO
Males	8	3.87	0.656	2.85	4.66	3.23	1.051	1.08	4.71	4.46	0.640	3.56	5.34	3.9	3.2	4.5
Females	8	3.78	0.627	2.83	4.88	3.35	0.464	2.58	4.29	3.82	0.336	3.32	4.50	3.8	3.4	3.8

1995-1996	n	Components of somatotype														
		ENDOMORPH				MESOMORPH				ECTOMORPH				AM		
		AM	SD	MIN	MAX	AM	SD	MIN	MAX	AM	SD	MIN	MAX	ENDO	MESO	ECTO
Males	11	3.07	0.430	2.11	3.65	3.69	1.031	1.72	4.99	4.17	0.411	3.54	5.02	3.1	3.7	4.2
Females	6	3.50	0.356	3.13	4.19	3.16	1.505	1.22	5.40	4.07	1.097	2.82	5.70	3.5	3.2	4.1

2002-2005	n	Components of somatotype														
		ENDOMORPH				MESOMORPH				ECTOMORPH				AM		
		AM	SD	MIN	MAX	AM	SD	MIN	MAX	AM	SD	MIN	MAX	ENDO	MESO	ECTO
Males	7	2.40	0.669	1.50	3.44	3.75	1.376	1.33	5.33	4.03	1.311	2.16	6.47	2.4	3.2	4.0
Females	9	3.56	0.850	2.11	3.65	1.98	0.844	1.72	4.99	5.08	0.627	3.54	5.02	3.6	2.0	5.1

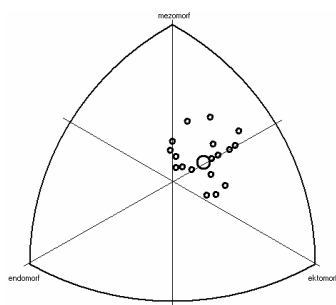
For clear and rapid orientation in the distribution of phenotypes in the sets of male (n = 66) and female (n = 51) high jumpers we have calculated components of

somatotypes in five stages of measurements and entered them in the somatographs after computer processing. (Fig. 2-6).

Fig. 2

Somatographs of the best male (a; n = 19) and female (b; n = 14) high jumpers measured during the period 1983 to 1984

a)



b)

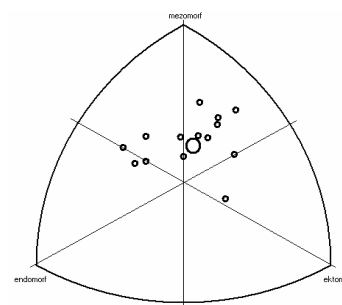
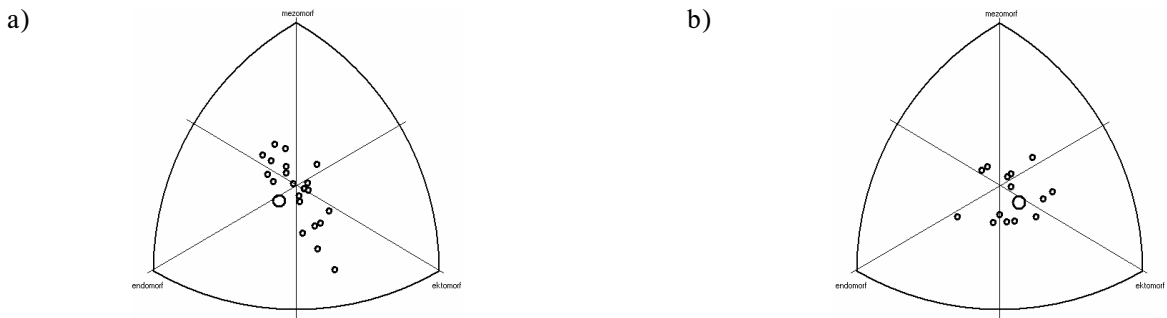
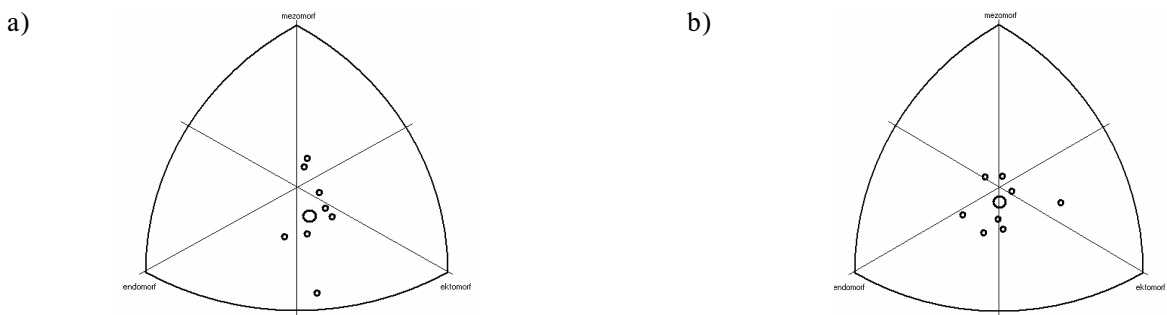


Fig. 3

Somatographs of the best male (a; n = 21) and female (b; n = 14) high jumpers measured during the period 1985 to 1986

**Fig. 4**

Somatographs of the best male (a; n = 8) and female (b; n = 8) high jumpers measured during the period 1989 to 1991

**Fig. 5**

Somatographs of the best male (a; n = 11) and females (b; n = 6) high jumpers measured during the period 1995 to 1996

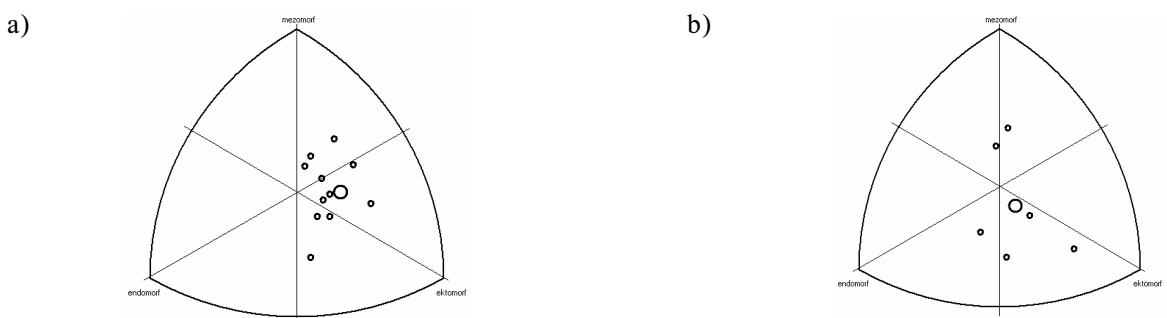
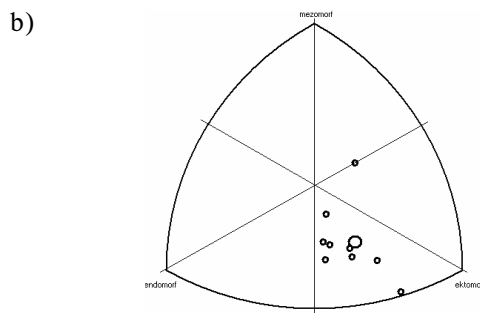
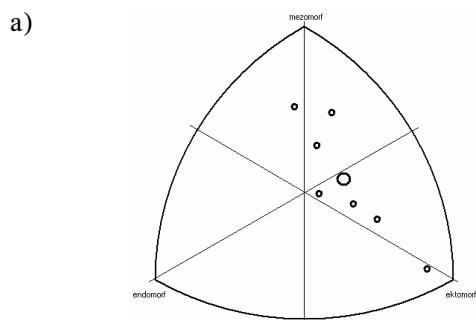


Fig. 6

Somatographs of the best male (a; n = 7) and female (b; n = 9) high jumpers measured during the period 2002 to 2005



It is interesting to compare the somatotypes of the male and female high jumpers from the viewpoint of the two techniques of getting over the bar – the straddle

technique and the fosbury flop technique (Fig. 7 and 8).

Fig. 7

Somatographs comparing male high jumpers–flopers (a; n = 14) and male high jumpers–straddlers (b; n = 7) measured during the period 1986 to 1991

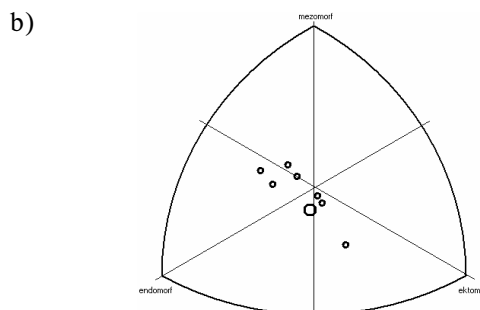
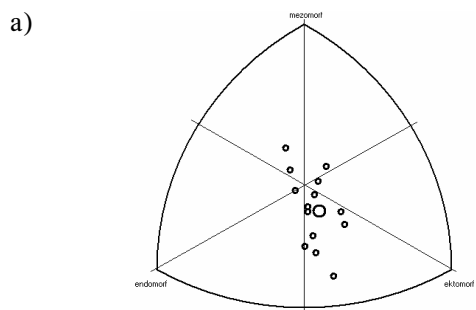


Fig. 8

Somatographs comparing female high jumpers–flopers (a; n = 10) and female high jumpers–straddlers (b; n = 4) measured during the period 1986 to 1991

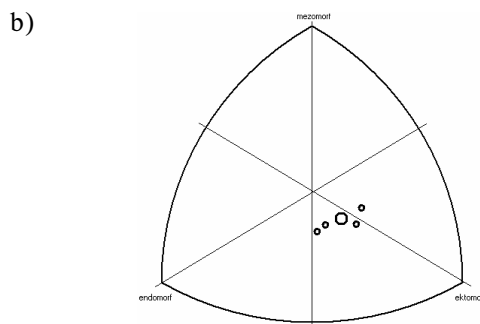
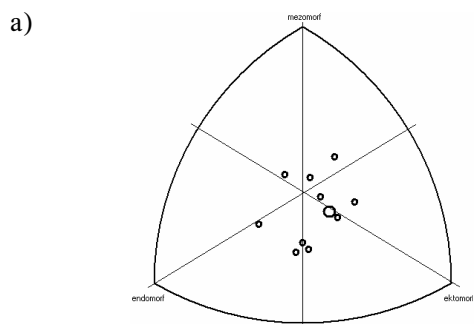
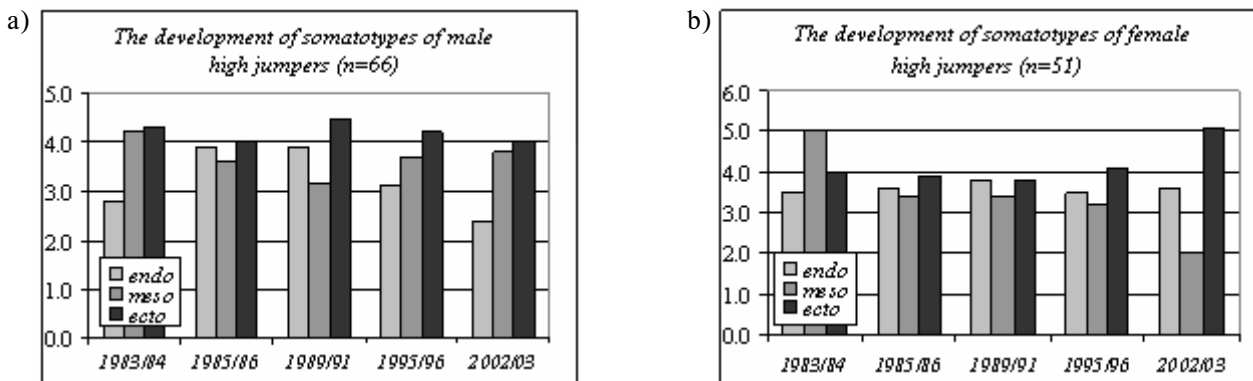


Fig. 9

The development of average somatotypes of male (a) and female (b) high jumpers during the period 1983 to 2003



In the overwhelming majority of measurements the particular components of somatotypes show a tendency to increase and the average somatotype of high jumpers is 3.4–3.7–4.2. On the basis of matching the somatotypes to categories according to Carter (Štěpnička, 1979), our set of male athletes can be described as falling into categories of mesomorphs and ectomorphs. Endomorphic ectomorphs (36.4%) occur in most cases. Endomorphic mesomorphs (16.7%), mesomorphic ectomorphs (15.2%) and ectomorphic mesomorphs (13.5%) are other frequent somatotypes. With the high jumpers we have kept under review there is an apparent dominance of the ectomorphic component (51%), especially in the last two measurement stages.

Note: Štěpnička (1967, 1974) specifies the somatotypes of the Czechoslovak high jumpers ($n = 15$) using the following values 1.5–5.5–3.0 (1967) or 1.6–5.5–2.8 (1974) and defines the groups having the ectomorphic mesomorphs designation. With the men the mesomorphic component (55%) dominates considerably, while the ectomorphic component is represented by only 33%.

With female high jumpers ($n = 51$) we have calculated the average somatotype 3.4–3.8–4.2. The third component is dominant and the second is higher than the first. Thus, according to Carter (Štěpnička, 1979) it is the same category as with the male high jumpers – ectomorphic mesomorphs. Endomorphic ectomorphs (43.8%), mesomorphic ectomorphs, ectomorphic endomorphs (identically 16.3%) and ectomorphic mesomorphs (15.2%) were the most frequent somatotypes of the female high jumpers measured.

Based on the characteristics resulting from the values of various indexes it is possible to claim that male and female high jumpers have, on an average, above average body height and length of the lower limbs as regards length dimensions.

DISCUSSION AND CONCLUSION

The anthropometric research that we carried out with Czech and foreign male and female high jumpers on a long term basis was especially informative.

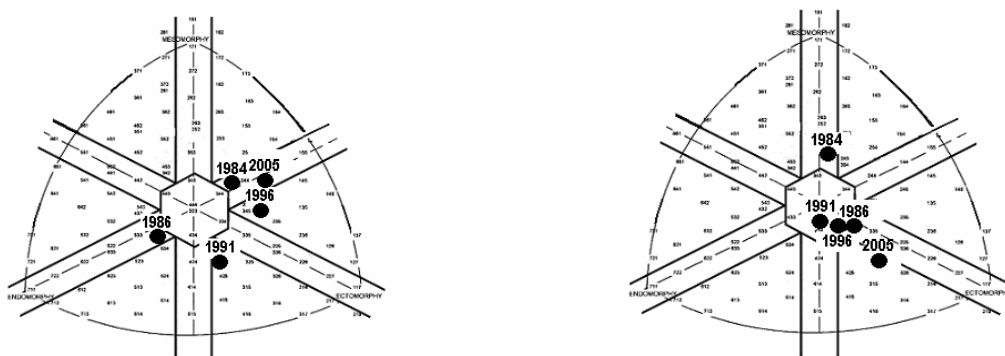
As for the data about average body height, the tested male high jumpers ($\bar{h} = 1.92$ m) do not differ much from the first ten world male jumpers and are shorter only by 0.02 m. The female high jumpers of our set are as tall as the best female high jumpers in the world tables ($\bar{h} = 1.78$ m). The trend of body height that becomes evident with all the five sets of the best men and women in a period lasting more than 20 years is the most interesting in the above mentioned comparison. The increases in body height average values are slowing down gradually, nonetheless the differences are clearly evident with our choices over a 22 year period.

The body weight average values with the measured male and female high jumpers are approximately the same in some stages of the research. The last measurement of women (2002–2005) when the average body weight decreased considerably in comparison with the previous periods is an exception.

In the overwhelming majority of measurements, the particular somatotype components show a tendency to increase (3.4–3.7–4.2), which corresponds to the category of mesomorphs ectomorphs with groups of high jumpers. Particularly, in the last two stages of measurements the dominance of the ectomorphic component (51%) is evident. We have calculated the combination of components 3.4–3.8–4.2 for the female high jumpers. Thus, it is the same category as with men – mesomorphs ectomorphs. Most of the athletes do not show the extreme mesomorphy and are placed in the graph from mesomorphic ectomorphs through balanced mesomorphs up to endomorphic mesomorphs.

Fig. 10

The average values of male (a) and female (b) high jumpers somatotypes obtained in particular periods and their inclusion in categories of somatotypes



Based on the development of measured data relating to the physique of female and male high jumpers it is evident that the measured groups were selected intentionally and can be designated as partially selected groups, namely with respect to both performance and physique. In the course of the research, adaptation changes in the physique become evident with all the sets. These changes were caused by the selection and subsequently by the specific training load as well as by the execution of the demanding athletic event itself.

REFERENCES

- Ballreich, R., & Kuhlow, A. (1986). *Biomechanik der Sportarten. Band 1, Biomechanik der Leichtathletik*. Stuttgart: Ferdinand Enke Verlag.
- Bláha, P. et al. (1986). Antropometrie československé populace od 6 do 55 let. In *Československá spartakiáda 1985: I. a II. díl* (pp. 228–333). Praha: VO ÚV ČSTV.
- Carter, J. E. L. (1980). *The Heath-Carter somatotype method*. San Diego: San Diego State University Service.
- Carter, J. E. L., & Ackland, T. R. (1998). Sexual dimorphism in the physique of world championship divers. *J. Sports Sci.*, 16(4), 317–329.
- Carter, J. E. L., & Heath, B. H. (1990). *Somatotyping: Development and applications*. Cambridge: Cambridge University Press.
- Fetter, V., Prokopec, J., Suchý, J., & Titelbachová, S. (1967). *Antropologie*. Praha: Academia.
- Fetter, V., & Suchý, J. (1966). Základní tělesné rozměry cvičenců III. CS ve srovnání s rozměry cvičenců I. a II. CS. *Teor. Praxe těl. Vých.*, 14(6), 1–13.
- Gualdi-Russo, E., & Graziani, I. (1993). Anthropometric somatotype of Italian sport participants. *J. Sports Med. Phys. Fitness*, 33(3), 282–291.
- Chytráčková, J. (1990). Možnosti individuálního hodnocení motorické výkonnosti dětí podle somatických předpokladů. In *3rd Anthropol. congress of Aleš Hrdlička*, 105. Praha.
- Kopecký, M., & Přidalová, M. (2001). Srovnání vybraných somatických charakteristik 9 až 11-letých hokejistů a tenistů. *Bull. Slov. Antrop. Spol.*, 3, 80–82.
- Kopřiva, J. (1990). Program pro výpočet tělesné výšky v dospělosti. *Teor. Praxe těl. Vých.*, 38(6), 376–377.
- Krawczyk, B., Sklad, M., & Jackiewicz, A. (1997). Heath-Carter somatotypes of athletes representing various sports. *Biol. Sports*, 14, 305–310.
- Langer, F. (1989). *Dynamografická analýza vertikálního výskoku – význam a využití motorických testů ve sportovní praxi*. Brno: PdF UJEP.
- Langer, F. (2004). Poranění při skoku do výšky – příčina, prevence a rehabilitace. In E. Sigmund & F. Neuls (Eds.), *Seminář v oboru kinantropologie – sborník příspěvků* (pp. 36–44). Olomouc: FTK UP.
- Langer, F., & Langerová, I. (2002). Antropometrická charakteristika uchazečů o studium předmětu tělesná výchova na Univerzitě Champagne-Ardenne de Reims (I.). In E. Sigmund & F. Neuls (Eds.), *Seminář v oboru kinantropologie – sborník příspěvků* (pp. 54–61). Olomouc: FTK UP.
- Linz, R. (1971). *K problematice růstu mládeže na základě opakovaného longitudinálního sledování antropometrických ukazatelů u studujících tělesné výchovy*. Praha: FTVS UK.
- Linz, R., & Fleischman, J. (1965). Antropometrická charakteristika posluchačů FTVS UK I. část. In *Sborník FTVS UK* (pp. 69–82). Praha: FTVS UK.
- Martin, R., & Saller, K. (1961). *Lehrbuch der Anthropologie*. Stuttgart: G. Fischer-Verlag.
- Matiegka, S. P. (1927). *Somatologie školní mládeže*. Praha.
- Michálek, J. (2001). *Vztah tělesné výšky a hmotnosti k atletickým výkonům*. Brno: Masarykova univerzita.

- Moravec, R., & Slamka, M. (1983). Analýza vztahov medzi niektorými motorickými, somatickými ukazovateľmi a športovou výkonnosťou u vrcholových skokanov do výšky. *Teor. Praxe těl. Vých.*, 31(6), 341–347.
- Novotný, V. (1964). *Pohled na tělesný rozvoj a zdatnost současné nespportující vysokoškolské mládeže*. Habilitační práce, Univerzita Karlova, Fakulta tělesné výchovy a sportu, Praha.
- Pavlík, J. (1999). *Tělesná stavba jako faktor výkonnosti sportovce*. Brno: Masarykova univerzita.
- Přidalová, M., Dostálová, I., Kvaka, Z., & Pechtor, P. (2004). Je populace studentů FTK UP v Olomouci a VVŠ PV ve Vyškově modelová a selektovaná? *Česká antropologie*, 54, 163–166.
- Riegerová, J., Přidalová, M., & Ulbrichová, M. (2006). *Aplikace fyzické antropologie v tělesné výchově a sportu (příručka funkční antropologie)*. Olomouc: Hanex.
- Riegerová, J., Přidalová, M., Vařeková, R., & Vodička, P. (1995). Hodnocení tělesné stavby studentů 1. ročníku FTK UP. In *Sborník II. celostátní konference v oboru zdravotní TV a funkční antropologie* (pp. 41–48). Olomouc: Univerzita Palackého.
- Riegerová, J., & Ulbrichová, M. (1993). *Aplikace fyzické antropologie v tělesné výchově a sportu (příručka funkční antropologie)*. Olomouc: Univerzita Palackého.
- Riegerová, J., & Vodička, P. (1992). Vztah somatotypu a motorické výkonnosti u dětí a dospělých. *Těl. Výchov. Šport.*, 2(3), 41–43.
- Rienzi, E. (2000). Investigation of anthropometric and work rate profiles of elite South American international soccer players. *J. Sports Med. Phys. Fitness*, 40(2), 166.
- Stawczyk, Z. (1965). Wpływ niektórych cech budowy ciała na wysokość skoku wzwyż. *Lek. Atlet.*, 10(4), 9–10.
- Susane, C. et al. (1998). Factor analysis and somatotyping: Are these two physique classification methods comparable? *Annals of Human Biology*, 25(5), 405–414.
- Štěpnička, J. (1972). *Typologická a motorická charakteristika sportovců a studentů vysokých škol*. Praha: Univerzita Karlova.
- Štěpnička, J. (1974). Typologie sportovců. In J. Šimon (Ed.), *Vybrané problémy rozvoje speciální síly v atletice – sborník ze semináře trenérů* (pp. 67–90). Praha: ČAS VMK.
- Štěpnička, J. (1983). Návod na odhad přibližného somatotypu. *Těl. Vých. Mlád.*, 49, 323–326.
- Štěpnička, J. et al. (1979). *Somatické předpoklady ke studiu tělesné výchovy*. Praha: Univerzita Karlova.
- Ulbrichová, M., & Nováková, H. (1988). Vztahy mezi somatickým a motorickým vývojem a jejich význam pro výběr sportovně talentované mládeže. In *Sborník vědecké rady ÚV ČSTV*. Praha: Olympia.
- Vařeková, R., Valenta, M., Vařeka, I., Přidalová, M., & Burianová, K. (2006). Somatometrická studie fotbalistů SK Sigma Olomouc ve věku juvenis a adultus. In K. Hůlka & F. Neuls (Eds.), *Efektivity pohybového zatížení v edukačním prostředí tělesné výchovy – sborník referátů 6. mezinárodního semináře* (44). Olomouc: Univerzita Palackého.
- Vařeková, R., & Vařeka, I. (2005). Svalové dysbalance ve vztahu k pohlaví, věku a tělesné konstituci dětí školního věku. *Rehabilitácia*, 42(2).
- Žára, J. (1968). Tělesná výkonnost branců v letech 1966–1968. *Teor. Praxe těl. Vých.*, 17(2), 729–735.

SOMATOMETRICKÉ CHARAKTERISTIKY SKOKANŮ DO VÝŠKY (Souhrn anglického textu)

Význam somatických předpokladů je u skoku do výšky zřejmý. V průběhu našeho hodnocení byla potvrzena významná závislost tělesné stavby a výkonu, a to u všech skupin žen a mužů věnujících se skoku do výšky s vysokými průměrnými výkony. Měření probíhalo v období od r. 1983 do r. 2005. Všechny tyto skupiny se vyznačovaly relativně velkou homogeností většiny somatických ukazatelů.

Měření, která používáme za základ v následujících částech příspěvku, probíhala v průběhu více než dvou desetiletí. Zahrnují jednoduchý průřezový průzkum skupin žen a mužů (n = 117) a také průběžné monitorování vybraných jednotlivců.

V souladu s tělesným vývojem žen a mužů věnujících se skoku do výšky byly měřené skupiny voleny samozřejmě záměrně a lze je označit za „částečně zvolené skupiny“ s ohledem na výkon i tělesnou stavbu. V průběhu našeho průzkumu lze u všech skupin pozorovat změny v tělesné stavbě způsobené výběrem a následně specifickou tréninkovou zátěží a rovněž samotnou náročnou atletickou disciplínou.

Klíčová slova: somatické předpoklady, antropometrický průzkum, typologie, somatotyp, tvrzení, sportovní výkon.

PaedDr. František Langer, CSc.



Palacký University
Faculty of Physical Culture
tř. Míru 115
771 11 Olomouc
Czech Republic

Education and previous work experience

1994-1996 - ISTAPS, Université Champagne - Ardenne de Reims, Thèse du Doctorat.

1988-1990 - FTVS UK Praha - CSc.

1986-1988 - FF UJEP Brno - postgraduate study.

1978-1980 - PF UJEP Brno - PaedDr.

1968-1973 - PF UK Praha - Physical Education - Geography.

PT teacher at the PT School of the Czech PT Association, lecturer at the Department of PT Theory, Pedagogi-

cal Faculty, UJEP Brno, lecturer and associate professor at the ISTAPS, Université Champagne - Ardenne de Reims, lecturer at the Faculty of Physical Culture, UP Olomouc.

Scientific orientation

Research in the branches called Biomechanics of physical exercises, Theory and didactics of sports training, Theory and didactics of athletics and sporting performance diagnostics. Athletic coach of the 1st class.

First-line publications

Langer, F. (2002). *Atletika - od výkonu k prožitku*. Seminář FTK UP Olomouc „Efekty pohybového zatížení v edukačním prostředí tělesné výchovy a sportu“. Pastviny, Česká republika.

Langer, F. (2006). Hodnocení stavu pohybové soustavy skokanů do výšky, příčiny, poranění, prevence. In *Sborník příspěvků z XIII. ročníku mezinárodní konference Optimální působení tělesné zátěže a výživy „Kinantropologické dny MUDr. V. Soukka“*, (pp. 41-47). Hradec Králové: Univerzita Hradec Králové.

Langer, F. (2006). Diagnostika sportovní výkonnosti. In A. Pražák & A. Tvrzník (Eds.), *Sborník z konference trenérů Olympijské solidarity* (pp. 10). Nymburk: Český olympijský výbor.

A TEST OF MANIPULATION FUNCTIONS USING THE CONSTRUCTIONAL SET “MINISTAV” IN PHYSIOTHERAPY AND THE VERIFICATION OF ITS RELIABILITY

Jana Vyskotová, František Vaverka

Faculty of Physical Culture, Palacký University, Olomouc, Czech Republic

Submitted in May, 2007

The main goal of the study was to analyse the reliability of the “Test of manipulation functions” using the constructional set Ministav. This newly carried out test is designed to test the impaired manipulation functions of the hand. The number of healthy subjects tested was 417, which was further divided into four groups according to age. The tested subjects performed 17 subtests in three trials. The outcome score is an average of these three trials. The tested criterion was the time necessary to perform each subtest. To assess the reliability of the new test, a correlation analysis using the Pearson correlation coefficient was applied. The values of reliability coefficients range, in particular subtests in given groups, from 0.14 to 0.94. The lowest average values of the reliability coefficient are seen in children ($r = 0.54$). In contrast, the highest values are reached in seniors ($r = 0.82$).

Keywords: Hand, dexterity, manipulation, test of manipulation functions, reliability.

INTRODUCTION

Manipulation is an intentionally targeted ideokinetic movement characteristic of homo sapiens able to do creative activities (Véle, 1997). The term “manipulation” is often used to mean that the hands move an object to perform the activities wanted, i. e. the object moves in the hand or between both hands or the hands are holding the object that they are moving in space (Exner, 1993). Manipulation functions are closely connected with cognitive functions of the brain. It is a complex and dynamic system comprising visual perception, space recognition, concentration, memory and executive functions (Grieve, 2000).

The impairment of manipulation functions means a severe problem for patients and may have physical, psychological and social impacts. Advances in hand therapy depend on the quality of the tests used to perform assessments. To evaluate how severe the problem is, it is necessary to use a suitable objective test that is able to disclose insufficiencies in performance, to register the improvement, stagnation or deterioration of the course of a disease. This is the only way to choose an adequate therapy and enable patients to perform daily and working activities. A hand function test should provide pertinent information about the quality and the speed of performance of the hand as the person accomplishes a task and the time required to complete that task (Aaron & Stegink-Jansen, 2003). The performance of manipulation activities is always connected with the state of CNS. This is why creative tests are able to disclose not only local impairments but also disfunctions in

concentration, memory, planning tasks, choosing strategies, etc. Such tests, nevertheless, are missing among the equipment of many therapists.

One of the most frequent tests of manipulation functions in use is the Jebsen test of hand function (Hardin, 2002). It comprises seven subtests, six of which involve manipulating objects (i. e., turning cards, stacking checkers, lifting objects) and the seventh one is a writing test (Thonnard, Plaghki, & Bragard, 1994; Hluchníková, 1999; Hardin, 2002). Other tests are a combination of this basic test with activities of daily living (e. g. Timed manual evaluation test, Upper extremity performance test for the elderly, and the Smith hand function evaluation, to name three such tests). A further group of tests evaluates the time necessary for the performance of a simple repeated task or a number of objects manipulated in a given time (e. g. The Minnesota rate of manipulation tests, The nine-hole peg test, The functional dexterity test, The purdue pegboard test, The box and block test).

Most tests of manipulation functions are for time and economic reasons very simple and require only one kind of manipulation to be repeated (e. g. the insertion of pegs into a hole, displacing blocks from one box into another box, etc.). What is not tested is a greater number of kinds of grasp or combined grasps or coordination of both upper extremities, and no creativity is asked for within the performance of tasks and, moreover, motivation is often absent. For this reason, when using these tests we may overlook some of the present disorders of hand functions that may lead to a lack of successful of the therapy. In many such tests the statistical parameters

of a test are missing (Croarkin et al., 2004). Furthermore, these tests are not easily accessible to therapists in the Czech Republic and are very expensive. In regard to these facts, new standardised tests have been carried out. It is expected that the newly designed and carried out Test of Manipulation Functions (TMF) may be qualitatively a new type of test enabling us to gain a broader spectrum of information on each tested person.

The TMF was designed to serve physiotherapists and occupational therapists as well as other specialists evaluating the manipulation abilities of any tested person. It evaluates the abilities of an individual in using his hands in uni and bimanual activities by means of the constructional set *Ministav* made for this purpose. TMF complements the scale of the tests of manipulation functions. Its advantage, as opposed to other tests, is that, thanks to positive motivation and a creative approach, the patient experiences a minimum of stress caused by failure (Vyskotová, 2003). The testing resembles child's play, in which it is possible to test various types of grasp, the ability to manipulate objects, the coordination of both upper extremities as well as some psychological processes (initiation, selection of strategy, task memory, etc.). During testing, it is possible to set a degree of difficulty and to make use of suitable subtests according to a particular condition and the course of a certain illness. The constructional set *Ministav* may be used, besides in diagnostics, also for treatment, as it gives a great number of working variants and is easily portable.

TMF may be regarded to be one of the specialised motoric tests. The contents of the motoric tests are movement activities listed according to their movement task and respective rules (Měkota & Novosad, 2005). Their standardization requires the use of standardised aids (tools, etc.), the same well thought out, exact instruction, and that they be easy to reproduce (Měkota & Blahuš, 1983). Manipulation function tests are very sensitive to a great number of outer and inner disturbing influences. This is why the tested subject must fully concentrate during testing and must not be disturbed.

The quality of the tests is evaluated by its objectivity, reliability and validity (Komenda, 1995). This study is focussed on one of the aspects of this test - reliability. Measurement reliability shows how the result of measurement changes when repeated (Komenda, 1995). The results of testing should be, to the maximum degree possible, independent of casual errors. The resulting reliability then shows to which degree this requirement is being met (Měkota et al., 1988). To evaluate reliability, several steps are taken: test-retest reliability, reliability of parallel measurements, and/or reliability found out due to the test being done in halves (Hendl, 2006). To verify TMF, the test-retest reliability of two measurements of a number of objects was used, applying a given method in two time periods by means of the Pearson correlation coefficient.

The aim of this study is to verify the reliability of the new TMF test.

METHOD

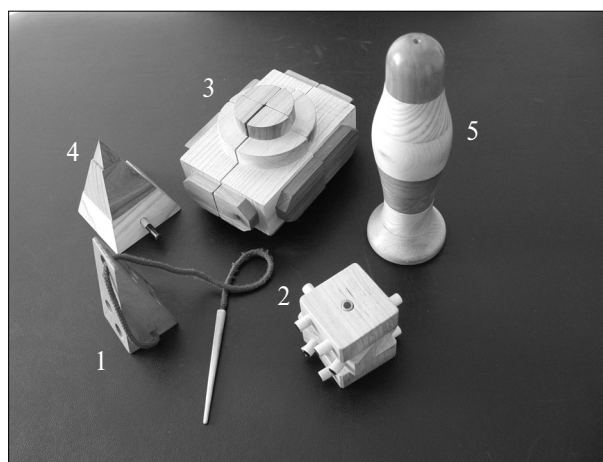
Description of test

TMF is performed using the special patented constructional set *Ministav* (Vyskotová, 2003). TMF comprises 17 subtests, as a whole, performed by means of 5 constructional objects, the so called the "Needle", "Cube", "House", "Pyramid" and "Mummy" (Fig. 1).

1. A "Needle" has the shape of a cone with five holes through which a wooden needle is put, attached to the cone using a cord.
2. A "Cube" is a three segmental prism, which forms three parts having the same dimensions with differently placed side pegs.
3. A "House" is a quadrilateral object, having four independent parts. Provided all four parts are composed in the right way, their walls form simple geometrical shapes according to their axial symmetry.
4. A "Pyramid" is composed of three parts that hold together due to the central axis and the lateral peg.
5. A "Mummy" is a body formed by seven independent segments with a circular diametre, having together a skittle shape.

Fig. 1

Group of five objects of constructional set *Ministav*



Legend

1 - Needle, 2 - Cube, 3 - House, 4 - Pyramid, 5 - Mummy

Each of these objects may be manipulated in a specific way (Vyskotová & Vaverka, 2003). The overview of subtests made using particular objects is shown in TABLE 1. The tested criterion is the time achieved.

TABLE 1

Test of manipulation functions using the constructional set Ministav

Object	Name of subtest	Contents of subtest	Tested quality
Needle	BHS DHS	- both hands sewing (where both hands spell in holding the needle) - dominant hand sewing	tridigital grip, bimanual coordination
Cube	BHA BHD DHA DHD ACP	- both hands assembling (assembling the Cube by both hands) - both hands dismantling (dismantling the Cube by both hands) - dominant hand assembling (assembling the Cube by dominant hand) - dominant hand dismantling (dismantling the Cube by dominant hand) - assembling the Cube according to pattern	bidigital grip, taxis, coordination, stereognosis
House	LDH _p LDH _f AHP	- lifting the House by dominant hand using a palm grip - lifting the House by dominant hand using a finger grip - assembling the House by both hands according to pattern	palm grip, pinch grip, power of grip, coordination, recognition of geometrical shapes
Pyramid	BHA BHD DHA DHD	- both hands assembling (assembling the Pyramid by both hands) - both hands dismantling (dismantling the Pyramid by both hands) - dominant hand assembling (assembling the Pyramid by dominant hand) - dominant hand dismantling (dismantling the Pyramid by dominant hand)	combination of grips, bimanual coordination, taxis, memory, action planning
Mummy	DHA DHD AMP	- dominant hand assembling (assembling the Mummy by dominant hand) - dominant hand dismantling (dismantling the Mummy by dominant hand) - assembling the Mummy according to pattern	bidigital grip, taxis, memory, cognitive functions

The course and organization of measurement

The testing was carried out in a quiet room. The examiner and tested person were sitting facing each other at the table. The tested subject was placed sitting upright having his/her forearms freely put on the table with hands in a working position. The examiner demonstrated the task to be performed. The subject made a try at each subtest. After the instruction three trials were made. The tasks demanding manipulation conducted by one hand were performed by the preferred extremity. The examiner measured the achieved time by means of a stop-watch. The measured data (in seconds) were registered in given forms. The resulting score of each subtest was represented by the average value of these three trials. The total duration of the whole test TMF took, on the average, 20 minutes.

Tested Groups

The test was applied to a group of subjects divided into four age categories: children 9–10 years, adults aged 20–25, adults in the age category 40–50 years and seniors over 65 years old (TABLE 2). The selection of the group was conducted in the region of Northern Moravia. As a whole, 417 healthy subjects were tested (245 women and 172 men).

Statistical data

The mutual relationship among the trials in the particular group were assessed by means of correlation coefficients, by differences via the Wilcoxon pair test and, alternatively, also by a one selection pair t-test. The reliability of measurement was verified by means of the correlation relationship among the single trials and the resulting score. In order to assess the reliability of a new test, statistical analysis was conducted using the Pearson coefficient. The data were processed with the help of the software system to analyse data by StatSoft, Inc. (2001), Statistica Cz, version 6 (www. StatSoft.cz).

TABLE 2
Measured groups

Group	Figure			Age		min	max
	total	female	male	\bar{x}	s		
Children 9-10 year	105	49	56	9.7	0.44	9	10
Adults 20-25 year	109	61	48	21.8	1.88	20	25
Adults 40-50 year	101	69	32	44.3	3.75	40	50
Seniors over 65 year	102	66	36	73.0	6.48	65	90
Whole group	417	245	172	36.7	24.35	9	90

RESULTS

In all four age groups, as well as in the whole set, the mutual relations among these particular three trials in all 17 subtests were tested. Average values of each reliability coefficient were obtained for each subtest and these are considered to be final values.

The baseline of data processing was presented by the calculation of basic statistical characteristics in all

measurements for each of 17 subtests. Subsequently, the calculation of correlation coefficients among the particular trials was carried out. TABLE 3a and 3b show the survey of correlation coefficients giving final values when the first trial was compared with an average value of the second and third one, as well as the second trial with an average value of the first and third one, and the third trial with an average value of the first and second one. Using the three numerical values in each subtest,

TABLE 3a

Reliability coefficients expressed in correlation coefficients among single trials in groups of children, adults 1 and adults 2

Test	Subtest	Groups								
		Ch			A1			A2		
		Correlation among trials			Correlation among trials			Correlation among trials		
		1:23	2:13	3:12	1:23	2:13	3:12	1:23	2:13	3:12
Needle	BHS	0.65	0.69	0.73	0.75	0.76	0.77	0.61	0.67	0.72
	DHS	0.58	0.64	0.59	0.72	0.71	0.62	0.49	0.58	0.69
	Cube	BHA	0.29	0.39	0.32	0.47	0.61	0.48	0.52	0.55
	BHD	0.71	0.78	0.75	0.72	0.77	0.75	0.71	0.77	0.74
	DHA	0.44	0.45	0.48	0.67	0.70	0.69	0.65	0.75	0.60
	DHD	0.63	0.73	0.77	0.75	0.82	0.82	0.64	0.69	0.68
	ACP	0.12	0.25	0.38	0.60	0.68	0.70	0.37	0.53	0.45
	House	LDHp	0.65	0.71	0.64	0.67	0.80	0.78	0.62	0.68
	LDHf	0.13	0.19	0.11	0.53	0.52	0.51	0.30	0.30	0.32
	AHP	0.51	0.55	0.56	0.73	0.74	0.67	0.54	0.69	0.62
	Pyramid	BHA	0.62	0.58	0.66	0.58	0.59	0.59	0.68	0.81
	BHD	0.49	0.64	0.60	0.68	0.66	0.60	0.45	0.54	0.41
	DHA	0.50	0.62	0.60	0.54	0.61	0.60	0.46	0.55	0.65
	DHD	0.45	0.45	0.46	0.67	0.63	0.61	0.65	0.52	0.54
	Mummy	DHA	0.59	0.68	0.56	0.70	0.70	0.73	0.61	0.68
	DHD	0.56	0.74	0.67	0.79	0.85	0.77	0.72	0.50	0.83
	AMP	0.45	0.57	0.50	0.55	0.63	0.56	0.35	0.50	0.51

Legend

1:23 means the correlation between the 1st trial and an average value of the 2nd and 3rd trial; 2:13 correlation between 2nd trial and an average value of the 1st and 3rd trial; 3:12 correlation between the 3rd trial and an average value of the 1st and 2nd trial.

Ch - group of children 9-10 year; A1 - group of adults 20-25 year; A2 - group of adults 40-50 year; Sr - group of seniors over 65 year; Gro - whole group; BHS - both hands sewing; DHS - dominant hand sewing; BHA - both hands assembling; BHD - both hands dismantling; DHA - dominant hand assembling; DHD - dominant hand dismantling; ACP/AHP/AMP - assembling the Cube/House/Mummy according to pattern; LDHp - lifting the House by dominant hand using a palm grip; LDHf - lifting the House by dominant hand using a finger grip.

TABLE 3b

Reliability coefficients expressed in correlation coefficients among single trials in groups of seniors and whole group

Test	Subtest	Groups					
		Sr			Gro		
		Correlation among trials			Correlation among trials		
		1:23	2:13	3:12	1:23	2:13	3:12
Needle	BHS	0.92	0.95	0.94	0.92	0.94	0.94
	DHS	0.94	0.93	0.96	0.90	0.91	0.92
Cube	BHA	0.83	0.88	0.80	0.79	0.83	0.79
	BHD	0.83	0.88	0.90	0.84	0.88	0.88
	DHA	0.84	0.88	0.83	0.82	0.86	0.82
	DHD	0.81	0.89	0.87	0.84	0.90	0.90
	ACP	0.67	0.78	0.77	0.67	0.78	0.78
House	LDHp	0.79	0.87	0.86	0.74	0.82	0.79
	LDHf	0.62	0.58	0.66	0.49	0.47	0.45
	AHP	0.77	0.83	0.68	0.78	0.83	0.71
Pyramid	BHA	0.89	0.86	0.86	0.86	0.85	0.86
	BHD	0.78	0.87	0.81	0.78	0.86	0.82
	DHA	0.84	0.87	0.83	0.79	0.85	0.82
	DHD	0.85	0.84	0.80	0.84	0.83	0.81
Mummy	DHA	0.80	0.78	0.78	0.82	0.82	0.82
	DHD	0.89	0.94	0.87	0.90	0.95	0.91
	AMP	0.83	0.85	0.79	0.79	0.84	0.80

Legend

BHS - both hands sewing; DHS - dominant hand sewing; BHA - both hands assembling; BHD - both hands dismantling; DHA - dominant hand assembling; DHD - dominant hand dismantling; ACP/AHP/AMP - assembling the Cube/House/Mummy according to pattern; LDHp - lifting the House by dominant hand using a palm grip; LDHf - lifting the House by dominant hand using a finger grip.

and in each group, an average value of reliability coefficients have been calculated. The survey of these values is shown in TABLE 4. All the reliability coefficient values are statistically significant ($p < 0.01$) except for the subtest ACP (Assembling Cube according to Pattern) in the group of children and LHfg (Lifting House using a Finger Grip) in the same group.

The results of the statistical analysis in TABLE 4 show that the values of reliability coefficients within the particular subtests vary with regard to age groups and to particular subtests. The values of reliability coefficients are within particular subtests in particular groups in the range of 0.14 to 0.94.

The lowest average value of reliability coefficient were reached in the group of children ($r = 0.54$). Contrary, the highest values were reached in seniors as well as in the whole group (average value $r = 0.82$). The values of the reliability coefficients given in TABLE 4 show that only the group of seniors can be considered highly reliable in all the subtests except for the subtest LHfg (Lifting House using a Finger Grip).

The groups of adults aged 20-25 and 40-50 years are in the middle range of reliability. The groups of adults in the age category of 20-25 years reached an average value of reliability coefficient of $r = 0.67$ and the group of adults in the age category of 40-50 years had an

average value of $r = 0.60$. The lowest value of reliability coefficient as observed in the subtest LHpg ($r = 0.14$) in the group of children and the highest one in the subtest BHS (Both Hands Sewing) and DHS (Dominant Hand Sewing) was $r = 0.94$ in the group of seniors.

DISCUSSION

According to the rules of the American Society of Hand Therapists, the reliable motoric tests of the manipulation ability of the hand must include a statement of the purpose of the test and evidence of the reliability and validity of the test meant for the target population. Equipment standards must be available for the instrumental and standardized instructions for administering, scoring, and interpreting the test. The norms should include a large normal population sample, which is divided into specific categories according to age, handedness, or occupation (Aaron & Stegink-Jansen, 2003).

Reliability can be evaluated by means of various methods. One of the possibilities is so called test-retest reliability. Its purpose is to determine whether the repeated applications of measuring the same subject or group of subjects tend to change the results. Reliability coefficients above 0.85 are generally regarded as high

TABLE 4

Reliability coefficients expressed in average values of the correlation coefficients among single trials

Test	Subtest	Groups				
		Ch	A1	A2	Sr	Gro
Needle	BHS	0.69	0.76	0.67	0.94	0.93
	DHS	0.60	0.68	0.59	0.94	0.91
Cube	BHA	0.33	0.52	0.57	0.84	0.80
	BHD	0.75	0.75	0.74	0.87	0.87
	DHA	0.46	0.69	0.67	0.85	0.83
	DHD	0.71	0.80	0.67	0.86	0.88
	ACP	0.25	0.66	0.45	0.74	0.74
	House	LDHp	0.67	0.75	0.68	0.84
House	LDHf	0.14	0.52	0.31	0.62	0.47
	AHP	0.54	0.71	0.62	0.76	0.77
	Pyramid	BHA	0.62	0.59	0.74	0.87
Pyramid	BHD	0.58	0.65	0.47	0.82	0.82
	DHA	0.57	0.58	0.55	0.85	0.82
	DHD	0.45	0.64	0.57	0.83	0.83
Mummy	DHA	0.61	0.71	0.62	0.79	0.82
	DHD	0.66	0.80	0.80	0.90	0.92
	AMP	0.51	0.58	0.45	0.82	0.81
	\bar{x}	0.54	0.67	0.60	0.83	0.82
	SD	0.16	0.09	0.12	0.07	0.10

and between 0.60 and 0.85 as moderate (Thonnard, Plaghki, & Bragard, 1994).

The metric parameters of coordination tests are less favourable than those of condition tests (Měkota & Novosad, 2005). Dexterity tests, where the criterion of performance is the measure of the accuracy of a move, are much less reliable. The successive trials often correlate only on a level with $r = 0.3-0.4$. Reliability will increase to reach an acceptable value when there are a greater number of test repetitions (Měkota & Blahuš, 1983).

The reliability of single subtests TMF expressed by the Pearson coefficient of reliability moves in a large range from 0.14 to 0.94. Most subtests reach a value of over 0.60. This result is in conformity with those found in dexterity tests where reliability also moves within a range of 0.68-0.94 (Thonnard, Plaghki, & Bragard, 1994). In the best known dexterity test - the Jebsen test of hand function, the estimate of test-retest reliability in seven subtests was made within a range of 0.60-0.99 with the mean value of 0.84 (Thonnard, Plaghki, & Bragard, 1994).

Dexterity tests are more sensitive than other kinds of tests towards external and/or internal disturbing influences. There are various situational and accidental factors that may play a significant role (Měkota & Blahuš, 1983). An important factor which can influence results is the individual's motoric learning ability, previous experience, motivation, etc. The significant influence of motoric learning as a factor was proven by Aaron and

Stegink-Jansen (2003) when verifying the functional dexterity test. They observed this influence as having stopped at the third trial. They proposed that one experimental trial should be conducted before proper testing to reduce the influence of motoric learning. In case that more than three trials were carried out, the results could also be influenced by fatigue.

In TMF, the group of seniors reached the highest values of correlation coefficient in almost all subtests, which could be explained by a smaller influence of motoric learning and greater experience in this group. In consequence, the group of seniors was able to show steadier performance. Three other groups improved their score throughout the course of repeated trials probably due to the influence of motoric learning. Mostly this impact and practical experience with fine motorics as well were shown in the group of children.

The group of children showed mildly lower values of the coefficient of reliability in almost all subtests, which could be explained not only by the influence of motoric learning, but also by a lesser ability to concentrate, a higher inclination to divert attention, lower motivation, a less developed sense of spatial orientation, etc. The lowest values of the reliability coefficient appeared in subtests demanding a greater participation of the cognitive functions of the brain. It concerned the subtests of assembling objects (Cube, House, Mummy) according to a model and lifting the House using a finger grip.

The above seen results indicate a good reliability of the TMF for the groups of adults and seniors. In these age groups, after evaluation of the test validity of the TMF, it can be used in rehabilitative practice.

In the group of children, the average value of the correlation coefficient varies. There are subtests which can not be assessed as reliable (assembling the Cube using both hands, assembling the Cube according to a pattern, assembling the Mummy according to a pattern and lifting the House using a finger grip). Other subtests can be considered as reliable (both hands sewing, dismantling the Cube using both hands, dismantling the Cube using the dominant hand, lifting the House using the dominant hand and using a palm grip, assembling the Pyramid using both hands, assembling and dismantling the Mummy using the dominant hand). Subtests in which proper reliability was not shown will be taken out of the battery of TMF subtests. They will be further used though, in this age category, as a therapeutic tool.

A further step to take in the given project will be to verify the validity of the TMF and to process normative data.

The TMF has its limits. It is sensitive to all the possible external and internal disturbing influences. This is why the tested subject must fully concentrate during testing and must not be disturbed. To date, the test has been verified on a group of healthy subjects and, at present, testing of the groups of patients with functional deficiency in the hand region is underway.

CONCLUSION

The TMF using the constructional set Ministav was designed to give therapists a diagnostic tool to evaluate decreased manipulation functions of the hand. The TMF presents quite a new original test that broadens and gives more precision to information on the level of the manipulation functions of a tested person. The TMF informs us about the patient's ability to use his hands in mono and bimanual activities, and completes the so far used tests of dexterity. The test consists of 17 subtests conducted by means of five objects of the constructional set Ministav. The performance of each subtest comprises one training trial and three measured trials. For each trial the endurance time is measured. The outcome score of single test items is given by an average of three trials.

Evaluation of its reliability has proven that the given test meets all the requirements made for this type of motoric test, and can be employed for the age category of seniors and adults, respectively. For the age category of children it is recommended to employ only the chosen subtests from the given test battery. A further recommended step before implementing of TMF into clinical

practice is to verify the validity of this test and to work out binding norms.

REFERENCES

- Aaron, D. H., & Stegink-Jansen, C. W. (2003). Development of the functional dexterity test (FDT): Construction, validity, reliability, and normative data. *Journal of Hand Therapy, 16*(1), 12–21.
- Croarkin, E., Danoff, J., & Barnes, C. (2004). Evidence based rating of upper extremity motor function tests used for people following a stroke. *Physical Therapy, 84*(1), 62–74.
- Disman, M. (2006). *Jak se vyrábí sociologická znalost*. Praha: Karolinum.
- Exner, Ch. E. (1993). Content validity of the in hand manipulation test. *The American Journal of Occupational Therapy, 47*(6), 505–513.
- Hardin, M. (2002). Assessment of hand function and fine motor coordination in the geriatric population. *Topics in Geriatric Rehabilitation, 18*(2), 18–27.
- Hendl, J. (2006). *Přehled statistických metod zpracování dat: Analýza a metaanalýza dat* (2nd ed.). Praha: Portál.
- Hluchníková, O. (1999). Hodnocení, testování v ergoterapii. *Informační bulletin České asociace ergoterapeutů, 8*, 18–26.
- Grieve, J. (2000). *Neuropsychology for occupational therapists: Assessment of perception and cognition* (2nd ed.). Oxford: Blackwell.
- Komenda, S. (1995). *Úvod do metodologie zdravotnického výzkumu*. Olomouc: Univerzita Palackého.
- Měkota, K., & Blahuš, P. (1983). *Motorické testy v tělesné výchově*. Praha: Státní pedagogické nakladatelství.
- Měkota, K., Kovář, R., & Štěpnička, J. (1988). *Antropomotorika*. Praha: Státní pedagogické nakladatelství.
- Měkota, K., & Novosad, J. (2005). *Motorické schopnosti*. Olomouc: Univerzita Palackého.
- Thonnard, J. L., Plaghki, L., & Bragard, D. (1994). EVA-MAIN: Computerised system for the evaluation of the hand. In F. Schuind et al. (Eds.), *Advances in the biomechanics of the hand and wrist* (pp. 499–509). New York: Plenum Press.
- Tomášková, H. (2006). *Základy biostatistiky*. Ostrava: Ostravská univerzita.
- Véle, F. (1997). *Kineziologie pro klinickou praxi*. Praha: Grada Publishing.
- Vyskotová, J., & Vaverka, F. (2003). Test of manipulation abilities as a means of therapy to tackle insufficient hand functions. In F. Vaverka (Ed.), *Proceedings of the 3rd International conference Movement and Health* (pp. 357–360). Olomouc: Univerzita Palackého.
- Vyskotová, J. (2003). The use of a special constructional set to diagnose and treat brain function disorders

and those of the hand. *Slovenská antropológia: Bulletin Slovenskej antropologickej spoločnosti pri SAV*, 6 (n.s. 1), 190–192.

**TEST MANIPULAČNÍCH FUNKCÍ
VE FYZIOTERAPII POMOCÍ STAVEBNICE
MINISTAV A OVĚŘENÍ JEHO RELIABILITY**
(Souhrn anglického textu)

Hlavním cílem studie bylo ověření reliability nově vytvořeného „testu manipulačních funkcí“ pomocí stavebnice Ministav (TMF), určeného k testování poruch funkcí ruky. TMF zahrnuje celkem 17 subtestů, prováděných pomocí pěti stavebnicových objektů. Test absolvovalo 417 zdravých osob (245 žen, 172 mužů), rozdělených podle věku do čtyř kategorií: děti 9–10leté, dospělí ve věku 20–25 let, dospělí ve věkové kategorii 40–50 let a senioři ve věku nad 65 let. Testované osoby vykonaly celkem 17 subtestů. Provedení každého subtestu spočívalo v 1 zácvičném pokusu a třech měřených pokusech. Měřila se doba trvání každého pokusu. Výsledné skóre tvořil průměr ze tří pokusů. Testovaným kritériem byl dosažený čas.

U všech 4 věkových podskupin i celého souboru byly zjišťovány korelace mezi jednotlivými třemi pokusy u všech 17 subtestů. K posouzení reliability nového testu byl použit Pearsonův korelační koeficient. Byly vypočteny průměrné hodnoty koeficientů reliability pro každý subtest.

Hodnoty koeficientů reliability se pohybují v jednotlivých subtestech u jednotlivých souborů v rozmezí od 0,14 do 0,94. Nejnížší průměrné hodnoty koeficientu reliability dosahuje soubor dětí ($r = 0,54$). Naopak nejvyšších hodnot dosahuje soubor seniorů ($r = 0,82$).

Většina subtestů dosahuje hodnot nad 0,60. Tento nález se shoduje s nálezy jiných testů manuální dovedností.

Výsledky naznačují dobrou reliabilitu testu TMF pro soubory dospělých a seniorů. U těchto věkových skupin po prokázání validity testu bude moci být test TMF využíván v rehabilitační praxi. Subtesty, u kterých nebyla prokázána vyhovující reliabilita, budou z baterie subtestů TMF vyřazeny. Dále budou využívány jako terapeutický nástroj.

Klíčová slova: ruka, zručnost, manipulace, test manipulačních funkcí, reliabilita.

Mgr. Jana Vyskotová



Palacký University
Faculty of Physical Culture
tř. Míru 115
771 11 Olomouc
Czech Republic

Education and previous work experience

University education, work experience in physiotherapy.

Since 2001 – doctoral study program at the Faculty of Physical Culture, Palacký University.

First-line publications

Vyskotová, J., & Pech, J. (2002). Využití speciální stavebnice k diagnostice a léčbě poruch mozkových funkcí. In J. Riegerová (Ed.), *Diagnostika pohybového systému* (187). Olomouc: Univerzita Palackého.

Vyskotová, J., & Vaverka, F. (2003). Test of manipulation abilities as a means of therapy to tackle insufficient hand functions. In F. Vaverka (Ed.), *Proceedings of the 3rd International conference Movement and Health* (pp. 357–360). Olomouc: Univerzita Palackého.

Vyskotová, J. (2003). The use of the special constructional set to diagnose and treat brain functions disorders and those of the hand. *Slovenská antropológia. Bulletin Slovenskej antropologickej spoločnosti pri SAV*, 6 (n.s. 1), 190–192.

Vyskotová, J., & Kristiníková, J. (2004). Výcvik manipulačních schopností u gerontů v domovech důchodců. *Česká antropologie*, 54, 209–210.

THE IMPAIRMENTS OF SENSORIMOTOR HAND FUNCTIONS IN STROKE PATIENTS – THE COMPARISON OF THE RESULTS OF A CLINICAL ASSESSMENT AND THE ASSESSMENT UTILIZING THE STANDARD TESTS (A CASE STUDY)

Kateřina Macháčková, Jana Vyskotová, Jaroslav Opavský, Hana Sochorová*

Faculty of Physical Culture, Palacký University, Olomouc, Czech Republic

**Medico-Social Faculty, Ostrava University, Ostrava, Czech Republic*

Submitted in May, 2007

The impairments of sensorimotor hand functions after a stroke have a negative impact on the subject's interaction with external settings and on performing common daily and working activities and thus on the quality of his or her life (Carey, 1995). Since the structure and function of the cerebral cortex is capable of after stroke modifications, new therapies are being looked for that support the desirable plasticity of the central nervous system to the maximum. The main condition for a successful treatment is a reliable target focused examination of all hand functions affected by the stroke. This requires both a differentiated and complex examination.

This study presents the results and experience of treating patients hospitalized after a stroke. The impaired motor and somatosensory functions have been assessed through somatosensory and manipulation tests. In three case studies, the differences are pointed out between the results of the clinical neurological hand examination and the functional hand examination. Both examinations use target focused specialized tests.

Keywords: Stroke, post stroke hand, sensorimotor functions, hand function tests, neurological examination.

INTRODUCTION

After stroke the loss of differentiated hand motility occurs and activities move towards the shoulder girdles. The impairments of sensorimotor functions of the hand develop into the disability to carry out and to take control of the grasp, to hold various objects, to handle them, to combine compound movements, to recognize the surface of an object by the fingertips of the fingers and accordingly to adapt the strength of pressure (Mayer & Hluštík, 2004; Carey, 1995). The relation of sensory and motor functions is a topic of longstanding research. Recently, the research has focused on the relationship between these functions in performing real activities of daily living. Obviously, the impairment of somatosensory performance can be the main reason of dysfunction, particularly of hand (Carr & Shepherd, 1998).

In patients with central lesion we can find variously high sensation deficiency, occurring contralaterally, ipsilaterally or bilaterally, as well. Routine examination does not have to reveal the presence of all impairments of sensorimotor functions. Ignored and uncorrected impairments can later be the cause for resulting patient's dexterity during common handling activities, which can be very frustrating for him, it can enhance the risks for his damage and for him it can mean complications in social contacts.

Our experience from the clinical practice has brought us to the consideration if the standard entry neurological examination of stroke patients are sufficient to:

- assess the patient's current condition and, in detail, all the impairments of his sensorimotor functions,
- choose appropriate therapeutic procedures to adjust the impairments,
- perform sufficiently sensitive control examinations,
- conclude the prognosis of next process of the disease and adjustment of the impairments.

The aim of this study is to demonstrate on three case studies the differences between the results obtained through standard examination of sensorimotor functions by a neurologist from the results obtained through standardized tests used in rehabilitation.

METHODS

According to the case studies of three patients who were treated in Faculty hospital Ostrava in Ostrava-Poruba we show different findings during the examination by standard neurological tests and during more detailed examination by special tests created for sensation impairments and handling functions.

All of the three patients suffered from ischemic stroke of arteria cerebri media (ACM). They were treated in the department of clinical neurology and later transferred to the rehabilitation in patient department. In the enclosed documentation we obtained the results of a check out examination by a neurologist and the entrance examination by a rehabilitation doctor. The patients were two men and one woman who were, according to the results of neurological examination, among the patients with low level of disability.

The patients were selected according to the following criteria: aged between 45–75, without aphasia, neglect syndrom, polyneuropathy, and with ability to cooperate.

In all patients we used eight tests for evaluating sensorimotor functions:

- three neurological tests: NIH SS – National Institutes of Health Stroke Scale (Brott et al., 1989), Mingazzini's trial and modified Ashworth's scale of spasticity;

- two sensation tests: FMT – The Fabric Matching Test (Carey, Oke, & Matyas, 1997) and RASP – The Rivermead Assessment of Somatosensory Performance;
- three motor skill tests: FRT – The Functional Reach Test (Duncan et al., 1990), NPHT – The Nine Peg Hole Test (Mathiowetz et al., 1985) and TMF – The Manipulating Hand Functions Test by means of the set of blocks Ministav (Vyskotová & Vaverka, 2003) – see TABLE 1.

With all three patients we show the results of examination and assessment of sensorimotor functions of upper extremities by chosen scales, tests and trials (TABLES 2, 3, 4). For better clarity we also show these results in graphic form (Diagrams 1, 2, 3). The results of sensation tests are demonstrated in percentages there. For better clarity and to enable the comparison to other tests, the results of motoric tests measured in seconds were recalculated in percentage rate in relation to expected standard (Vyskotová, 2003).

TABLE 1
Scales, tests and trials used

Title of the test	Test characteristics
NIHSS (National Institutes of Health Stroke Scale)	Standardized clinical assessment of neurological results/deficits and level of regeneration. It assesses eleven issues: level of consciousness (3 issues), speech, neglect, viewing field, oculomotorics, paresis n. facialis, motorics of the upper limb, motorics of the lower limb, ataxia, dysarthria, and sensation. The test criterion is the achieved score.
Mingazzini's trial	Basic orientation trial for symptoms of paralysis in the upper extremities. In compliance with the lowering of the arm and raising it forward (cm/s) with slightly closed eyes, medium grave and grave paralysis can be assumed.
Modified Ashworth's scale of spasticity	Scale for assessing muscle tone and spasticity. It is assessed on a scale of 0–4.
The rivermead assessment of somatosensory performance	Test for assessing somatosensory functions in neurological diseases. It contains seven subtests: sharp/dull discrimination, surface pressure touch, surface localization, bilateral touch discrimination, two point discrimination, temperature discrimination, proprioception movement discrimination, and proprioception direction discrimination. The test criterion is the achieved score.
The fabric matching test	Test for assessing sense discrimination focused on the surfaces of various fabrics. Part of it is a set of ten standardized fabric surfaces, which range on a scale from the softest to the roughest. The goal is to distinguish the variety and to match identical surfaces. The test criterion is the achieved score.
The functional reach test	This test measures balance with the help of assessing stability limits in a forward direction. It is defined as the difference between the length of the arm and the maximum to which onward reaching can be done while maintaining a permanent basis of support in a standing position. The validity of the test derives from measurements of an action commonly performed in the activities of daily living.
The nine peg hole test	Test for assessing fine motorics. The patient's task is to place, as quickly as possible, nine pegs into holes in a testing board and then to pick them up with one hand, one by one, and to put them into a bowl. Unimanual dexterity of the fingers is tested. The test criterion is the achieved time.
The manipulating hand functions test by means of the set of blocks Ministav	This test assesses handling skills, unimanual and bimanual, by means of five objects of the special set of blocks "Ministav", which are called Needle, Cube, House, Pyramid and Mummy. As a whole, it is made up of 17 subtests, in which tasks such as the composition and decomposition of objects, including the composition of an object being held up as an example, with the palmar and pinch grasp or by putting a needle through holes into an object, are performed. The test criterion is the achieved time.

Case study 1

Patient 1 – man, 52 years old, right handed. Hospitalized from 31. 8. 2006 to 13. 9. 2006 at the neurological department and from 13. 9. 2006 to 12. 10. 2006 at the inpatient department of rehabilitation.

Diagnostic summary (neurological report after discharge): central sinistral spastic-ataxic hemiparesis, central facial paresis on the left and dysarthria as a result of ischemia in ACM on the right. Cardioembolic etiology, NIH SS 4.

According to the results of neurological tests (TABLE 2) received by the preliminary examination of the patient at the in patient rehabilitation department it follows that there is a slight disability (NIH SS 1), without presence of paresis (Mingazzini test in norm), with hypertonic (spastic) flexors of the elbow joint of the left upper limb (based on modified Ashworth's scale level 2).

Somatosensory functions of the left upper limb: according to the results of FMT the patient had a severe

impairment of sense discrimination for fabric matching (assessed as anesthesia) and according to RASP for modality of two points discrimination assessed as anesthesia as well. In proprioception movement discrimination and in proprioception direction discrimination he achieved 33% of the standard performance and approximately 60% of the standard performance for modality of "distinction of sharp and dull objects" and "localization of touching". In the modality "slight pressure touching" he reached 91% of the standard performance. All sensorimotor functions of the right upper extremity were standard.

Motor functions: dynamic balance was bilaterally assessed as normal, fine motoric in terms of NPHT on the left as damaged (Fig. 1) for non performance of time limit. By means of TMF the deceleration of manual composition and decomposition subtests called Pyramid and Mummy was found in manipulating functions and the patient was not able to press and uphold the object called House by the help of palmar and pinch grasp of his left hand. The examination at common daily activities by means of Barthel's index: 85 points.

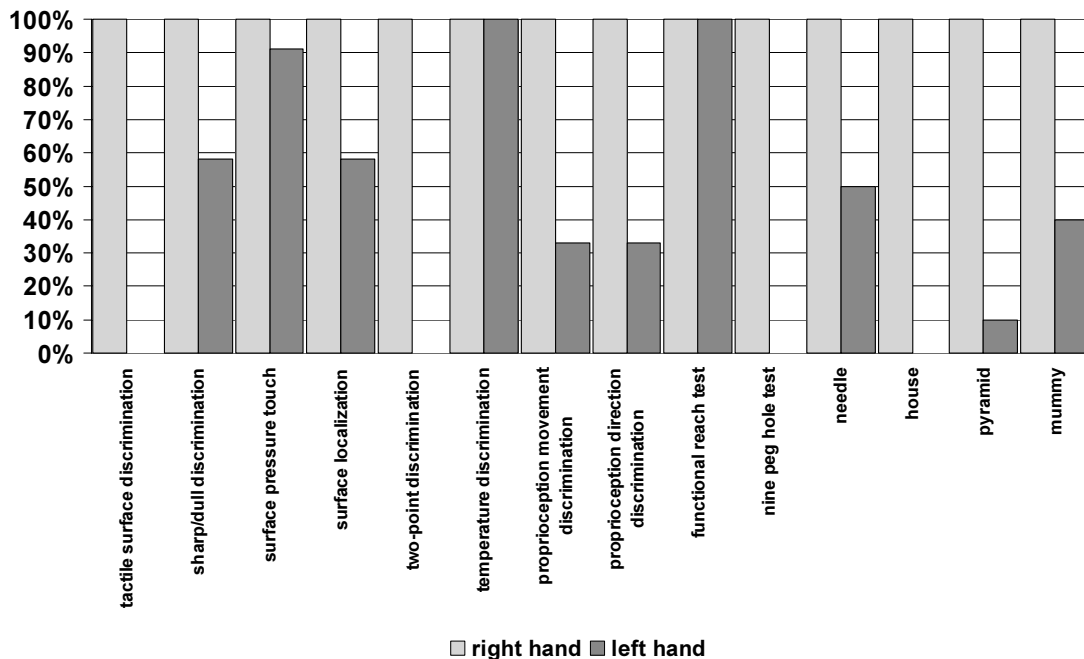
TABLE 2

Examination and assessment of sensorimotor functions of the upper extremities by means of selected scales, tests and trials

Examination	Modality	Right upper limb	Left upper limb	Assessment
NIH SS				1 – slight deficit
Mingazzini		norm/standard	norm/standard	norm/standard
Ashworth		0	2	norm/standard except for flexors of the elbow joint
FMT	tactile surface discrimination	norm/standard	0 – total loss	anesthesia of the left hand
RASP	sharp/dull discrimination	norm/standard	58%	hypo-aesthesia more on the left
	surface pressure touch	norm/standard	91%	slight hypo-aesthesia
	surface localization	norm/standard	58%	hypo-aesthesia
	two point discrimination	norm/standard	0 – total loss	anesthesia of the left upper limb
	temperature discrimination	norm/standard	norm/standard	norm/standard
	proprioception movement discrimination	norm/standard	33%	damaged
	proprioception direction discrimination	norm/standard	33%	damaged
FRT	dynamical balance	norm/standard	norm/standard	norm/standard
NPHT	fine motorics	norm/standard	over 30s	damaged on the left
TMF	manipulating functions – needle	norm/standard	deceleration	deceleration of effort of the upper limb
	house	norm/standard	is not able to do	he can not uphold the object using the left upper limb
	pyramid	norm/standard	distinct deceleration of effort	deceleration of effort during the composition of the object
	mummy	norm/standard	deceleration	deceleration of composition

Diagram 1

Sensorimotor hand functions tests



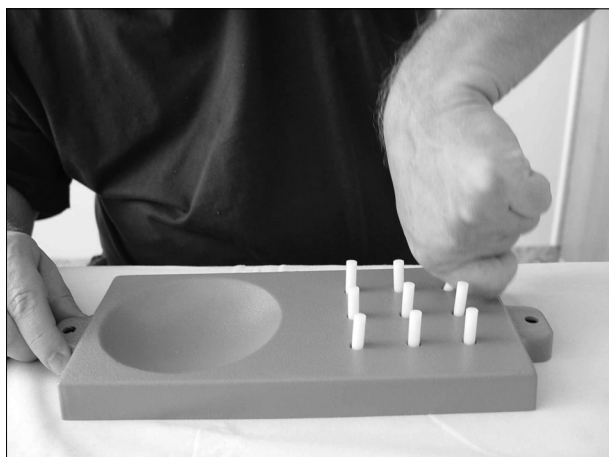
Legend

For better clarity the measured data of motoric tests assessing the performance according to the achieved time were averaged and converted to percentages.

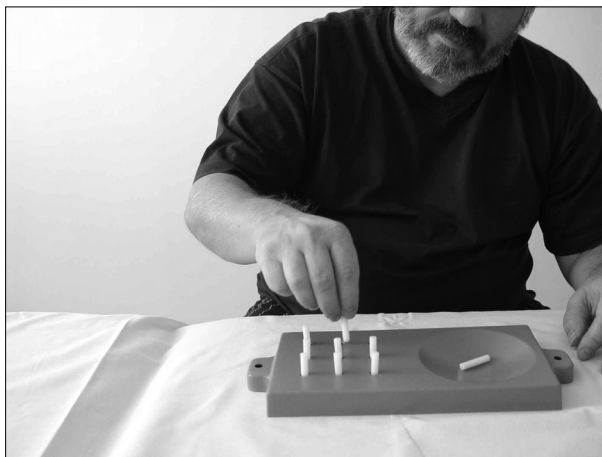
Fig. 1

The assessment of fine motorics by means of NPHT

a)



b)



Legend

The comparison of the effort of the right and left hands. Obviously on the left, the damaged grasp stereotype can be seen. The patient was able to fulfil the task but he did not perform within the time limit.

Case study 2

Patient 2 – man, 68 years old, right handed. Hospitalized from 22. 3. 2006 to 12. 4. 2006 at the neurological department and from 18. 4. 2006 to 12. 5. 2006 at the inpatient department of rehabilitation.

Diagnostic summary (neurological report after discharge): residual discrete sinistral destructive hemiparesis, central facial paresis on the left as a result of ischemia in ACM on the right, v.s. cardioembolic etiology, NIH SS 1.

According to the results of neurological tests (TABLE 3) received by the preliminary examination of the patient at the in patient rehabilitation department it follows that there was no neurological deficit identified in this patient (NIH SS 0, Mingazzini test in norm, Ashworth's scale – level 0).

The examination of somatosensory functions of the left upper limb: according to the results of FMT the

sense discrimination was normal. The RASP test demonstrated a total loss of two point discrimination and in the modality “distinction of sharp and dull objects” the patient reached 83% of standard performance. All sensorimotor functions of the right upper extremity were normative, except for a slight deficit in the modality “discrimination of heat stimulation”.

The examination of motor functions: dynamic balance was bilaterally assessed as normal, fine motoric in terms of NPHT on the left as damaged (Fig. 1) for non performance of the time limit. By means of TMF the manipulating functions were assessed as deceleration of performance in the composition and decomposition subtests and the patient was not able to press and uphold the object called House (Fig. 2) with the help palmar and pinch grasp of his left hand. The examination at common daily activities by means of Barthel's index: 100 points.

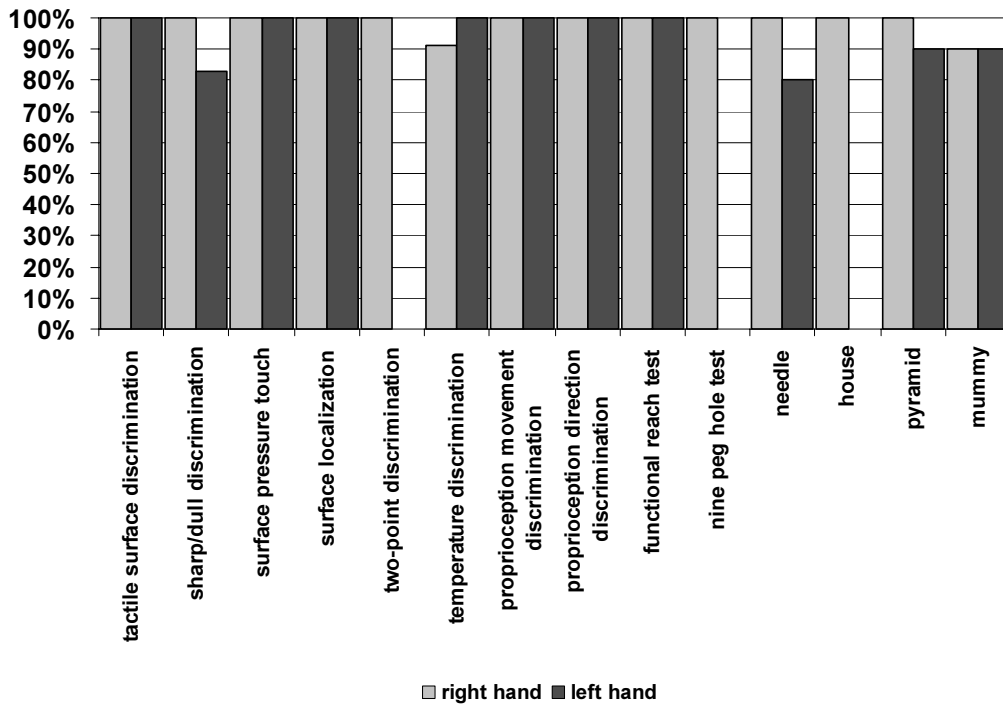
TABLE 3

Examination and assessment of sensorimotor functions of upper extremities by means of selected scales, tests and trials

Examination	Modality	Right upper limb	Left upper limb	Assessment
NIH SS				0 - norm
Mingazzini		norm/standard	norm/standard	norm/standard
Ashworth		0	0	norm/standard
FMT	tactile surface discrimination	norm/standard	norm/standard	norm/standard
RASP	sharp/dull discrimination	norm/standard	83%	slight hypo-aesthesia
	surface pressure touch	norm/standard	norm/standard	norm/standard
	surface localization	norm/standard	norm/standard	norm/standard
	two point discrimination	norm/standard	0 – total loss	anesthesia of the left upper limb
	temperature discrimination	91%	norm/standard	slight damage on the left
	proprioception movement discrimination	norm/standard	norm/standard	norm/standard
	proprioception direction discrimination	norm/standard	norm/standard	norm/standard
FRT	dynamical balance	norm/standard	norm/standard	norm/standard
NPHT	fine motorics	norm/standard	over 30s	damaged on the left
TMF	manipulating functions - needle	norm/standard	deceleration	deceleration of effort of the left upper limb
	house	norm/standard	is not able to do	he can not uphold the object by the left upper limb
	pyramid	norm/standard	deceleration of effort	deceleration of effort during composition and decomposition of the object
	mummy	deceleration	deceleration	deceleration of composition

Diagram 2

Sensorimotor hand functions tests

**Fig. 2**

The assessment of fine motorics by means of NPHT

a)



b)

**Legend**

Subtest TMF “upholding the House by means of the palmar grasp” – the comparison of effort of the right and left hands. The patient did not manage to hold four parts of the House together by his left hand and to uphold the object. Associated movements of the right hand are visible (photo on the right).

Case study 3

Patient 3 - woman, 70 years old, right handed. Hospitalized from 11. 11. 2006 to 30. 11. 2006 at the neurological department and from 30. 11. 2006 to 14. 12. 2006 at the inpatient department of rehabilitation.

Diagnostic summary (neurological report after discharge): discrete central sinistral hemiparesis, central facial and hypoglossal paresis on the left and dysarthria as a result of ischemia in ACM on the right, NIH SS 4.

According to the results of neurological tests (TABLE 3) received by the preliminary examination of the patient at the in patient rehabilitation department it follows that there is a slight neurological deficit in this patient (NIH SS 3, Mingazzini test standard, Ashworth's scale - 0).

Somatosensory functions of the left upper limb: according to the results of FMT the patient had a grave impairment of sense discrimination for fabric matching (assessed as anesthesia). The RASP test demonstrated intact two point discrimination and proprioception movement discrimination. Other modalities were damaged (TABLE 4). All sensorimotor functions of the right upper extremity were normal.

Motor functions: the FRT test demonstrated failed dynamic balance on the left and the NPHT test showed damaged fine motoric. In the TMF test deceleration of performance was identified in all tests performed by the left hand and by both upper limbs and the trial moreover evidenced deceleration of performance in subtests concerning composition and decomposition of the objects called "Pyramid" and "Mummy". The examination at common daily activities by means of Barthel's index: 100 points.

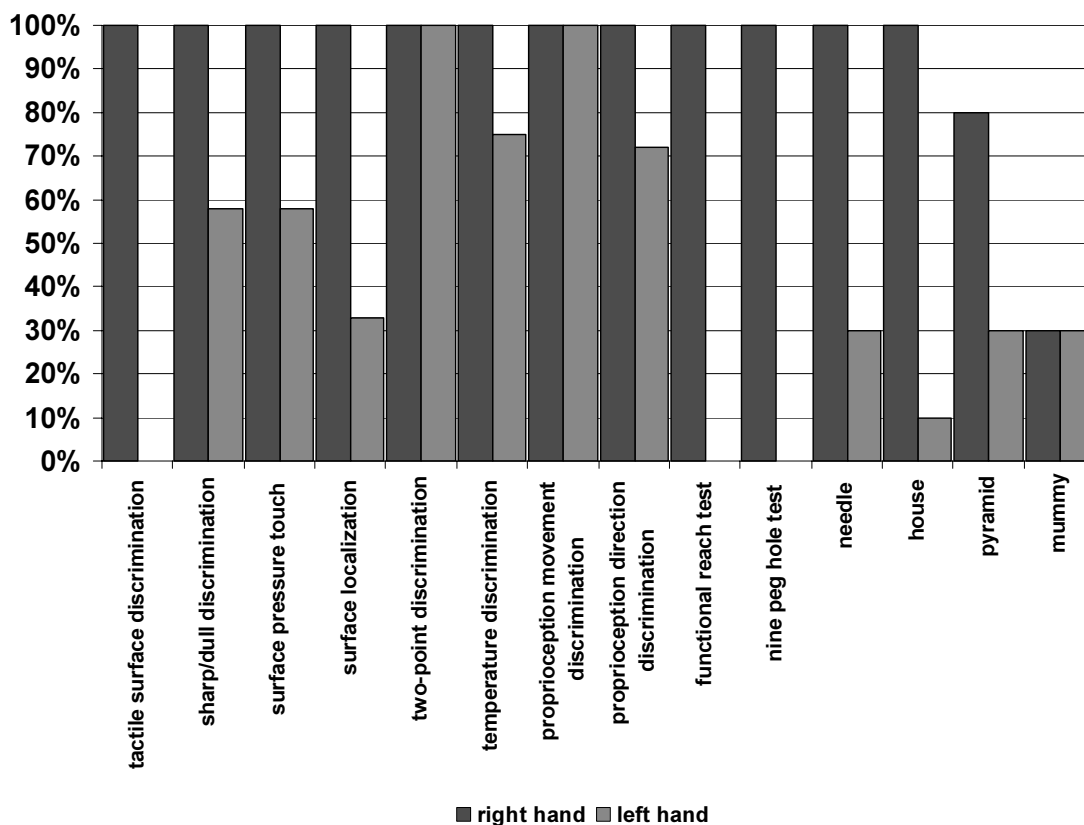
TABLE 4

Examination and assessment of sensorimotor functions of upper extremities by means of selected scales, tests and trials

Examination	Modality	Right upper limb	Left upper limb	Assessment
NIH SS				3
Mingazzini		norm/standard	norm/standard	norm/standard
Ashworth		0	0	norm/standard
FMT	tactile surface discrimination	norm/standard	0 - total loss	anesthesia of the left upper limb
RASP	sharp/dull discrimination	norm/standard	58%	hypo-aesthesia more on the left
	surface pressure touch	norm/standard	58%	hypo-aesthesia more on the left
	surface localization	norm/standard	33%	hypo-aesthesia bilaterally
	two-point discrimination	norm/standard	norm/standard	norm/standard
	temperature discrimination	norm/standard	75%	hypo-aesthesia bilaterally
	proprioception movement discrimination	norm/standard	norm/standard	norm/standard
	proprioception direction discrimination	norm/standard	72%	damaged
FRT	dynamical balance	norm/standard	decreased effort	decreased effort in the left upper limb
NPHT	fine motorics	norm/standard	over 30s	damaged on the left
TMF	manipulating functions - needle	norm/standard	norm/standard	co-ordination of upper limbs stagnates
	house	norm/standard	deceleration of effort	grip lift by the left stagnates
	spire	deceleration of effort	distinctive deceleration of effort	coordination of upper limbs stagnates
	mummy	deceleration of effort	deceleration of effort	deceleration of composition

Diagram 3

Sensorimotor hand function tests

**Fig. 3**

The assessment of the ability to match fabrics; assessed via the manipulating hand function test (TMF - Needle)

a)



b)

**Legend**

On the left photo the patient's task is to find a shape of the same surface as the control shape without looking (on the photo located utmost on the left). Before performing the task, the patient received verbal instructions, an illustrative example and the possibility to feel the tested surface. On the right photo the same patient while performing one of the TMF subtests - putting the needle through the holes using both hands. The coordination of both hands in bimanual activity is stagnating.

DISCUSSION

In the three case studies we show the differences between the results of estimative neurological examinations and the detailed examination of sensorimotor hand functions through other five tests used in our rehabilitation practice. According to clinical neurological examination, all the above mentioned patients were classified as patients with slight deficit or without neurological motor deficit. However, more extended functional examination revealed various deficits in somatosensory and motor hand functions with impact on performance common and work activities.

In the first patient, a deficit in sensory discrimination and also a motoric defect of the hemiparetic upper limb has been diagnosed. It was evidenced not only by achieving time limits during the motor hand tests but also in the quality of the grasp and in the motorics of the whole upper extremity (Fig. 1). According to the results obtained through Barthel's index the patient was completely self-sufficient in common daily tasks.

In the second patient, a motoric deficit of the hemiparetic upper limb is observed, which is evidenced in a deceleration of performance in the fine motoric test NPHT as well as in performing of the handling tasks in the TMF test using of the set of blocks Ministav (Fig. 2). According to the results obtained through Barthel's index, the patient was completely self-sufficient in common daily tasks.

In the third patient, both a severe deficit of somatosensory functions and the deficit of motoric functions were seen. During more detailed examination it has been found that if the patient can compensate sensory impairment via sight, she is able to manage common activities of daily living without bigger problems. As soon as this possibility is restricted or excepted, severe impairment of motor hand functions occurs, which is manifested in deceleration of fine manual activity, less accuracy and excessive effort (Fig. 3). According to the results obtained through Barthel's index the patient was completely self-sufficient in common daily tasks.

In 1999, the Winward group carried out a project in Great Britain. It's aim was to find out to what extent attention and space is given by three groups of professionals (neurologists, physiotherapists and occupational therapists) to the examination of somatosensory functions into their clinical practice. The clinical neurologists consider testing somatosensory functions to be important within the context of identifying the extent and grade of a stroke. The physiotherapists consider the results of the tests important for planning the treatment and aims of rehabilitation. The occupational therapists claimed that the main reason for assessing somatosensory functions was the education of the patient and his/her career. All three groups agreed that testing so-

matosensory functions generates useful information for the patient's prognosis. They also point out that there are no simple objective nor standardized assessments in clinical practice (Winward et al., 1999).

The choice of tests used during the examination of sensorimotor hand functions should correspond with the planned intervention (therapy) and should be aimed at the patient, i. e. should correspond with the tasks being assessed (e. g. impairment, activity or participation).

The choice of tests depends on economic, material and personnel potentialities of the professional workplaces. The requirements for testing can be changed during the treatment in relation to changes in the patient's condition and to specific defined goals of rehabilitation. Obviously the problem of testing has not been unambiguously solved so far because particular clinical workplaces concerned with this issue are still looking for appropriate sets of tests or they even try to create their own test or their set of tests. The reasons are on the economic and the actual unavailability of some testing procedures used abroad, poor awareness of their standardization and sometimes also unwillingness to cooperate in workplaces where these patients are hospitalized, during the verification and implementation of the new tests.

CONCLUSIONS

High quality tests should provide valid information on present impairments in examination systems in order to be able to focus on the therapy appropriately. The tests must be based on sensorimotor mechanisms and neurophysiological rules of motor control. This type of approach complies with the evidence based practice rehabilitation. Routine neurological examinations are appropriate for fast primary targeting, interception of apparent disorders, and related impairments of sensorimotor functions. For accurate functional diagnostics it is necessary to use special tests and scales for recording also discrete impairments, to avoid ignoring them or neglecting the possibility of adjustment within the process of rehabilitation. This would also help to make the best use of the patient's potential to remove the motoric function deficit.

We consider the following as to be a basis for effective therapy in disabled sensorimotor hand functions of the stroke patients:

- neurological clinical examinations with more detailed focus on motoric and sensory deficits,
- a more specific rehabilitation examination using valid tests, more accurately revealing the presence of impairments in the field of the sensorimotor system,

- targeted use of methods based on the knowledge of neurophysiological mechanisms of motion control and their combinations,
- cooperation within teams and workplaces treating patients with this diagnoses.

The whole expert team must participate in the sensitive diagnostics of impairments and in the diagnosis of the extent of the deficit. The result of their effort should be preferably a complete and integrated diagnosis that would facilitate the choice of the most efficient therapy and to ensure that it is applied according to the highest standards.

REFERENCES

- Brott, T., Adams, H. P., Olinger, C. P. et al. (1989). Measurements of acute cerebral infarction: A clinical examination scale. *Stroke*, 20, 864–870.
- Carey, L. M. (1995). Somatosensory loss after stroke. In *Critical Reviews in Physical and Rehabilitation Medicine*, 7, 51–91.
- Carey, L. M., Oke, L. E., & Matyas, T. A. (1997). Impaired touch discrimination after stroke: A quantitative test. *Journal of Neurological Rehabilitation*, 11, 219–232.
- Carr, J., & Shepherd, R. (1998). *Neurological rehabilitation: Optimizing motor performance*. Oxford: Butterworth-Heinemann.
- Duncan, P. W., Weiner, D. K., Chandler, J., & Studenski, S. (1990). Functional reach: A new clinical measure of balance. *Journal of Gerontology*, 45, 195–197.
- Mathiowetz, V., Weber, K., Kashman, N., & Volland, G. (1985). Adult norms for the nine hole peg test of finger dexterity. *The Occupational Therapy Journal of Research*, 5, 24–37.
- Mayer, M., & Hlušík, P. (2004). Ruka u hemiparetického pacienta: Neurofyziologie, patofyziologie, rehabilitace. *Rehabilitácia*, 41, 9–13.
- Opavský, J. (2003). *Neurologické vyšetření v rehabilitaci pro fyzioterapeuty*. Olomouc: Univerzita Palackého.
- Vyskotová, J. (2003). The use of the special constructional set to diagnose and treat brain function disor-

ders and those of the hand. *Slovenská antropológia: Bulletin Slovenskej antropologickej spoločnosti pri SAV*, 6, 190–192.

Vyskotová, J., & Vaverka, F. (2003). Test of manipulation abilities as a means of therapy to tackle insufficient hand functions. In F. Vaverka (Ed.), *Movement and Health* (pp. 357–360). Olomouc: Univerzita Palackého.

PORUCHY SENZOMOTORICKÝCH FUNKCÍ RUKY PACIENTŮ PO ISCHEMICKÉ CÉVNÍ MOZKOVÉ PŘÍHODĚ - SROVNÁNÍ VÝSLEDKŮ OBVYKLÉHO KLINICKÉHO VYŠETŘENÍ A VYŠETŘENÍ POMOCÍ STANDARDIZOVANÝCH TESTŮ (PŘÍPADOVÁ STUDIE) (Souhrn anglického textu)

Poruchy senzomotorických funkcí ruky po prodělané cévní mozkové příhodě mají negativní dopad na interakce jedince se zevním prostředím, na provádění běžných denních a pracovních činností a tedy na kvalitu života jako takovou (Carey, 1995). Vzhledem k tomu, že struktura i funkce mozkové kůry jsou schopné modifikace po jejím poškození, hledají se nové postupy terapie, které maximálně podporují plastické změny centrálního nervového systému. Výchozím předpokladem úspěšné terapie je cílené a validní vyšetření všech postižených funkcí ruky diferencovaně i komplexně.

V práci prezentujeme výsledky a zkušenosti z vyšetření hospitalizovaných pacientů po cévní mozkové příhodě. Porušené motorické a somatosenzorické funkce jsme hodnotili pomocí testů somatosenzorických a manipulačních funkcí ruky. Na třech kazuistických případech poukazujeme na rozdíly mezi nálezy klinického neurologického a funkčního vyšetření ruky s použitím cíleně zaměřených speciálních testů.

Klíčová slova: cévní mozková příhoda, hemiparetická ruka, senzomotorické funkce, klinické neurologické vyšetření, funkční testy ruky.

Mgr. Kateřina Macháčková



Palacký University
Faculty of Physical Culture
tř. Míru 115
771 11 Olomouc
Czech Republic

Education and previous work experience

University education at Charles University, Prague.

Work experience in physiotherapy (Rehabilitation centre in Hrabyně), lecturer at the Medical-Social Faculty, University of Ostrava at present.

Foreign study visits:

1992 - Seattle, USA (Hands therapy clinics).

2004 - Glasgow Caledonian University, Great Britain.

2005 - Savonia Polytechnic, Kuopio, Finland.

2006 - National Stroke Research Institute, Melbourne, Australia.

2006 - Savonia University of Applied Sciences, Kuopio, Finland.

First-line publications

Macháčková, K., Vyskotová, J., Opavský, J., & Sochorová, H. (2006). Diagnostika poruch senzomotorických funkcí ruky pacientů po ischemické cévní mozkové příhodě (případové studie). *Rehabilitace a fyzikální lékařství (in press)*.

Řasová, K., & Macháčková, K. (2007). Vyšetření somatosenzorických funkcí. In K. Řasová (Ed.), *Fyzioterapie u neurologicky nemocných (se zaměřením na roztroušenou sklerózu mozkomíšní)*. Praha: Ceros.

PHYSIOLOGICAL ANAEROBIC CHARACTERISTICS OF SLOVENIAN ELITE TABLE TENNIS PLAYERS

Miran Kondrič, Radoje Milić, Gordana Furjan-Mandić*

Faculty of Sport, University of Ljubljana, Ljubljana, Slovenia

*Faculty of Kinesiology, University of Zagreb, Zagreb, Croatia

Submitted in December, 2006

The aim of this research was to analyze the anaerobic characteristics of Slovenian elite table tennis male and female players. A total of 8 subjects were divided into two groups. The first group consisted of the four best Slovenian female players while the second group consisted of the four best Slovenian male players. For measurements we used Wingate test (WAnT). WAnT requires pedaling for 30 s at maximal speed against a constant force setting to yield the highest mean and peak power. We used the original recommended equation for force settings ($0.075 \text{ kp}\cdot\text{kg}^{-1} \text{ bw}$, a force equivalent to a level of mechanical work of $4.41 \text{ J rev}^{-1} \text{ kilogram}^{-1} \text{ bw}$) on the Monark 634 ergo meter. To estimate the lactate concentration in the blood and muscles, we collected $20 \mu\text{L}$ blood samples from the participants' heparinized earlobes, before and immediately after finishing the test and also, respectively, 3, 5 and 7 minutes after the test for lactate analysis. The data were processed by the statistical software SPSS 8.0 for Windows and the software for WAnT. The anaerobic capacities of the subjects as measured by the WAnT 30 second test indicated that the male group developed a mean power of $7.95 \text{ watts}\cdot\text{kg}^{-1}$ with a peak power of $9.60 \text{ watts}\cdot\text{kg}^{-1}$, and that power output declined by 33.08% over 30 seconds. For the female group the corresponding values were a mean power of $6.55 \text{ watts}\cdot\text{kg}^{-1}$ with a peak power of $8.03 \text{ watts}\cdot\text{kg}^{-1}$, and that power output declined by 31.83% over 30 seconds. The peak power calculated in this study ranged from $8.7 \text{ watts}\cdot\text{kg}^{-1}$ to $10.4 \text{ watts}\cdot\text{kg}^{-1}$ in the male group and $7.0 \text{ watts}\cdot\text{kg}^{-1}$ to $8.8 \text{ watts}\cdot\text{kg}^{-1}$ in the female group. Based on the established sensitivity of the WAnT to detect changes brought about by the basic physical preparation of table tennis players, our research addresses the problem of training effects on anaerobic performance.

Keywords: Table tennis, motor tests, anaerobic ability, Wingate anaerobic test.

INTRODUCTION

The modern table tennis game demands very good motor abilities such as: speed, strength, endurance, agility, balance and good reflexes and sense of touch. The majority of world top players prefer to concentrate on an attacking or counter attacking game. Many young players have sound backhand plays but very few are able to match their forehand power capabilities.

Numerous table tennis trainers have focused on maximal aerobic capacity, completely ignoring such items as peak muscle power and local muscle endurance, even though these fitness components are important for various situations in the table tennis game. For example, there are many events where it is essential to develop high intensity power instantaneously or within a few seconds. Intermediate term anaerobic performance capacity is defined as the total work output during a maximal exercise repetition lasting for about 30 s. This can be considered as being equivalent to the Wingate test in terms of intensity and duration (MacDougall, Wenger, & Green, 1991).

Tests of anaerobic ability involve very high intensity exercise lasting between a fraction of a second and several minutes (Skinner & Morgan, 1985). The anaerobic capacity is set by an accumulation of lactic acid within the active muscles during the training or testing. During the effort, production of lactate continues for about 40 to 50 seconds, but usually exercise is halted when a blood lactate concentration of 10 to 15 mmol per liter has been reached, although intramuscular concentrations may be then be as high as 30 mmol per liter (Shephard, 1987). Gladden (2004) reports that lactate can no longer be considered the usual suspect for metabolic "crimes", but is instead a central player in cellular, regional and whole body metabolism. Very few scientific studies in table tennis have been conducted on anaerobic performance as a component of fitness. Even today, many coaches, fitness appraisers, health professionals and others consider fitness and physical working capacity to be synonymous with aerobic fitness (deVries, 1986).

Performance in table tennis and also in any sporting event is the result of a number of factors, which include the amount and structure of training performed, the

body's predisposition and adaptation to the training, motivation level, facilities, social-cultural background, etc. Therefore, physiological parameters only account for a portion of any performance, and so the role of any exercise physiologist is also similarly limited. Through fitness testing, the factors involving physiological processes, over which there is some control, can be measured and ultimately improved upon. Competition is the ultimate test of performance capability, and is therefore the best indication of training success. Nevertheless, when trying to maximize performance, it is important to determine the player's ability in individual aspects of performance. Fitness testing attempts to measure individual components of performance, with the ultimate aim of studying and maximizing the player's ability in each component (Kondrič & Furjan-Mandić, 2002).

Benefits of fitness testing in table tennis are necessarily for the exact planning of training. First of all we can identify and establish the weaknesses and strengths of the player. This can be done by comparing test results to those of other athletes in the same training group or a similar population group. Previous test results of large groups are often published as normative tables. In the case of the smaller nations there is a problem of how to assure enough subjects in order to set standards, which are to be declared as norms for table tennis players.

Fitness testing is primarily used for help in designing the most appropriate athletic training programme for the achieving of better results in the table tennis game. Training at the anaerobic level is, for the table tennis player, just as important as training at the aerobic level. Table tennis is a unique game requiring instant explosive power and endurance at the same time; both tempered with the fine motor control utilized during the overall match. In modern table tennis most international competitors favor an aggressive and powerful game in which anaerobic performance is of great importance. The aim of our research was to find out what are the physiological anaerobic characteristics of Slovenian elite table tennis players.

METHODS

Subjects

A total of 8 subjects were divided into two groups. The first group consisted of the four best Slovenian female players while the second group consisted of the four best Slovenian male players. All of them are members of the Slovenian national table tennis team. These players were highly ranked in the national ranking list and had taken part in the last two World and European Championships.

Description of the test and test lay-out

The Wingate anaerobic test (WAnT) has been accepted in laboratories around the world to assess muscle power, muscle endurance and fatigability (Bouchard, Taylor, Simoneau, & Dulac, 1991; Inbar, Bar-Or, & Skinner, 1996; Bar-Or, 1987). The Wingate anaerobic test (WAnT) is a state of the art review of the most widely used anaerobic performance test in the world. The test has been chosen because numerous laboratories have confirmed its very high reliability as well as its validity as a test that can yield information on peak mechanical power and on local muscle endurance. Peak power is the highest mechanical power elicited from the test taken as the average power over any 5 s period. Mean power is the average power maintained throughout the six 5 s segments. The fatigue index is the amount of the decline in power during the test expressed as a percentage of peak power (Inbar, Bar-Or, & Skinner, 1996). For a long period of time it has been considered that the 30 s maximal test does not tax maximally lactic anaerobic capacity (Jacobs et al., 1982) but the latest study on energetics of WAnT (Beneke, Pollmann, Bleif, Leithäuser, & Hütler 2002) clearly underlined the fact that WAnT metabolism is highly anaerobic, and showed that 80% of the energy turnover during test is derived from anaerobic alactic and lactic acid metabolism dominated by glycolysis. According to the published data, we can support the hypothesis that the maximal ATP generation rate from the ATP-PC system is insufficient for the generation of energy necessary for the production of peak power (Weicker & Strobel, 1994), so that energy from anaerobic lactic acid metabolism can be assumed to contribute to power output even within the initial 5 s of the WAnT (Bangsbo et al., 1990; Boobis, Williams, & Wooton, 1982; Jones et al., 1985; Jacobs et al., 1982, 1983). Kavanagh and Jacobs (1988) investigated oxygen consumption during the Wingate test after noting conflicting data that reported aerobic contributions ranging from 13 to 44% during the 30 s test. Based on an assumed mechanical efficiency of 25% for cycle exercise, they estimated the aerobic contribution to be 18.5%. Other studies (Smith & Hill, 1991) using similar procedures, estimated the aerobic contribution to be 16%. In contrast to these rather low estimates, 5 studies that used the accumulated oxygen deficit to quantify energy supply reported values between 23 to 33% for 30 s of maximal, exhaustive exercise (Withers, Sherman, & Clark, 1991; Gatin & Lawson, 1994; Calbet, Chavarren, & Dorado, 1997; O'Brien, Payne, & Gatin, 1997). The peak oxygen deficit was determined by the method developed by Hermansen and Medbø (1984). Peak oxygen deficit was calculated as the difference between the total oxygen uptake (liters) and the estimated total energy required during the supramaximal bout of

exercise. The total energy required was calculated as the product of the rate of energy expenditure and the exercise duration. In line with these estimates, Bogdanis et al. (1996) using direct muscle measures, reported a 29% aerobic contribution.

The WAnT requires pedaling for 30 s at maximal speed against a constant force setting to yield the highest mean and peak power. We used the original recommended equation for force settings ($0.075 \text{ k} \cdot \text{p} \cdot \text{kg}^{-1} \text{ bw}$, a force equivalent to mechanical work of 4.41 J per pedal revolution per kilogram body weight) on the Monark 634 ergometer (Bar-Or, 1987). A sampling period of 1 s was obtained by using the special sensor and data acquisition software (SMI, USA). Warm-ups were done on a cycle ergometer to promote more specific physiological and motor adaptations. The subjects pedal as fast as possible against a low resistance to overcome the inertial and frictional resistance of the flywheel and to shorten the acceleration phase. After a few seconds the full load is then applied to start the 30 s test. The subject needs to pedal as fast as possible from the beginning and to maintain maximal speed throughout the 30 s period.

To estimate lactate concentration in the blood and muscles, we collected $20 \mu\text{L}$ blood samples from their heparinized earlobes, before and immediately after they finished the test and also, respectively, 3, 5 and 7 minutes after the test for lactate analysis. Blood samples

were stored in special plastic containers with EDTA (Eppendorf, Germany) and sent for immediate biochemical analysis by an Eppendorf Ebio+ lactate analyzer. The lactate analysis was carried out within one hour after the test.

To prevent dizziness and syncope following the exertion of the WAnT, each subject pedalled for 2–3 minutes against a light resistance immediately after the test to cool down.

Statistics

Data were processed by the statistical software SPSS 8.0 for Windows and the software for WAnT. The results, unless otherwise specified, are in median values with standard deviations. A oneway analysis of variance (ANOVA) was used to test all variables for significant differences among two groups (Petz, 1981). When the result of the ANOVA was significant ($p < 0.05$), canonical discriminant analysis was done for significant effects between the two groups.

RESULTS

The results of both groups are presented in TABLE 1 and TABLE 2. In TABLE 3 are the results of ANOVA and in TABLE 4 the results of canonical discriminant analyses.

TABLE 1

Anaerobic capacities of selected male table tennis players

Group A											
Player	Ppeak	Pmean	Pmin	F-Index	La rest	La max	La 3	La 5	La 7	Work	Rel Work
	W/kg	W/kg	W/kg	%	mmol/L	mmol/L	mmol/L	mmol/L	mmol/L	Joules	J/kg
M1	9.2	7.5	5.80	37.50	1.8	3.4	7.5	8.2	8.2	15 449	224.0
M2	8.7	7	5.60	35.40	1.8	5.2	9.6	11.1	11.2	16 170	210.0
M3	10.1	9	7.70	23.80	1.7	3.4	8.2	9.4	10.2	20 853	271.0
M4	10.4	8.3	6.70	35.60	1.9	7	10.1	11.5	11.4	18 653	249.0
No cases	4	4	4	4	4	4	4	4	4	4	4
Min	8.70	7	5.60	23.80	1.70	3.4	7.50	8.20	8.20	15 449.00	210.00
Med	9.65	7.9	6.25	35.50	1.80	4.3	8.90	10.25	10.70	17 411.50	236.50
Max	10.40	9	7.70	37.50	1.90	7	10.10	11.50	11.40	20 853.00	271.00
Average	9.60	7.95	6.45	33.08	1.80	4.75	8.85	10.05	10.25	17 781.25	238.50
SD	0.79	0.88	0.96	6.26	0.08	1.72	1.21	1.53	1.46	2 465.16	27.01
Skew	-0.21	0.25	0.81	-1.86	0.00	0.85	-0.14	-0.44	-1.33	0.57	0.31
Kurt	-3.49	-1.97	-1.20	3.60	1.50	-1.29	-3.67	-2.92	1.17	-2.13	-2.03

TABLE 2

Anaerobic capacities of selected female table tennis players

Group B											
Player	Ppeak	Pmean	Pmin	F-Index	La rest	La max	La 3	La 5	La 7	Work	Rel Work
	W/kg	W/kg	W/kg	%	mmol/L	mmol/L	mmol/L	mmol/L	mmol/L	Joules	J/kg
F1	7.9	6.7	5.40	31.30	1.6	6.6	10.4	11.3	10.8	12 663	201.0
F2	7.0	5.8	4.90	30.30	1.9	6.5	11.7	12.0	12.1	12 065	175.0
F3	8.4	6.6	5.10	38.70	1.2	4.5	9.2	8.7	8.6	11 942	199.0
F4	8.8	7.1	6.40	27.00	1.6	3.2	7.1	7.4	7.6	13 301	225.0

No cases	4	4	4	4	4	4	4	4	4	4	4
Min	7	5.80	4.90	27	1.20	3.20	7.10	7.4	7.60	11 942	175
Med	8.15	6.65	5.25	30.8	1.60	5.50	9.80	10	9.70	12 364	200
Max	8.80	7.10	6.40	38.7	1.90	6.60	11.70	12	12.10	13 301	225
Average	8.03	6.55	5.45	31.83	1.58	5.20	9.60	9.85	9.78	12 492.75	200.00
SD	0.78	0.54	0.67	4.94	0.29	1.65	1.95	2.16	2.05	624.11	20.43
Skew	-0.80	-1.04	1.46	1.16	-0.52	-0.51	-0.53	-0.21	0.13	0.79	0.00
Kurt	0.13	1.97	2.12	2.10	1.65	-3.11	-0.04	-3.84	-3.13	-1.35	1.45

The anaerobic capacities of the subjects as measured by the WAnT 30 second test are presented in TABLE 1 and TABLE 2 and indicated that the male group developed a mean power of 7.95 watts per kg⁻¹ and a peak power of 9.60 watts per kg⁻¹, which power output declined by 33.08% over a 30 second period. For the female group the corresponding values were

a mean power of 6.55 watts per kg⁻¹ and a peak power of 8.03 watts per kg⁻¹, which power output declined by 31.83% over a 30 second period.

The peak power, calculated in this study, ranged from 8.7 watts per kg⁻¹ to 10.4 watts per kg⁻¹ in the male group and 7.0 watts per kg⁻¹ to 8.8 watts per kg⁻¹ in the female group. The fatigue index varied from 23.80% to 37.50% in males and 27.00% to 38.70% in females.

TABLE 3

One way ANOVA table

		Sum of squares	df	Mean square	F	Sig
PPEAK Groups	Between	4.961	1	4.961	8.117	.029
	Within	3.668	6	0.611		
	Groups	8.629	7			
	Total					
PMEAN Groups	Between	3.920	1	3.920	7.304	.035
	Within	3.220	6	0.537		
	Groups	7.140	7			
	Total					
PMIN Groups	Between	2.000	1	2.000	2.927	.138
	Within	4.100	6	0.683		
	Groups	6.100	7			
	Total					
FINDEX Groups	Between	3.125	1	3.125	0.098	.764
	Within	190.535	6	31.756		
	Groups	193.660	7			
	Total					
LAREST Groups	Between	0.101	1	0.101	2.271	.183
	Within	0.267	6	4.458E-02		
	Groups	0.369	7			
	Total					

LAMAX	Between	0.405	1	0.405	0.143	.719
Groups		17.050	6	2.842		
Groups	Within	17.455	7			
	Total					
LA3	Between	1.125	1	1.125	0.426	.538
Groups		15.830	6	2.638		
Groups	Within	16.955	7			
	Total					
LA5	Between	8.000E-02	1	8.000E-02	0.023	.885
Groups		21.100	6	3.517		
Groups	Within	21.180	7			
	Total					
LA7	Between	0.451	1	0.451	0.143	.719
Groups		18.998	6	3.166		
Groups	Within	19.449	7			
	Total					
WORK	Between	55936464.500	1	55936464.500	17.300	.006
Groups		19399661.500	6	3233276.917		
Groups	Within	75336126.500	7			
	Total					
RELWORK	Between	2964.500	1	2964.500	5.169	.063
Groups		3441.000	6	573.500		
Groups	Within	6405.500	7			
	Total					

A one way analysis of variance (ANOVA) was used to test all variables for significant differences between the two groups. In three variables (PPEAK, PMEAN and WORK) there are significant differences between the two measured groups. A canonical discriminant analysis showed that there is a high correlation (0.939) but because of the low number of variables it is not statistically significant.

TABLE 4
Canonical discriminant function

Function	Eigenvalue	% of variance	Cumulative %	Canonical correlation
1	7.508 ^a	100.0	100.0	0.939

DISCUSSION

During high intensity exercise, lactate accumulates as the result of lactic acid production being greater than its removal. At a physiological pH level, lactic acid, a strong organic acid, dissociates a proton (H⁺) and almost completely dissociates into hydrogen and lactate ions; therefore, the term lactic acid and lactate are used synonymously (Brooks, 1985). A strong correlation between blood and muscle lactate concentrations exists during exercise (Foster, Schrage, & Snyder,

1995; Jacobs, 1986; Karlsson & Jacobs, 1982). However, it is erroneous to interpret blood lactate accumulation as being wholly reflective of muscle lactate production. Blood lactate concentration depends on the existence of a net positive gradient for lactate between muscle tissue and the blood, and is affected by dilution in the body's water; by removal by organs such as the liver, heart and inactive skeletal muscle; and by the temporal lag before lactate produced in the muscle appears in the blood (Foster, Schrage, & Snyder, 1995). Therefore, at high muscle lactate concentrations there may be a significant time lag before lactate equilibrates with the blood. In our measurements we found peak lactate concentrations in the blood after the 7th minute in group A, and after the 5th minute in group B. Also, the values of peak lactate concentrations were significantly higher in group A.

It is generally agreed that most anaerobic tests are reliable in motivated subjects and that they correlate highly with each other, but there is less agreement about what they measure. It is difficult to determine the amount of aerobic and anaerobic involvement in tests lasting more than a few seconds. WAnT measures the performance of several muscle groups combined and therefore cannot yield information about any specific muscle or muscle group.

The practical problem of measuring the anaerobic characteristics of table tennis players during sporting activity has meant that the majority of assessments have

been carried out in the laboratory on cycle ergometers and not in the practice hall at the table. However, many sports, including table tennis, require intermittent exercise, and such tests therefore represent artificial situations.

The desirability of a minimum quantity of strength in table tennis has long been recognized. Unfortunately the advantages of maximum levels of strength in table tennis have not yet been recognized by all physical educators, athletes and coaches. This neglect of the strength factor was the result of an unscientific acceptance by almost everyone concerned that the development of large amounts of strength in the musculature inevitably resulted in a condition known as muscle-bound. Being muscle-bound was supposed to limit both the range and speed of table tennis strokes.

The importance of strength in table tennis is not always obvious. However, the need to produce powerful strokes, the need for maximum power is apparent. From this point of view we can observe power as the result of two factors: strength to produce the force and speed to increase the rate at which the force can be applied (first of all by putting a spin on a spin play).

The registered changes are different due to different choices of force settings that would elicit the highest possible peak power and mean power. In the present study we used the recommended force settings $0.075 \text{ kpkg}^{-1} \text{ bw}$, a force equivalent to mechanical work of 4.41 J per pedal revolution per kilogram of body weight. It is difficult to compare the findings of several authors (e.g. Inbar & Bar-Or, 1977; Inbar et al., 1989; Rhodes, Cox, & Quinney, 1986) because of their different testing protocols, incompatible athletic proficiency and unequal ages. Skinner and O'Connor (1987) tested 44 male athletes from several specialties who performed the WAnT. There were no significant differences between "anaerobic" and "aerobic" athletes in mean power (8.8 to 9.3 W.kg^{-1}). The peak power of the group was 11.2 W.kg^{-1} and the fatigue index was 38.1% . Although there are no significant differences in mean power, the "anaerobic athletes" had higher initial values but fatigue more rapidly, while the "aerobic" athletes had lower initial values but fatigue less rapidly. There are no data for table tennis players. Inbar (1985) found that the highest absolute values in W for mean and peak power were found in rowers. In Fig. 1 (male) and Fig. 2 (female) anaerobic performance capacities of elite Israeli athletes in various sport events are compared with Slovenian table tennis players.

Fig. 1

Anaerobic performance capacity (relative to body mass) of elite male Israeli athletes in various sport events and Slovenian table tennis players

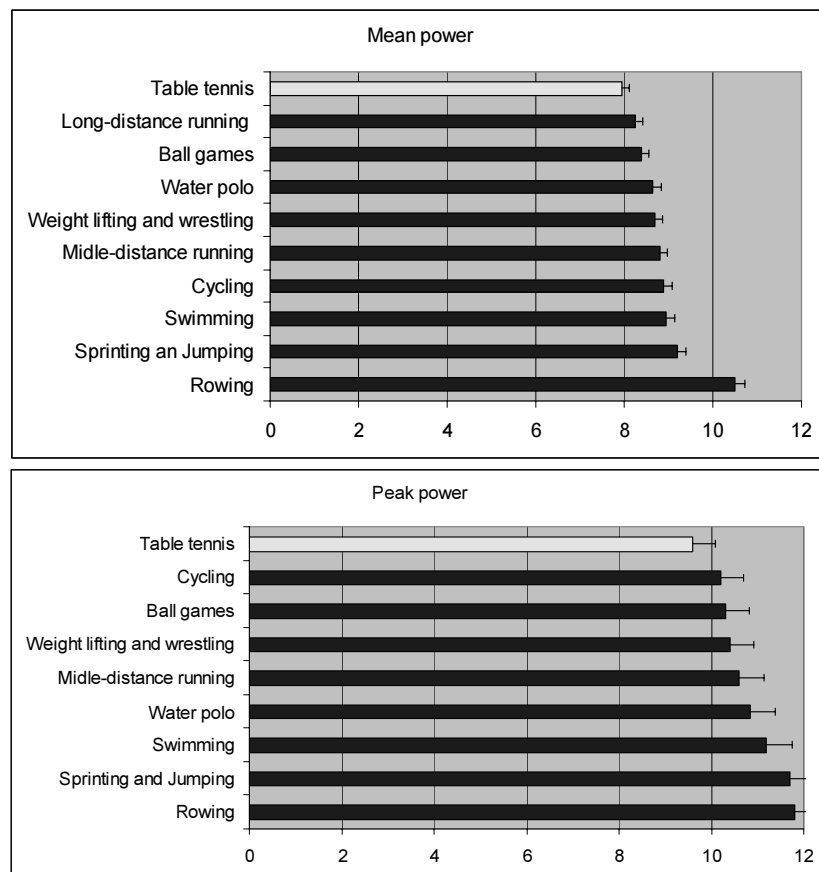
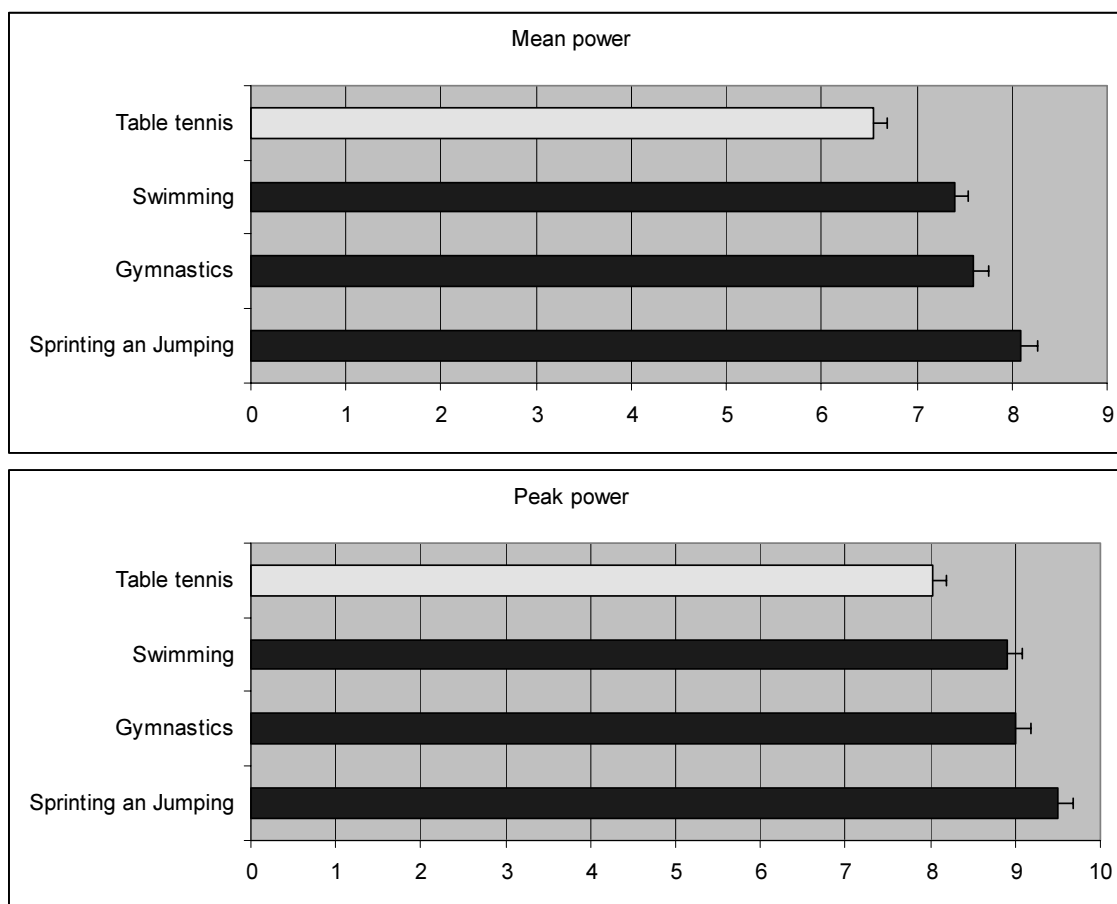


Fig. 2

Anaerobic performance capacity (relative to body mass) of elite female Israeli athletes in various sport events and Slovenian table tennis players

**TABLE 5**

The anaerobic performance capacity of Slovenian and Australian table tennis players

	Peak power (watts.kg ⁻¹)	Total power (watts.kg ⁻¹)	Power decline (%)
Australia - male	9.89	7.60	39.95
Slovenia - male	9.60	7.95	33.08
Australia - female	7.68	6.13	32.59
Slovenia - female	8.03	6.55	31.83

Allen (1986) tested 21 male and female table tennis players nominated by four State table tennis associations performed the WAnT. As shown in TABLE 5, there were some differences between Slovenian and Australian players. Despite the fact that we do not have enough data about physical preparation programs, it is difficult to find a reason why there are differences.

CONCLUSIONS

Based on the established sensitivity of the WAnT to detect changes brought about by the basic physical

preparation of table tennis players, our research addresses the problem of training effects on anaerobic performance.

We can conclude that performance under conditions measured by WAnT is primarily anaerobic with a major lactic component. The work rate at the end of such a performance test can perhaps be considered to be an indirect estimate of the lactic anaerobic power output.

Despite being involved in an anaerobic sport, it appears that these athletes - both male and female - do not possess appropriately developed anaerobic energy delivery systems. These capacities should be well developed in athletes who depend on anaerobiosis dur-

ing long stretches where they are trying to win points, especially if they play the half distance or are defensive players.

In spite of the fact that the group we measured is so small, much more research must be done on this topic.

REFERENCES

- Allen, G. D. (1986). Physiological characteristics of elite table tennis athletes and their responses to high level competition. In *Australian sports commission's: Applied sports research program*. Australian sports commission.
- Bangsbo, J., Gollnick, P. D., Graham, T. E., Juel, C., Kiens, B., Mizuno, M., & Saltin, B. (1990). Anaerobic energy production and O₂ deficit-debt relationship during exhaustive exercise in humans. *Journal of Physiology*, 539-559.
- Bar-Or, O., Dotan, R., Inbar, O., Rothstein, A., Karlsson, J., & Teach, P. (1980). Anaerobic capacity and muscle fibre type distribution in man. *International Journal of Sports Medicine*, 1, 82-85.
- Bar-Or, O. (1987). The Wingate anaerobic test: An update on methodology, reliability and validity. *Sports Medicine*, 4, 381-391.
- Beneke, R., Pollmann, C., Bleif, I., Leithäuser, R., & Hütler, M. (2002). How anaerobic is the Wingate anaerobic test for humans? *European Journal of Applied Physiology*, 87(4/5), 388-392.
- Billat, V. L., Sirvent, P., Py, G., Koralsztein, J. P., & Mercier, J. (2003). The concept of a maximal lactate steady state: A bridge between biochemistry, physiology and sport science. *Sports Medicine*, 33(6), 407-426.
- Bogdanis, G. C., Nevill, M. E., Boobis, L. H., & Lakomy, H. K. (1996). Contribution of phosphocreatine and aerobic metabolism to energy supply during repeated sprint exercise. *Journal of Applied Physiology*, 80(3), 876-878.
- Boobis, L. H., Williams, C., & Wooton, S. A. (1982). Human muscle metabolism during brief maximal exercise. *Journal Physiology*, 338, 21-22.
- Bouchard, C., Taylor, A. W., Simoneau, J. A., & Dulac, S. (1991). Testing anaerobic power and capacity. In J. D. MacDougall, H. A. Wegner, & H. J. Green (Eds.), *Physiological testing of the high performance athlete* (pp. 175-221). Champaign, IL: Human Kinetics.
- Brooks, G. A. (1985). Anaerobic threshold: Review of the concept and direction for future research. *Med. Sci. Sports Exer.*, 17, 31-35.
- Calbet, J. A. L., Chavarren, J., & Dorado, C. (1997). Fractional use of anaerobic capacity during a 30 and a 45 s Wingate test. *European Journal of Applied Physiology*, 76, 308-313.
- DeVries, H. A. (1986). *Physiology of exercise*. Dubuque, Iowa: Wm. C. Brown Publisher.
- Evans, J. A., & Quinney, H. A. (1981). Determination of resistance settings for anaerobic power testing. *Canadian Journal of Applied Sport Sciences*, 6, 53-56.
- Foster, C., Schrager, M., & Snyder, A. C. (1995). Blood lactate and respiratory measurement of the capacity for sustained exercises. In P. J. Maud & C. Foster (Eds.), *Physiological assessment of human fitness* (pp. 57-59). Champaign, IL: Human Kinetics.
- Gastin, P. B. (2001). Energy system interaction and relative contribution during maximal exercise. *Sports Medicine*, 31(10), 725-741.
- Gastin, P. B., & Lawson, D. L. (1994). A variable resistance all-out test to generate accumulated oxygen deficit and predict anaerobic capacity. *European Journal of Applied Physiology*, 69, 331-336.
- Gladden, L. B. (2004). Lactate metabolism: A new paradigm for the third millennium. *Journal of Physiology*, 558(1), 5-30.
- Hermansen, L., & Medbø, J. I. (1984). The relative significance of aerobic and anaerobic processes during maximal exercise of short duration. *Med. Sport Sci.*, 17, 56-67.
- Inbar, O. (1985). *The Wingate anaerobic test: Its performance, characteristics, application and norms*. Netanya, Israel: Wingate Institut.
- Inbar, O., Bar-Or, O., & Skinner, J. S. (1996). *The Wingate anaerobic test*. Champaign, IL: Human Kinetics.
- Jacobs, I., Bar-Or, O., Karlsson, J., Dotan, R., Tesch, P., Kaiser, P., & Inbar, O. (1982). Changes in muscle metabolites in females with 30 s of exhaustive exercise. *Medicine and Science in Sports and Exercises*, 14, 457-460.
- Jacobs, I., Bar-Or, O., Karlsson, J., Dotan, R., Tesch, P. A., Kaiser, P., & Inbar, O. (1982). Lactate in human skeletal muscle after 10 and 30 s of submaximal exercise. *Journal of Applied Physiology*, 55, 365-367.
- Jacobs, I., Tesch, P. A., Bar-Or, O., Karlsson, J., & Dotan, R. (1983). Changes in muscle metabolites in females with 30 s of exhaustive exercise. *Medicine and Science in Sports and Exercises*, 14, 457-460.
- Jacobs, I. (1986). Blood lactate: Implication for training and sports performance. *Sports Medicine*, 3, 10-25.
- Jones, N. L., McCartney, N., Graham, T., Spriet, L. L., Kowalchuk, J. M., Heigenhauser, G. J. F., & Sutton, J. R. (1985). Muscle performance and metabolism in maximal isokinetic cycling at slow and fast speeds. *Journal of Applied Physiology*, 59(1), 132-136.
- Karlsson, J., & Jacobs, I. (1982). Onset of blood lactate accumulation during muscular exercise as a thresh-

- old concept: Theoretical considerations. *International Journal of Sports Medicine*, 3, 190–201.
- Kavanagh, M. H., & Jacobs, I. (1988). Breath by breath oxygen consumption during performance of the Wingate test. *Canadian Journal of Applied Sport Sciences*, 13(1), 91–93.
- Kondrič, M., & Furjan-Mandič, G. (2002). *Telesna priprava namiznoteniskega igralca*. Ljubljana: Faculty of sport.
- MacDougall, J. D., Wenger, H. A., & Green, H. J. (1991). *Physiological testing of the high performance athlete*. Windsor: Canadian association of sport sciences.
- O'Brien, B., Payne, W., & Gastin, P. (1997). A comparison of active and passive warm ups on energy system contribution and performance in moderate heat. *Aust. J. Sci. Med. Sport*, 29(4), 106–109.
- Petz, B. (1981). *Osnovne statističke metode za nematematičare*. Zagreb: SNL.
- Rhodes, E. C., Cox, M. H., & Quinney, H. A. (1986). Physiological monitoring of National hockey league regulars during the 1985–1986 season. *Canadian Journal of Applied Sport Sciences*, 11, 36.
- Shepard, R. (1987). *Exercise physiology*. Toronto, Philadelphia: B. C. Decker Inc.
- Skinner, J. S. (1987). Wingate test: Cross-sectional and longitudinal analysis. *Medicine and Science in Sports and Exercises*, 19(2), 73.
- Skinner, J. S., & Morgan, D. W. (1985). *Limits of human performance*. Champaign, IL: Human Kinetics.
- Smith, J. C., & Hill, D. W. (1991). Contribution of energy systems during a Wingate power test. *British Journal of Sports Medicine*, 25(4), 196–199.
- Weicker, H., & Strobel, G. (1994). *Sportmedizin-biomechanisch-physiologische Grundlagen und ihre Bedeutung*. Stuttgart: Fischer.
- Withers, R. T., Sherman, W. M., Clark, D. G., Esselbach, P. C., Nolan, S. R., Mackay, M. H., & Brinkman, B. (1991). Muscle metabolism during 30, 60, and 90 s of maximum cycling on an air-braked ergometer. *European Journal of Applied Physiology*, 63(5), 354–362.

**FYZIOLOGICKÉ ANAEROBNÍ
CHARAKTERISTIKY SLOVINSKÝCH
ELITNÍCH HRÁČŮ STOLNÍHO TENISU**
(Souhrn anglického textu)

Cílem tohoto výzkumu byla analýza anaerobních charakteristik slovinských elitních hráčů a hráček stolního tenisu. Celkem 8 osob bylo rozděleno do dvou skupin. První skupina zahrnovala čtyři nejlepší slovinské hráčky a druhá skupina zahrnovala čtyři nejlepší slovinské hráče. Pro měření jsme používali Wingate

test (WAnT). Při WAnT se provádí šlapání po dobu 30 sekund při maximální rychlosti proti konstantnímu silovému nastavení, aby se dosáhlo nejvyšší střední a vrcholové síly. Pro silové nastavení jsme použili původní doporučenou rovnici ($0,075 \text{ kpkg}^{-1} \text{ bw}$, síla odpovídající stupni mechanické práce o $4,41 \text{ J rev.}^{-1} \text{ kilogram}^{-1} \text{ bw}$) na ergometru Monark 634. Pro odhad koncentrace laktátu v krvi a svalech jsme odebírali vzorky krve o $20 \mu\text{L}$ z heparinem ošetřených ušních lalůčků účastníků před a bezprostředně po ukončení testu a také vždy 3, 5 a 7 minut po zkoušce pro analýzu laktátu. Údaje jsme zpracovávali pomocí statistického software SPSS 8.0 pro Windows a pomocí software pro WAnT. Anaerobní vlastnosti subjektů naměřené 30sekundovou zkouškou WAnT ukázaly, že skupina mužů vyvinula střední sílu $7,95 \text{ wattů.kg}^{-1}$ a vrcholovou sílu $9,60 \text{ wattů.kg}^{-1}$ a že silový výkon se po 30 sekundách snížil o 33,08 %. U skupiny žen činila odpovídající hodnota střední síly $6,55 \text{ wattů.kg}^{-1}$ a vrcholová síla $8,03 \text{ wattů.kg}^{-1}$, přičemž silový výkon se po 30 sekundách snižoval o 31,83 %. Vrcholová síla vypočtená při tomto průzkumu se pohybovala od $8,7 \text{ wattů.kg}^{-1}$ do $10,4 \text{ wattů.kg}^{-1}$ ve skupině mužů a od $7,0 \text{ wattů.kg}^{-1}$ do $8,8 \text{ wattů.kg}^{-1}$ ve skupině žen. Na základě stanovené citlivosti WAnT pro detekci změn vyvolaných základní tělesnou přípravou hráčů stolního tenisu se náš výzkum týká problematiky účinků tréninku na anaerobní výkon.

Klíčová slova: stolní tenis, motorické testy, anaerobní schopnosti, anaerobní Wingate test.

Miran Kondrič, PhD.



University of Ljubljana
Faculty of Sport
Gortanova 22
1000 Ljubljana
Slovenia

Education and previous work experience

Head of the department for racquet sports of Faculty of Sport in Ljubljana, Slovenia.

Scientific orientation

His research activities are focused on table tennis, badminton and relations between morphological and motor characteristics.

First-line publications

Kondrič, M. (1996). The expert system for orientation of children into table tennis in the Republic of Slovenia. *International Journal of Table Tennis Sciences*, 3, 125–130.

- Kondrič, M., & Mišigoj-Duraković, M. (2002). Changes of certain anthropometric characteristics in boys 7 to 18 years of age. *International Journal of Physical Education*, 39, 30–35.
- Kondrič, M., & Leskošek, B. (2002). Computer supported system for the evaluation of fitness of Slovenian youth table tennis players. *International Journal of Table Tennis Sciences*, 4(5), 117–126.
- Kondrič, M., Mišigoj-Duraković, M., & Metikoš, D. (2002). A contribution to understanding relations between morphological and motor characteristics in 7 and 9 year old boys. *Kinesiology*, 34(1), 5–15.
- Kondrič, M., Furjan-Mandić, G., & Medved, V. (2006). Myoelectric comparison of table tennis forehand stroke using different ball sizes. *Acta Universitatis Palackianae Olomucensis. Gymnica*, 36(4), 25–31.
-

INSTRUCTIONS FOR MANUSCRIPT

The Acta Universitatis Palackianae Olomucensis. Gymnica is an independent professional journal. The content of the magazine is focused on presentation of research notifications and theoretical studies connected with the problems of kinanthropology. The Editorial Board is looking forward to all manuscripts written on the above subject.

General instructions

The text of the contribution is in English. The contribution is not to exceed a maximum limit of 15 pages (including tables, pictures, summaries and appendices). A summary will be in the Czech language, and by rule 1 page at the most.

The text is to be presented in MS Word editor and also as a printout.

All contributions are reviewed anonymously.

Interface of the contribution

Title of the contribution, name(s) of its author(s), workplace, date of handing in the contribution, summary of the text in English, key words.

Text of the contribution

Names of individual chapters are to be written in capital letter from the left margin. References to quoted authors see a brief from the publication manual <http://www.gymnica.upol.cz>.

Epilogue of the contribution

A reference summary (see a brief from the publication manual <http://www.gymnica.upol.cz>), address of the main author, summary including the key words.

Tables, pictures, graphs, appendices

To be written on separate pages. A table is to be marked as TABLE 1 with its name below, write on the left margin above the table (the same applies for appendices). A picture is to be marked as Fig. 1, write from the left above the picture (the same applies for a graph).

All contributions to Acta UPO Gymnica must have been corrected by an English expert before being submitted to us. Please enclose an official confirmation of this correction. If possible we would appreciate the text in the original language.

We look forward to our further cooperation!

Doc. PhDr. Vlasta Karásková, CSc.
Executive Editor

Doc. MUDr. Pavel Stejskal, CSc.
Chairman of the Editorial Board

Address: Palacký University
Faculty of Physical Culture
tř. Míru 115
771 11 Olomouc
Czech Republic

Phone: +420 585 636 357
E-mail: aupo@ftknw.upol.cz

POKYNY PRO PŘÍPRAVU RUKOPISU

Acta Universitatis Palackianae Olomucensis. Gymnica je nezávislý odborný časopis. Svým obsahem je zaměřen na prezentaci původních výzkumných sdělení a teoretických studií, které se vztahují k vědecké problematice kinantropologie. Redakce vítá všechny rukopisy zpracované v tomto duchu.

Obecné pokyny

Text příspěvku v jazyce českém odevzdejte laskavě výkonnému redaktorovi. Na základě doporučující recenze upraví autor příspěvek k publikaci.

Text příspěvku je v jazyce anglickém. Rozsah příspěvku je max. 15 stran (včetně tabulek, obrázků, souhrnu a příloh). Souhrn je v jazyce českém (max. 1 strana).

Odevzdává se text v editoru Word a 1 výtisk textu.

Všechny příspěvky jsou anonymně recenzovány.

Úvod příspěvku

Název příspěvku, plná jména autorů, pracoviště, datum odevzdání příspěvku, krátký souhrn textu, klíčová slova.

Text příspěvku

Názvy jednotlivých kapitol velkými písmeny píšeme zleva. Odkazy jen na autory a publikace, uvedené v referenčním seznamu.

Závěr příspěvku

Referenční seznam, adresa hlavního autora, souhrn v češtině, včetně názvu a klíčových slov.

Tabulky, obrázky, grafy, přílohy

Píšeme na samostatné stránky. Tabulku označíme TABLE 1, obrázek nebo graf Fig. 1, přílohu Appendix 1. Název je pod označením, píšeme zleva.

Všechny příspěvky musí být před odevzdáním opraveny znalcem anglického jazyka (nejlépe rodilým mluvčím). Provedení korektury je nutno doložit oficiálním potvrzením. Příspěvek je třeba odevzdat taktéž v originální jazykové verzi.

Děkujeme Vám za spolupráci.

Doc. PhDr. Vlasta Karásková, CSc.
výkonný redaktor

Doc. MUDr. Pavel Stejskal, CSc.
vědecký redaktor

Adresa: Univerzita Palackého
Fakulta tělesné kultury
tř. Míru 115
771 11 Olomouc

Telefon: 585 636 357
E-mail: aupo@ftknw.upol.cz

**ACTA
UNIVERSITATIS PALACKIANAE OLOMUCENSIS
GYMNICA**

Vol. 37 No. 3

Published by Palacký University, Olomouc 2007

Preparation and arrangement before print: Mgr. Zuzana Hanelová & Iva Tezzelová
Technical Editor and graphic arrangement: Jitka Bednaříková

Electronic form available on address: <http://www.gymnica.upol.cz>

**ISBN 978-80-244-1850-6
ISSN 1212-1185**