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## PROFESSOR KAREL FRÖMEL IS SIXTY YEARS OLD



Karel Frömel was born on 23<sup>rd</sup> December 1941 in Šumvald as a Christmas present to his parents. The silent period of Christmas filled his character with equanimity and serenity. He finished secondary school by passing the state examination in the "royal" town of Uničov. Later, he graduated from the Faculty of Natural

Sciences of the Palacký University in Olomouc, majoring in the teaching of physical education and mathematics. He became a teacher at the Secondary Agriculture School in Bruntál for a long period of ten years. Living and working in close proximity to the mountains evoked in him a passion for skiing. Nevertheless, his career led him the lowlands of Haná. In 1971, he became a professional assistant at the Department of theory and methodology of physical education at the Faculty of Natural Sciences, Palacký University, and it was here that his university career took off. Through the doctorate of philosophy in 1976 (PhDr.), science candidature in 1980 (CSc.) and habilitation in 1984 (doc.), he rose to the prestigious position of a prominent specialist in the field of theory of teaching of physical education. In 1990, he belonged to the most active pedagogues, merited in the founding of the Faculty of Physical Culture under the Palacký University, where he continued his pedagogical and scientific activities. In 1992, he obtained the doctorate degree in the pedagogical sciences (DrSc.) and in 1997, he earned the honour of being appointed by the President as a professor of kinanthropology. He assumed leadership of the scientific activities at the Department of kinanthropology and the Faculty. On a long-term basis, he has participated on the concept of school physical education in the education system and the development of pedagogical kinanthropology in the Czech Republic. As an excellent specialist in the field of didactics, he is a member of the working team for the pedagogy, psychology and kinanthropology accreditation committee at the Ministry of Schools, Youth and Sports of the Czech Republic. He is invited as a keynote speaker at numerous international conferences to impart his expertise on health and sports. He has led and is leading, numerous research teams, including those with foreign participation from the Slovak Republic, Poland, Germany, Sweden and the U. S. A. He is a responsible head of the national and international scientific research grants. He has published 316 scientific and professional papers, 65 out of them abroad. He is attuned to the needs of the times to come and that is why, he became a supervisor for 12 post-doctorate students. Since 1994, he is the Vice-

dean for pedagogical affairs and the statutory representative for the Dean. His personal interest and efforts resulted in the establishment of a credit scoring study curriculum at the Faculty. As a prominent European specialist, he is a member of the Academic Senate and a visiting professor at the Academy of Physical Education in Katowice.

In his work, he is focused on the formation and the application of theory of programmed learning and creatively orientated instruction at schools and in the preparation of professional students. At the present time he studies first of all problems of physical activity in children and youth. Systematically, he strives for continuity in scientific and pedagogical works, and in the application of scientific findings in schools and sports practice. His current engagements are in the foreground of earlier works in the centre of top sport under the TJ University Olomouc, women's volleyball where he directed his efforts on the training practise and contributed to the long term extra-league status of the women's team (initially comprising the female students of physical education). When not at work, he finds time to engage in sporting activities of his choice in order to remain physically fit. He still takes part in the students' skiing course as an instructor. Professor Karel Frömel harbours an outstanding personality at the Faculty of Physical Culture of Palacký University.

We wish him good health, spiritual freshness, and many resolved research issues and we hope that he will continue to be stand by the Faculty for years to come.

Professor Frömel, thank you for being with us!

## PROFESOR KAREL FRÖMEL ŠEDESÁTNIKEM

Karel Frömel se narodil svým rodičům jako vánoční dárek pod stromček, a to dne 23. prosince 1941 v Šumvaldě. Období vánoční pohody naplnilo jeho povahu vyrovnaností a klidem. Střední školu absolvoval v královském městě Uničově a posléze vystudoval Přírodovědeckou fakultu Univerzity Palackého v Olomouci, obor učitelství tělesné výchovy a matematika. Deset let působil jako středoškolský profesor na Střední zemědělské škole v Bruntálu. Blízkost hor v něm probudila lásku k přírodě, zvláště pak k lyžování, kterému holduje dodnes.

V roce 1971 se stal odborným asistentem katedry teorie a metodiky tělesné výchovy na Přírodovědecké fakultě Univerzity Palackého v Olomouci a zahájil tak svou dráhu vysokoškolského učitele. Postupně zdolával všechny náročné úkoly, které souvisely s jeho působením na vysoké škole. V roce 1976 složil doktorát z filozofie (PhDr.), v roce 1980 získal kandidaturu věd (CSc.) a v roce 1984 se habilitoval v oboru kinantropologie. Každodenní houževnatá práce a vytrvalost doved-

ly K. Frömela mezi přední odborníky v oboru teorie vyučování tělesné výchově. V roce 1990 se v nemalé míře zasloužil (společně s ostatními kolegy) o ustavení Fakulty tělesné kultury na Univerzitě Palackého v Olomouci, na níž v současné době působí. V roce 1992 dosáhl vědecké hodnosti doktora pedagogických věd (DrSc.) a v roce 1997 byl prezidentem republiky jmenován profesorem pro obor kinantropologie. Stal se předním odborníkem nejen na katedře kinantropologie, ale i na Fakultě tělesné kultury. Dlouhodobě se podílí na vývoji koncepce školní tělesné výchovy v systému vzdělávání a na rozvoji pedagogické kinantropologie v České republice. Jako vynikající odborník v oblasti didaktiky je členem pracovní skupiny pro pedagogiku, psychologii a kinantropologii akreditační komise Ministerstva školství, mládeže a tělovýchovy České republiky. Přednáší zásadní referáty na četných mezinárodních konferencích zaměřených na zdraví a sport, vedl a vede řadu výzkumných týmů i se zahraniční účastí ze Slovenska, Polska, Německa, Švédska a USA. Je odpovědným řešitelem národních i mezinárodních vědeckovýzkumných projektů, do jejichž řešení zapojuje široký okruh spolupracovníků na Fakultě tělesné kultury Univerzity Palackého v Olomouci. Publikoval více než 316 vědeckých a odborných prací, z toho 65 v zahraničí. Nezapomíná ani na budoucnost, a proto se stal školitelem 12 doktorandů. Jako přední evropský odborník je zahraničním profesorem a členem Akademického senátu na Akademii wychowania fizycznego v Katowicích v Polsku.

Od roku 1994 je proděkanem pro pedagogickou činnost a statutárním zástupcem děkana Fakulty tělesné kultury na Univerzitě Palackého v Olomouci. V rámci této funkce se velkou měrou podílel na zavedení kreditního způsobu studia na fakultě.

Ve své práci se zaměřil na tvorbu a aplikaci teorie programovaného vyučování a kreativně orientovaného vyučování na školách i v profesní přípravě studentů. V současné době řeší především problematiku pohybových aktivit dětí a mládeže. Soustavně usiluje o kontinuitu vědecké a pedagogické práce a aplikace vědeckých výsledků ve školské a sportovní praxi. Již v dřívějších letech působil ve středisku vrcholového sportu při TJ Univerzita Olomouc. Věnoval se zejména trenérské činnosti a přispěl k tomu, že volejbalové družstvo žen, tvořené především studentkami oborů s tělesnou výchovou, hraje dlouhodobě v nejvyšší soutěži České republiky. Svou kondici si udržuje tím, že se věnuje sportům, které umožňují jeho pobyt v přírodě. Každoročně se účastní jako instruktor lyžařských kurzů pořádaných pro studenty fakulty.

Profesor Karel Frömel se stal významnou osobností Fakulty tělesné kultury Univerzity Palackého v Olomouci. Do dalších let mu přejeme pevné zdraví, duševní svěžest a mnoho dalších vyřešených výzkumných problémů. Jsme přesvědčeni o tom, že i nadále zůstane oporou naší fakulty.



## CULTURE – SPORT – POLITICS DURING A PERIOD OF SOCIETY TRANSFORMATION IN THE SLOVAK REPUBLIC

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Submitted in October, 2001

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Sport is a social phenomena. Its essence, importance, ways of expression is determined in universal context, especially by cultural, political and economical sphere. Society transformation has several essential features – transition from totality to democracy, building-up the political system of pluralism and legal state as well as transition from planned economy to market economy. Politics created fundamental scope form transformation of sport, particularly by means of laws, which guaranteed transition from totality to parliamentary democracy. It was mainly about free and democratic establishment of sport alliances and associations based on real citizen's interest, democratic principles of their functioning and forming their administrative organs, a new character of relationship between alliances and state. Creating a market milieu had conspicuous impact on the sport sphere. Sport entities – clubs, sections, associations, unions – had to adapted to market milieu, learn how to do business, and through business activities earn financial funds needed to fulfil their main task. Another aspect that brings rather contradictory tendencies is commercialisation and professionalisation of sport, eventually its top contests. It is important in sport for all to make all motor activities necessary and valuable for all members of the society and become a constant part of their lifestyles. This process is mainly determined by emancipation of the spiritual culture and creating the new social structure.

The process of accepting the new values, standards, examples in citizens behaviour, forming the new lifestyles corresponding with actual condition takes the longest period of time. Differences in individual social groups determine also the process of socialisation and re-socialisation, differences between their lifestyles, interests, and needs. Consequently large number of subcultures in society were created. The main subcultures might by assigned according to social, ethnical, national, religious, generation and regional-settlement aspect. The most complicated situation besides Gypsy ethnic group is in the case of the weakened social groups with the lowest income, long term unemployed and youth. In these cases the state help and the help of local bodies and self-government administration is necessary. They can help them in the process of socialisation and offer them available facilities to do sports in town and villages.

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*Keywords: physical activity, sport, sport for all, social interests and values, culture, subculture, social groups, socialisation, re-socialisation.*

Sport is a social phenomenon. Its essence, importance, ways of expression is determined in universal context, especially by cultural, political and economical sphere. It is a subsystem of society as such, it creates its own social system serving its needs and goals. There are a lot of definitions of sport. In my opinion, the one contained in the European Charter of Sport is true to life. It reads as follows: "Sport includes all forms of physical activities where the aim, through occasional or organised activity, is to show or increase man's physical fitness and mental well-being, to form social links, or achieve results in competitions of all categories" (Európska charta, 1992, 10).

Historical development continuity is provided by culture. From the point of view of sociology, culture is so-called „other nature“ a man creates and puts between him and the nature itself, in order to compensate his physical insufficiency, as well as the absence of instincts necessary to survive. A prerequisite for transforming the nature is the ability to co-ordinate

one's activities with those of other people's. It requires their mutual communication, which is not possible without symbols generally admitted. The need for communication determined the rise of language as a communicative instrument that, at the same time, enabled people to cumulate and conserve already gained experience. Since culture embodies all human background and knowledge, succeeding generations are able to continue with work of the one before. That is why the term socio-cultural system is sometimes used to indicate culture of a relatively closed autonomous social group, or a particular community.

As a whole culture is divided into material culture and spiritual culture. Material culture involves all economic results meeting people's material needs, and materialised demonstration of spiritual culture, as well. Spiritual culture is composed of values, standards, symbols, conception and knowledge system (hypotheses, rules, common people's consciousness, philosophical and religious conceptions), and social institutions.

In all its forms and expressions and at all levels sport is determined by both material and spiritual culture. As a result of social changes in November 1989 in former Czechoslovakia a new socio-cultural system started to be formed. It is characterised by its typical values in economic, political, social and spiritual sphere. Society transformation has several essential features – transition from totality to democracy, building-up the political system of pluralism and legal state as well as transition from planned economy to market economy. Spiritual culture was deliberated of its dependence upon state ideology and it started its independent development.

Politics also created fundamental scope for transformation of sport, particularly by means of laws which guaranteed transition from totality to parliamentary democracy. It was mainly about free and democratic establishment of sport alliances and associations based on real citizens' interest, democratic principles of their functioning and forming their administrative organs, a new character of relationship between alliances and state.

The uniform bureaucratic organisation ČSZTV was abolished, and on the basis of the Act on Citizens Associating voluntary alliances and associations were established (Zákon, 1990).

They express actual citizens' interests. Sport entities gained necessary autonomy and independence from the state. Directive and administrative methods of state control were eliminated. Mutual relationship between state and alliances was regulated in the Act on Physical Culture No 198/1990, later a new Act No 288/1997 was passed (Zákon, 1997).

In conformity with the law, the Ministry of Education is the supreme state organ being responsible for the field of sport. The Ministry co-ordinates activities of other concerned industries, it promotes activities of sport associations. Forms of administration used by the Ministry, are mainly indirect, such as offering grants, making legislative conditions, drawing up a long-range conception for development, supporting activities of entities acting in the field of sport. Law also specifies the competence of other central organs of state administration (the Ministry of Defence, the Ministry of Interior, the Ministry of Health), as well as the competence and duties of county, district and local organs of state administration and self-government.

In order to concentrate all financial funds, following from different sources, and to clarify sports financing, the State Fund of Physical Culture (ŠFTK) was founded in 1993. Main income resources of the Fund are as follows: subsidy from state budget, profit in running lotteries and betting shops, sponsorship, gifts, etc. The Fund Council regularly decides an apportionment of financial funds among certain sports entities.

However, it must be said that in the sphere of sport we did not cope with transformation problems to a sufficient extent, and did not take an opportunity to

build the most convenient and flexible organisation structure taking into account co-ordination of particular sports associations and relationship between alliances and state. Present structure of sports associations has got a number of negative features. First of all, it is asymmetric. On the one hand, there is the biggest alliance – the Slovak Association of Physical Culture, which is a successor of the ČSZTV, and on the other hand, a lot of small associations, so their mutual co-ordination is rather complicated. So far, there is no watchdog organisation in the field of sport that would represent sports movement in front of the state and abroad, as well. Financing of sports associations is complicated and non-transparent.

Creating a market milieu had a conspicuous impact on the sports sphere. Sport entities – clubs, sections, associations, unions – had to adapt to market milieu, learn how to do business, and through business activities earn financial funds needed to fulfil their main task. A part of business activities is also sponsoring and advertising. Being involved in market conditions, sport entities got started their business activities and have achieved different results. The process brings many positive but also negative elements. One of the negative phenomena is a widening gap between clubs taking part in top sports competitions and spectacular sports (football, hockey, tennis etc.), which earn great financial funds from sponsors on the one hand, and clubs acting in lower-class competitions or less spectacular sports, which are struggling for survival, on the other hand. Many lower-class competitions and also pupils and junior competitions cease to exist because of lack of means. There is a lot of potential danger involved in this tendency – mass character of sports is liquidated, so a possibility of choosing new young talents is becoming more and more difficult. If the sports sphere and the state do not compensate for these differences in an adequate way, we are going to be faced with explicit changes that will affect sport itself, particular sport disciplines as well as the position of sport in society.

Another aspect that brings rather contradictory tendencies is commercialisation and professionalisation of sport, eventually its top contests. Sports result is becoming an object of business – purchase and sale, it becomes a job for a professional athlete. Commercialisation opens significant financial sources which are so necessary to support sports, athletes, sports centres. On the other hand it is accompanied by a lot of negative phenomena which are a menace to the essence of sport itself. Being under pressure of producing better results combined with a large amount of money is a reason why negative loading affect on the athlete's organism is not often taken into account, the principles of fair play are broken. Athletes resort to drugs, violence, liquidating fouls, deceits in their effort to win at all costs. "As a result of this athlete's dependence upon sponsors (he/she often agrees with it), corporations, managers etc. His or her body does not

belong to him or her, it belongs to others. Money earned by deprived body is supposed to make up for absence of 'me'" (Oborný & Maňák, 1997, 3).

Tendencies to commercialism and professionalism are transferred to sports activities and any attempt to stop them or displace them from sports should be incorrect and utopian. The tendency of the progress goes naturally and irreversibly in this direction and it is up to us to use all the positive features which it carries. On the other hand we have to create the defensive mechanisms mainly by the state against these features to eliminate them because they can endanger the basis of sports and an athlete's health and safety. We agree with the Prof. Slepíčka's statement: "We do not solve the problem of violence, using drugs, swindles systematically and the preventive control is low. We cannot expect that the influence of so-called natural machinery will work on its own and could be able to prevent spreading up these features in sports..." (Slepíčka, 1996, 524).

Therefore it is possible to state that the character of the top sport was influenced by the commercialism and professionalism and the efficiency orientation that is the significant feature of the whole western civilisation. A lot of parallel negative features transferred from economy linked with the political methods of privatisation, breaking the ethics in doing business appeared in sports as well.

It is important in mass recreation sports to make all motor activities necessary and valuable for all members of the society and become a constant part of their lifestyles. This process is mainly determined by emancipation of the spiritual culture and creating the new social structure. The process of spiritual culture emancipation proceeds unequally and asymmetrically in its single segments. Creation of the basic legislative conditions of reconstruction we can achieve in a relatively short period of time [while the system of the new acts creating optimal conditions is proceeding up to present days]. The changes in spiritual culture take relatively longer period of time. The process of accepting the new values, standards, examples in citizen's behaviour, forming the new lifestyles corresponding with actual conditions takes the longest period of time. The process is going on in two main levels: at first it requires to get over an old stereotypes of thinking, examples in behaviour, previous values and on the other hand to accept internalisation and to absorb the new values. On behalf of middle and old generation it is the secondary phase of socialisation, with the character of re-socialisation. It does not have a streamline progress as an automatic acceptance of the new values but the citizens confront the new values to reality, to their own experience and consequently a lot of values are questioned and refused. This process is complicated because there is still one category of people who keep in their minds the values of the old socialistic system concerning mainly the social certainties and the state paternalism. According to surveys done by the FOCUS agency in 1997 about 63% citizens

in Slovakia think that the government should be responsible for employment issues-to provide everybody with job and an equivalent standard of living. Only 18% of respondents stressed the responsibility of an individual (Bútorová, 1997, 120).

The authors of this research feel that the trauma of the people in Slovakia is based upon the trends after November because their social securities are worse than they were before (Bútorová, 1997, 120).

These tendencies and attitudes concern the field of sports for all, too. The process of socialisation and re-socialisation influences the social status of individual social groups. Economy transformation is followed by the significant changes in social position notable in deep social differentiation. Speciality of the social differentiation which is without any exceptions the part of transformation process is that it does not proceeds parallel to growth in the standard of living of the majority of the society as it was in advanced countries. In our society there is an absence or there are only a few representatives of the people with average incomes. Majority of the society represents the group of people with extreme earnings. Concerning earnings more than half of the families are in the middle sphere incomes and an overwhelming majority-up to 75.5% is at the 0.5–1.5 multiple of the average earning—which is 10,750 SK. About 10% of the families are at the edge of the living wages. This information confirmed by the data involving the number of the people who are on the dole ("Nezmrazit minimum," 2000, 4).

Besides this there is about 20% unemployment. One half of all unemployed people are out of work for a long time and this means they are registered at the employment exchange more than one year.

The changes in social status and reality that the majority of the society is at the level which oscillates near to the average income, indicates the significant changes in the structure of spending. People change their habits. Majority of the families has enough money to cover just their basic subsistence. According to surveys by the international project "Customer's Barometer" which was done by the Public Opinion Research Institute in the Slovak Republic, about 41% of citizens indicated the fact they make both ends meet, 24% of the families are in debts or live on savings ("Spotřebiteľské nálady," 2000, 6).

Account on this low-income groups are not interested in so-called developing needs, families do not have money for sports activities, recreation and culture.

Differences in individual social groups determine also the process of socialisation and re-socialisation, differences between their lifestyles, interests, and needs. Consequently large number of subcultures in society were created. The main subcultures might be assign according to social, ethnical, national, religious, generational and regional-settlement aspect. In most cases we do not deal with a counterculture when the society refuses the dominant culture. [The elements of counterculture are partly shown only in the case of

Gypsy subculture created according to ethnic principle]. Other subcultures are not in the conflict with a dominant culture, they are only characterised by the different level of adopting and accepting dominant culture, its separate elements, and by the presence of their own identifying features. It is about perceiving the sports as an evident value and participation of these groups in sports activities.

The most complicated situation besides Gypsy ethnic group is in the case of the weakened social groups with the lowest income, long term unemployed and youth. In these cases the state help and the help of local bodies and self-government administration is necessary. They can help them in the process of socialisation and offer them available facilities to do sports in towns and villages.

It is possible to state that the process of the society transformation, creating the new socio-cultural system changed in every way the position, responsibilities and functions of the sport in society. This process does not advance easy and directly but it is accompanied by many problems and with failings. They appear at the wide-spread social level or in sport itself as a subsystem. This task belongs to sports associations entities, central and local official bodies and self-administration to assist in enforcement of those positive tendencies, to eliminate already existing faults and to create the suitable conditions where it is necessary.

## REFERENCES

- Bútorová, Z. (1997). Kontinuita a zmena na úrovni verejnej mienky. In S. Szomolányi (Ed.), *Slovensko: Problémy konsolidácie demokracie*. Bratislava: Interlingua.
- Európska charta o športe*. (1992). Bratislava: MŠ SR.
- Nezmraziť minimum. Každý desiaty občan Slovenska v stave chudoby. (2000, apríl 5). *Pravda*, p. 4.
- Oborný, J., & Maňák, Z. (1997). Etické problémy vzťahu športovca k svojmu telu. *Telesná výchova a šport*, VII, 4.
- Slepička, P. (1996). Fair play a súčasný sport. In P. Tilinger & T. Perič (Eds.), *Tělesná výchova a sport na přelomu století. Sborník referátů z národní konference* (pp. 523–524). Praha: FTVS UK.
- Spotřebitelské nálady obyvatelstva. (2000, marec 3–5). *Hospodárske noviny*, p. 6.
- Zákon o telesnej kultúre. (1997). *Zákon NR SR č. 288/1997*.
- Zákon o združovaní občanov. (1990). *Zákon SNR č. 83/1990 Zb.*
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## KULTURA – SPORT – POLITIKA V ETAPĚ TRANSFORMACE SPOLEČNOSTI VE SLOVENSKÉ REPUBLICCE (Souhrn anglického textu)

Sport jako součást sociálně kulturního systému podléhá v etapě transformace společnosti hlubokým změnám, které jsou podmíněny novými hodnotami v oblasti politické, kulturní, sociální, právní i morální. Sportu se bezprostředně dotkly procesy demokratizace společnosti, na jejichž základě svobodně vznikají sportovní spolky a sdružení, demokraticky si utvářejí svoje řídicí orgány, řídí a koordinují svou činnost. Nová kvalita se projevuje i ve vztazích mezi státem a spolkovou sférou, v metodách řízení státu. Sportovní subjekty byly nuceny adaptovat se na tržní prostředí a podnikatelskou činností zabezpečovat finanční prostředky pro svou hlavní činnost. Oblast vrcholového sportu nejvýrazněji poznamenaly procesy komercializace a profesionalizace sportu se svými pozitivními i negativními důsledky. Rekreační sport je ovlivněn transformací duchovní kultury, utvářením nového hodnotového systému občanů v závislosti na jejich sociálním postavení a vlastní subkultury. Nejsložitější situace kromě romského etnika je v případě sociálně nejslabších skupin s nejnižšími příjmy, u dlouhodobě nezaměstnaných a mládeže. V případě těchto sociálních skupin je potřebná pomoc státu, místních orgánů státní správy a samosprávy, které by napomáhaly procesu socializace a vytvářely dostupné podmínky pro sportovní aktivity na úrovni měst a obcí.

*Klíčová slova: pohybové aktivity, sport, sport pro všechny, sociální zájmy a hodnoty, kultura, subkultura, sociální skupiny, socializace, resocializace.*

## SPORTS AND WAR

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Sports and War seems to be an irrelevant topic in relation with the new discipline of Sports Humanistics, when viewed from the point of view of its subject and educational objectives. From many aspects, it is often referred to as a taboo subject. In these days when we think about other different things as war connections of sports we consider its topic as anachronisms or out of time matter. Partly it is true because at present humanistic political thinking considers war itself as an anachronism. Firstly, we speak about some kind of uncertainty whether war as a socio-political phenomenon is related to any other form of humanism. Within these contexts, it is necessary to point out that all social features are reflected in sports humanistics and that they bear a mutual correlation with sports. The fact whether these phenomena are or are not human. In au topic we want to reflect the reality of time, political, social, national and economic connections of sport and war during the whole history of mankind where sport and war was known as particular feature of its existence. We do not deal with the notion whether war is or is not present, and important problem or contemporary sports humanistics. We cannot deny the influence of wars at the beginning of the 90s of the 20<sup>th</sup> century on sports, sporting events and tournaments on sports relations between (even!) European countries, which were linked in small war conflicts. It is not possible to deny them even we have not spoken about them enough loudly.

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*Keywords: sports, war, culture, civilisation, policy.*

When recognising the problem of “Sports and War”, the first step is to discuss the philosophical aspects of the merit of these phenomenon and their mutual historical relationship. Ideas will be expressed in theses taking into account focused our attention on the merit of this problem. In methodology we have to set up the problem and its extrapolation out of socio-political process and logical manipulation with it. The main problem is the essential and causal-result connections of sports and war. The question is not about the instalment of the topic, summarising historical facts and historical-logical manipulation with these historical facts. Of course, philosophical intersection into some parts of given topic is not possible without historiography, because the facts are the units of thoughts.

The solution to the problem Sports and War was and still exists and they are separate theoretical and essay topics in different scientific disciplines. However, their mutual relation is not an often-discussed matter in the theory of sports and science, and not even in polemological theory. Unfortunately, this phenomenon is present in social reality to date; the history of human civilisation is full of thousands of small and big wars. It is not possible for sports and war to enter into a mutual relationship. History quotes several instances where sports and war have crossed paths. Why is it so?

Sports and war are considered as a cultural and civilisation phenomena. Perhaps a paradox, but war is an inevitable part of the human culture. We could

even declare that many excellent achievements of human intellectual and technical efforts were often used in the past within the military machinery. They were given for the needs of war and they still exist up to present times. In spite of cardinal differences between sports and war, these two phenomena have certain common general features and share mutual historical roots. In ancient times, the human civilisation wanted to use pre-historical forms of “sports” focused on surviving. The basic norms in this regard were “natural movements”, walking, running, jumping, jumping over obstacles, swimming and later more suitable movement activities with the gun in their hands, riding the horse and rowing. “Everyone had to acquire the same education, both boys and girls, for becoming hunters and warriors” (Kössl, Štumbauer, & Waic, 1999, 8). Long lasted historical evolution led the sport and war up to present modern form and its own existence. But something common still exists. Its essence and historical mission are coming from the socio-political status of their own civilisation level. Sports and War expresses the character of the “level” of the development of their own cultural and civilisation background.

If sports, in specific historical forms, effected and conjoined with wars, it was not because of its militant and war tendency, “war willingness”, but rather more it was subordinated for the needs of politics and war. For example during the war period Protectorate of Bohemia and Moravia, “Curatorium for Education of Youth in Bohemia and Moravia” was created in the

half of the year 1942. To achieve “Himmler’s act” was to create in different European countries under the rule of Nazis, youth organisations aimed at re-education of youth in a spirit of Nazi ideology. “One part of Curatorium was physical education as well, and they should be practised by P. E. instructors” (Kössl, Štumbauer, & Waic, 1999, 139).

An essential character of sports is to relate it with contemporary humanistic demonstrations of each civilisation, firstly together with modern societies of our century. It is necessary to joint the modern humanistic, educational and pacific movement. Because of this fact it is important to deal with the topic of Sports and War in different connections: contribution of sport and athletes to maintain or fight for peace, peace rules of sports struggle and competition and so on. It is right to discuss the topic sport (athletes) and pacifism (through different pacific movements). There were lots of pacifists among the athletes. To be true there were some pacifists with no inclination to sports. In general it is possible to say that sport, athletes, sport movements and organisations were in close connection with peace and peace activities than to war (but there are some exceptions, too). Sports as a whole expresses the values and ideals of peace, not war.

We believe that the topic of Sports and War and their mutual relation is, from the historical point of view, the topic for the 20<sup>th</sup> century. In fact, it relates to a wide range of historical, political, cultural and sporting events of this century. It was influenced by the growth, strength, importance and by the influence of these phenomena on social development in given historical stage of mankind. We put forward two reasons here: 1. Their mutual relation increased in the last century; 2. Differed spheres of this theory in this century mostly dealt with mutual connections of these phenomena in comparison with the past. We can hope that in the 21<sup>st</sup> century there will be no more reasons to study topical relations of sports and war.

With regards to the main objective of sports and war in the social life in the past, it is possible to deduce other facts. Certain groups of people were taught and exercised mainly for war reasons and for sport, or by means of “sports” activities for war (struggle) activities. The citizens were less taught about war and sport. Sports and war in the past had quite different pedagogical and educational interpretations than the present day understanding. Research results and information on sport (and war) addressed wider social group, mainly in the second part of the last 20<sup>th</sup> century. After that we speak about the right educational aspect and understanding the topic. In my opinion, the philosophical aspects of sports have gained their educational recognition in the last few centuries.

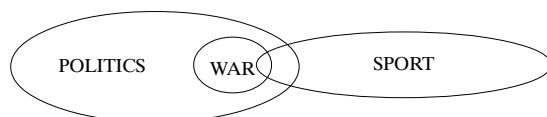
A brief outline of the history of the relationship between sports and wars offers four main developmental stages:

1. Predominance of sports over war. It concerns the historical period of Olympics. We all know that during the Games, the sound of war drums died away, sabre-rattling stopped, a “break” was declared in the war. “During the Games heavenly peace (ekecheiria) began to dominate through the entire Greek world and due to it, all the participants were allowed to come freely in Olympia and return back home” (Hošek, 1972, 125). At the same time, as we have learnt from history, sports and military training were in civilised antiquity de facto the identical processes. As far back as then Platon spoke about the need for gymnastic education and exercises for war guards. “It would be simple and reasonable gymnastics, predominantly for those who have to do with war” (Platon, 1980, 136–137).
2. Identification of sport art with “warlike art”. For certain social groups war (better – war activity) signified “sport”. Especially when the country was getting ready for war or was at war. Nicollo Machiavelli (1987, 102) wrote: “...service in the troops does not separate any soldier from his everyday craft, it does not take so long and training is going on only during free days. This system burdens neither the state nor the individuals and it engages young people during the time when they are usually idle, and whiling away the time, they do various foolish things. Moreover, training with a weapon is amusing and attractive especially to young men”. For a period in our history, there was an evident absence of classic sports, just knight and national motor games substituted for them. It was mainly medieval religious antipathy towards taking care of the sinful body that led to antipathy towards physical education. A sport was de-classed as immoral and sinful activity and at the same time war was glorified as a holy thing.
3. Predominance of wars over sport. Modern New Age politics, multi and bi-polarity of the world became an important determinant. During this historical stage, besides other events, two world wars took place. And sports became a part of war for some political powers. A lot of war (or military) events and interests made impossible to organise sports events. Predominance of war over sports is then the result of “predominance” of politics over sports. Reminiscences of this are evident to remain in some situations and regions of the world up to the present day. Historically, it is time to do away with war barriers to sports activities as well as to prevent unleashing wars at global and regional extent.
4. New Age and permanent predominance of sports over any war. Historically, it is time for predominance of sports (over war). As yet, it is only a humanistic ideal but there are reasons to believe that

mankind is likely to adopt sports and sport fight principles seeking for self-preservation and to accept them as general political peaceful principles of international relations.

In my opinion, the issue of relation between sports and war predominantly depends on political issues concerning politics and war, on solutions to the relation between politics and war. According to a classic paradigm, war is a continuation of politics with different (armed) means – this opinion is given by the 19<sup>th</sup> century military theorist Carl von Clausewitz (G. W. F. Hegel's contemporary). If nations or almost the whole mankind was entangled in war, then sports was also submitted to needs of war in a lot of aspects. In these historical situations, sports became a war tool as it was primarily submitted to political interests. It is impossible to imagine any sport pacific movement in a country which is at war.

Schematically we can present relations among war, politics and sport as follows:



From terminological point of view, one fact is important but not very pleasant – that sports and wars have couple of “common” terms through which the internal “technological” aspect of their nature is expressed. Today, it is difficult to determine the origin of the term given for certain, or to find the region where it was established as its immanent term. Since Herakleitos from Efes there has appeared the term “fight” in philosophy in some schools. The term, as we know, is often used in sports and polemologic (theory of war) terminology. Speaking of war it is the central term, speaking of sport one out of several terms. However, there are several terms, predominantly from aesthetic and ethic domains, which cannot be applied to war: game<sup>1</sup>, entertainment, competition, creativity, health, life. Furthermore, we have to emphasise that the philosophy of today renounces the term fight nearly in all schools.

Analysing the topic of Sports and War, there appear also open, controversial and differently interpreted opinions. Is it possible, for example, to talk about “war sports” (shooting, archery, biathlon, some combat disciplines or defence sports, boxing, fencing)? It is evident that some of the sports have at least outer features of warlike activities. The term war sports topical also in historical context – it concerns the sports which are organised and practised also during wars. During World War II there were held national championships in a number of sport events, but also

international competitions.<sup>2</sup> However, this does not express direct engagement of athletes in war (fair or unfair). And we can hardly eliminate interests of the political representatives of the states at war to involve sports and athletes in war machinery and propaganda.

In the New Age, we found out a historical fact of severance of Olympic cycles in 1914, 1918, 1940 and 1944 in consequence to the World Wars. There we could see the dichotomy of war and sports, their contradictory roles in the history. A historically new phenomenon – war globalisation, became an obstacle to realisation of another global phenomenon (it has already been introduced) in the field of sport – world sports competitions.

Specific issue within relation between sport and war is a problem of relation sport and “cold war”. The topic is historically present, “young” and therefore it is ideologically interpreted rather than scientifically. Sports events have, on several occasions, become a target for militant or armed terrorist activities, where fragments of appropriate war strategy (attack on Israeli athletes during the Games in Munich, 1972) – strategy of Arabic fundamentalism “holy” war could be seen.

However, much more concrete and pregnant are examples of sports engagement in the cold war – the period when two contradictory world political systems were competing – the period of the so called bi-polar division of world. Just for the illustration purposes, we can mention the boycott of Olympic Games in 1980 in Moscow and in 1984 in Los Angeles. In the course of cold war, but sometimes also at present days, we often encountered the effort to interpret sport victories and losses from the political point of view. They were considered either as an advantage of the system or as a weakness or disadvantage to the other one.

Speaking of mutual relation between sports and war, we can also attract attention to a specific episodic phenomenon which is expressed by the not absolutely precise term “sport wars”. These are geographically, politically and militarily limited wars the reasons or illusory reasons of which were sport events and their results. For example, so called “football war” between two countries of Central America.

Finally, the history of mankind reflects on sports as often being connected with war and it was even subjected to answering war needs and demands for fighters/soldiers qualities. It is necessary to respect this as a historical fact which resulted from the supremacy of politics over sport and from the political character of war. However, history also confirmed another fact – connection of sport with peaceful movement on re-

<sup>1</sup> For our needs it is not important to deal with war terminology, but we find it important to attract attention to the fact that the term “war games” is used in military theory.

<sup>2</sup> This fact is mentioned, for example, by J. Grexa in connection with the Olympic movement in Slovakia during World War II. “Since in 1940 there were to be held Winter Olympic Games in Garmisch-Partenkirchen and Summer Games in Helsinki, Slovak athletes were supposed to participate. ... In 1940 in Garmisch-Partenkirchen Slovak skiers and hockey players took part in <games>, but they were not very successful” (Grex, 1996, 22).

gional and global levels. The values of modern sports express the values of peace. Sports development has to be integrated and ironically, it should be aimed at supporting, enforcement and defence of peace.

## REFERENCES

- Grexa, J., Hazucha, M., Letenayová, Z., Machajdík, I., & Petrík, B. (1966). *Olympijské hnutie na Slovensku*. Bratislava: Vydavateľstvo Q 111.
- Hošek, R. (1972). *Země bohů a lidí. Pohledy do řeckého dávnověku*. Praha: Svoboda.
- Kössl, J., Štumbauer, J., & Waic, M. (1999). *Vybrané kapitoly z dějin tělesné kultury*. Praha: Karolinum.
- Machiavelli, N. (1987). *Úvahy o vládnutí a o vojenství*. (J. Hajný, Trans.). Praha: Naše vojsko. (Originál vydán 1966).
- Platón, (1980). *Ústava*. (J. Španiar, Trans.). Bratislava: Pravda. (Originál vydán 1899–1907).

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## SPORT A VÁLKA (Souhrn anglického textu)

Sport i válka jsou kulturní a civilizační fenomény. Absorbují v sobě relevantní hodnoty dané civilizace a epochy. Válka je společensko-politický jev, který v době své přípravy, v průběhu a také svými důsledky ovlivňuje všechny významné společenské jevy a události. Na sport má válka maligní vliv. Sport byl často podřízen potřebám politiky a války. Nelze však popřít vzájemný vliv válek, vojenských konfliktů a sportu jako složitého společenského podsystemu. Sportovní činnost v mládežnických a sportovních organizacích byla v době přípravy příslušných států na válku obsahově orientovaná jako součást bojové přípravy. Avšak bytostný charakter sportu je třeba spojovat především s humanistickými hodnotami každé civilizace. V podstatě sportu se deklarují moderní humanistické, edukologické a pacifistické ideje a hnutí. V celé svojí komplexnosti vyjadřuje sport hodnoty a ideály míru.

Souvislost války a míry má genezi ve čtyřech základních etapách. V první historické etapě dominuje na krátké období sport nad válkou. Jde o historické období her olympiád. Ve druhé etapě dochází ke ztotožnění sportovního a válečnického umění. Především tehdy, když se země nacházela v přípravě na válku anebo přímo ve válečném stavu. Ve třetí etapě je zřetelná dominance války nad sportem. Sport se stal pro určité politické síly součástí „studené“ i „horké“ války a to v důsledku nadvlády politiky nad sportem. Ve čtvrté novověké etapě se projevila trvalá dominance sportu nad válkou. Principy sportu a sportovního boje si lidstvo postupně osvojuje jako obecné politické mírové principy mezinárodních vztahů.

*Klíčová slova: sport, válka, kultura, civilizace, politika.*



## CHANGES IN THE MAIN ABILITIES OF FIELD HOCKEY PLAYERS DURING THE PREPARATORY PERIOD LEADING UP TO THE MAIN COMPETITION

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These changes, which lead to the competitors attaining competition norms, will be accompanied by a suitable (stable or lowered) level of lactic acid. It has also been assumed that the changes, resulting from this structured training during the pre-Olympic training cycle (1999), will form the basis for possible changes in the 2000 Olympic training cycle.

*Keywords: field hockey, player, physical efficiency, training loads.*

### INTRODUCTION

It has been assumed that the main motor property for Field Hockey players is speed endurance. This is the ability of maintaining very high running speeds in conditions of growing weariness (Bisanz & Gerisch, 1984; Chmura, 1993; Wachowski, Strzelczyk, Dylewski, & Wylegalski, 1995; Wachowski & Strzelczyk, 1999).

It is possible to estimate this ability by means of tests, which are established in accordance with the competition conditions (Bisanz & Gerisch, 1984; Bangsbo, 1994; Wachowski & Strzelczyk, 1999).

During these studies, we applied our own tests which were a culmination of the results of observations on several matches. These were subsequently verified for accuracy (Kowalski, Strzelczyk, & Wachowski, 1993; Wachowski & Strzelczyk, 1999; Wachowski, Strzelczyk, & Wylegalski, 1999).

Independent components like oxygen endurance and running speed were also studied. Exertion tests involving information on the serum lactic acid (LA) concentrations were also undertaken. We assumed that during the training cycles (1999, 2000), the level of these abilities would undergo changes. In the preparatory period, changes in oxygen endurance were expected to follow stabilisation of running speed and steady progression of speed endurance. Prior to the start period, the level of oxygen endurance stabilises, concurrently with the progression of running speed and speed endurance.

### METHOD AND MATERIALS

Direct tests were conducted on the competitors of the Polish National Hockey Team who participated in the Sydney 2000 training programme. For analysis purposes, all competitors taking part in the full set of 1999/2000 tests (8 people) were taken into account.

The average age of competitors in 1999 was 24.2 years (21–27). The body height in the range of 172–186 was 180.31cm and the average body mass was 77.3 kg (67.3–85.0 kg).

The average duration of training for these hockey players was 15.25 years, over a period of 13–20 years. The average duration of training in the National Hockey Team was 5.3 years (0.8–10 years). Tests were conducted on a continuous basis and comprised the training and the starting cycle for the VIII European Nations Cup in Padua (25. 02. 1999, 12. 04. 1999, 13. 07. 1999, 14. 08. 1999) and also for the Sydney 2000 Olympic Games (07. 01. 2000, 12. 07. 2000, 12. 08. 2000.) The Polish National Hockey Team secured 9<sup>th</sup> position in Padua (1 – 1. 09. 1999) and so had no guarantee for participation in the Olympic Games. Only when it achieved 4<sup>th</sup> place in the tournament in Osaka (Japan) was it assured participation in the XXVIII Olympic Games-Sydney 2000 (16. – 30. 09. 2000). The Polish National Hockey team ranked 12<sup>th</sup> in the final classification. All tests were planned and conducted according to the time and method schedule training structure. A series of fitness ability tests were applied, which enabled the identification of the physical condition of the field hockey players.

The rotation of these tests was as follows:

1. speed of running – this was tested on running speed over a distance of 30 m,
2. oxygen endurance – estimated on the Master's step – test,
3. speed endurance – repeated running 15 × 30 m (Wachowski & Strzelczyk, 1999).

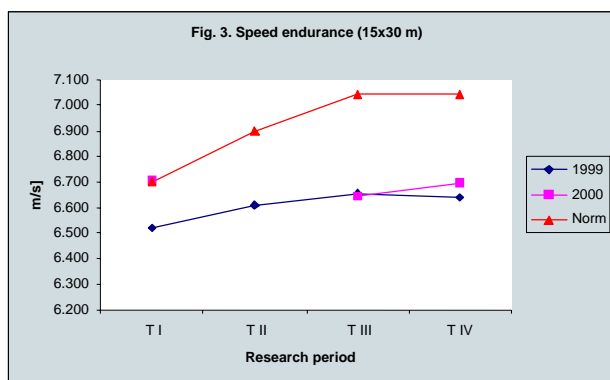
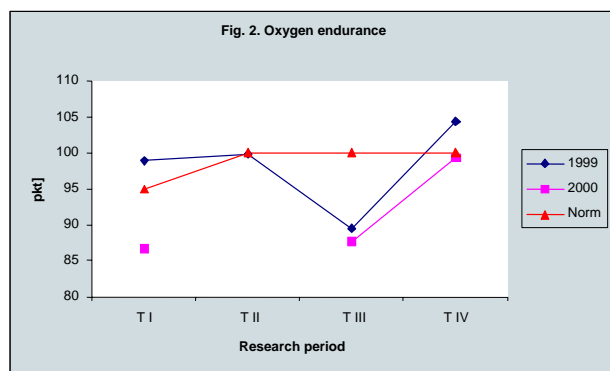
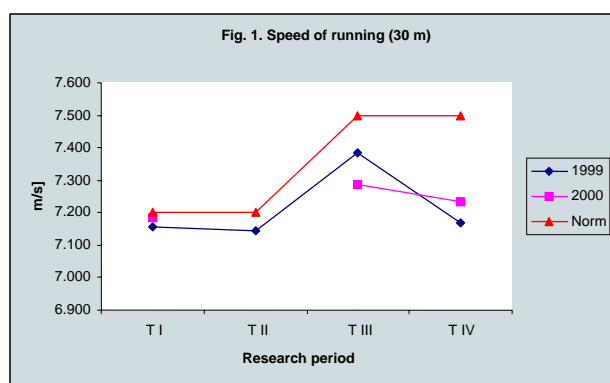
After these endurance tests (No 2 and 3) based on the enzymatic method, lactic acid concentration was noted.

The main statistical norms were prepared (arithmetic mean, standard deviation, essential difference – through the “t-Student” test). All results were assessed according to the arithmetical mean and stan-

dard deviation, and also presented in a graph form. Each table shows performance norms, allowing comparison between training schedules and achieved effects (Wachowski, Strzelczyk, & Wylegalski, 1999).

## RESULTS

Individual results in the training cycle 1999 and 2000 are presented in tables one and two and on figures 1, 2 and 3. The average of the lactic acid concentration and speed endurance tester presented in TABLE 1A and 2A.

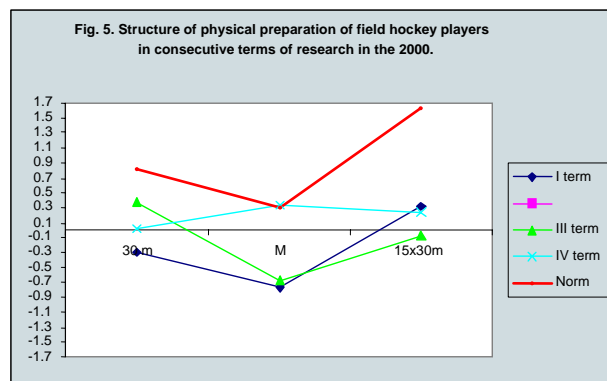
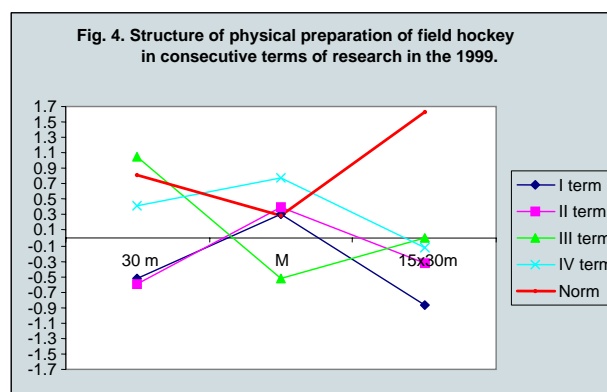


As can be seen from TABLE 1, the results of the oxygen endurance tests were irregular and not in accordance with established training procedure. It is notable that during the third term of the tests, both in 1999 and 2000, the average values of oxygen endu-

rance did not vary to any degree, being considerably below established training principles.

In the initial period of both cycles, the level of speed preparation of those under test was relatively in accordance with the accepted norms; however, in the 4<sup>th</sup> term of the research tests, speed endurance was definitely lowered (as in 1999 and 2000). It is to be noted that the oxygen endurance was at a high level during these periods.

As regards speed and endurance preparation in 1999 and 2000, the attained results differed only in as far as the first term tests were concerned, to the advantage of the Olympic cycle. Individual results obtained in particular tests related to the accepted training values. Nonetheless, in all the other terms they differed from the norm.



In addition, in order to present changes in physical ability structures, the results obtained in individual tests were standardised on a scale of standard values. Values of competition norms were reset in the same manner and were treated as a point of reference for the actual results.

In this way, it was established that none of the tests in both the training cycles reflected the accepted criteria. A notable characteristic was the high level of endurance preparation in periods preceding the main competitions, concurrent with a relatively low level of speed preparation. Consequently, an adequate level of speed endurance results, culminating in adequate speed endurance level.

**TABLE 1**

Combination of results of the research in 1999

Term	30 m [m/s]			Endurance			Speed endurance		
	x	d	test-t	x	d	test-t	x	d	test-t
T I	7.156	0.082		98.88	14.06		6.519	0.113	
T II	7.146	0.120	0.209	99.88	10.62	0.201	6.606	0.094	-2.353
T III	7.384	0.110	-4.490*	89.5	10.66	-2.239	6.656	0.112	-0.774
T IV	7.170	0.119	5.244*	104.38	9.1	3.617*	6.639	0.09	0.448
Norm	7.500			100			7.042		

**TABLE 2**

Combination of results of the research in 2000

Term	30 m [m/s]			Endurance [pkt]			Speed endurance [m/s]		
	x	d	test-t	x	d	test-t	x	d	test-t
T I	7.189	0.164		86.75	9.25		6.711	0.118	
T III	7.286	0.116	-1.802	87.75	7.23	0.239	6.647	0.157	1.588
T IV	7.236	0.132	1.006	99.25	10.4	5.509*	6.700	0.159	-1.181
Norm	7.500			100			7.042		

**TABLE 3**

Essential difference of examined ability in the analogous research period in 1999 &amp; 2000

Term	30 m [m/s]			Endurance			Speed endurance		
	x	d	test-t	x	d	test-t	x	d	test-t
T I 99	7.156	0.082		98.88	14.06		6.519	0.113	
T I 00	7.189	0.164	-0.616	86.75	9.25	-1.676	6.711	0.118	-3.274*
T IV 99	7.170	0.119		104.38	9.1		6.639	0.09	
T IV 00	7.236	0.132	-1.347	99.25	10.4	-1.544	6.700	0.159	-1.205

**TABLE 1A**

Combination of value of lactic acid concentration in cycle of 1999

Term	LA "0"			LA I			LA II		
	x	d	test-t	x	d	test-t	x	d	test-t
T I	1.790	0.523		5.40	1.905		11.690	1.567	
T II	1.820	0.532	-0.096	4.04	2.075	6.457*	9.900	3.062	2.604*
T III	1.930	0.53	-0.385	4.78	1.254	-1.508	9.920	2.668	-0.031
T IV	1.870	0.467	0.243	3.98	1.436	2.276	11.150	3.574	-1.384

**TABLE 2A**

Combination of value of lactic acid concentration in cycle of 2000

Term	LA "0"			LA I			LA II		
	x	d	test-t	x	d	test-t	x	d	test-t
T I	2.10	0.321		4.98	2.77		11.180	2.53	
T III	2.06	0.261	0.309	4.80	1.567	0.296	9.120	1.324	2.815*
T IV	1.89	0.301	1.205	3.68	1.105	2.756*	9.650	1.456	-1.481

## DISCUSSION

An analysis of the current trends in field hockey indicate that speed endurance can be accepted as the main motor ability, just as in football. Its biological source is the aerobic and anaerobic endurance of the competitor (Chmura, 1993; Bangsbo, 1994; Strzelczyk, Wachowski, & Wylegalski, 1996).

Further requirements relate to adequate preparation for sporting competition conditions taking into account the speed endurance and its necessary components, i.e. oxygen endurance and running speed.

Training loads conducted with regard to these abilities should lead to achievement of standard competition performance in the definitive mezocycles (Wachowski, Strzelczyk, & Wylegalski, 1999).

The level of these abilities and structure of physical preparations should, therefore, be optimal immediately before the main competition. Tests conducted before the most important cycles: pre-Olympic and Olympic, brought surprising results. It turned out that the changes in the abilities under test during the pre-Olympic cycle were, in fact, inadequate in relation to the accepted training norms, whilst in effect, the competitors achieved norms only as regards oxygen endurance. It should be noted that this occurred just before the main competitions. This probably had the effect of lowering running speed factors, which was reflected in lowered speed endurance. At the same time it showed that the structure of the motor preparation was other than the expected and did not fulfil the requirements of sporting competition at this stage of training. Similar situations giving lowered effects during the preparatory period, in comparison with other sporting activities, have already been discussed elsewhere (Tyka & Wnorowski, 1993; Wachowski, Strzelczyk, Dylewski, & Wylegalski, 1995). One of the contributory factors affecting the Polish National Hockey Team could well be the frequent disparity in training cycles and effective preparation caused by differing priorities between the clubs from which the National team took its competitors and the priorities of the National team. Attempts at improving any fitness inadequacies inevitably meant that motor fitness, along with oxygen endurance had to be treated as a priority. The disappointing competition outcome resulted, therefore, from the training cycle under discussion and reflected the tested training effects.

It was also surprising to note that in the main, Olympic cycle (2000), the monitored fitness abilities showed similar results, although running speed and speed endurance were at a slightly raised level. This could well be attributed to the heightened state of motivation and concentration which is only natural prior to competition in the Olympic Games themselves.

Physiological factors (concentration of lactic acid in the blood) were as expected but, taking into account the results of the initial start-up in the Games and the subsequent worsening fitness abilities of the monitored team in the following matches, it cannot be excluded that this resulted not so much from that aspect of training which aimed to eliminate lactic acid, but could well have been a symptom of over-training which gives similar effects (Fahey, 1997).

## CONCLUSIONS

- 1) The trend and extent of the changes in fitness abilities of the field hockey players were not in line with the training concepts.
- 2) The achievement of professional levels was noted only with regard to the elementary ability, i.e. aerobic endurance, which should be treated as a basic fitness ability relevant to the requirements of competitive sport.
- 3) Differences between training concepts and actual effects could perhaps indicate the presence of training inadequacies in an optimised process. One of the reasons could be the lack of training co-ordination at club/national team level.

## REFERENCES

- Bangsbo, J. (1994). *Fitness Training in Football – a Scientific Approach*. University Copenhagen: August Krogh Institute.
- Bisanz, G., & Gerisch, G. (1984). *Fussball Training, Technik, Taktik*. Reinbek.
- Chmura, J. (1993). Kształtowanie wytrzymałości szybkościowej piłkarzy. *Sport Wyczynowy*, 7–8, 32–39.
- Jordanskaja, F. A., Romancew, O. I., Kuzmina, W. N., Wasilkow, J. S., & Nuranewa, L. F. (1993). Ocenka specjalnoj rabotosposobnosti w procesie upravlienija podgotowki futbolistow. *Teoria i Praktika Fiziczeskoj Kultury*, 11–12.
- Kowalski, J., Strzelczyk, R., & Wachowski, E. (1993). *Z badań wytrzymałości szybkościowej w grach zespołowych*. Poznań: AWF.
- Lisen, H (1983). Schelligkeitauschdauertraining im Fussball aus sportmedizinischer Sicht. *Fussballtraining*, 5.
- Strzelczyk, R., Wachowski, E., & Wylegalski, S. (1996). Monitoring of training with regard to energetic abilities of football players. In *Sport Kinetics' 95*. Prague: Charles University.
- Tyka, A., & Wnorowski, A. (1993). Fizjologiczny efekt treningu fizycznego w okresie przygotowawczym piłkarzy nożnych. *Antropomotoryka*. Kraków: AWF.

- Wachowski, E., Strzelczyk, R., Dylewski, T., & Wylegalski, S. (1995). Wytrzymałość szybkościowa w piłce nożnej. *Trening*, 2, 26.
- Wachowski, E., & Strzelczyk, R. (1999). *Trafność pomiaru motorycznych cech kondycyjnych*. Poznań: AWF.
- Wachowski, E., Strzelczyk, R., & Wylegalski, S. (1999). Normy sprawności motorycznej dla wyczynowych piłkarzy zawodowych. In *Nowoczesna piłka nożna. Teoria i praktyka*. Gorzów: WLKP.

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**ZMĚNY HLAVNÍCH SCHOPNOSTÍ  
HRÁČŮ POZEMNÍHO HOKEJE  
V PRŮBĚHU PŘÍPRAVNÉHO OBDOBÍ  
PŘED HLAVNÍ SOUTĚŽÍ**  
(Souhrn anglického textu)

Analýza současných trendů v pozemním hokeji ukazuje, že na rychlostní vytrvalost lze nahlížet jako na hlavní pohybovou schopnost, podobně jako v kopané. Biologickým zdrojem této odolnosti jsou aerobní a anaerobní odolnost soutěžícího. Další požadavky zahrnují adekvátní přípravu na sportovní soutěžní podmínky a berou v úvahu rychlostní vytrvalost a její nezbytné součásti, např. kyslíkovou vytrvalost a rychlost běhu.

Tréninková zátěž vedená s ohledem na tyto schopnosti by měla vést k dosažení standardního závodního výkonu v rozhodných mezicyklech.

Úroveň těchto schopností a struktura fyzické přípravy by tudíž měly být optimální těsně před hlavní soutěží.

Testy provedené před nejdůležitějšími periodami, předolympijskou a olympijskou, přinesly překvapivé výsledky. Ukázalo se, že změny ve schopnostech testovaných v průběhu předolympijského cyklu, byly ve skutečnosti neadekvátní vzhledem k přijatým tréninkovým normám a ve svém důsledku soutěžící dosáhli norem pouze v kyslíkové vytrvalosti. Je třeba zdůraznit, že tato situace nastala těsně před hlavními soutěжами. Tohle pravděpodobně způsobilo snížení rychlostních faktorů, což se odrazilo ve snížené rychlostní vytrvalosti. Zároveň to ukázalo, že se struktura pohybové přípravy lišila od té plánované a nesplnila požadavky sportovní soutěže na této úrovni tréninku.

Podobné situace snižující účinky přípravné fáze, v porovnání s ostatními sportovními aktivitami, již byly diskutovány jinde. Jedním z přispívajících faktorů ovlivňujících polský národní hokejový tým by mohla být častá nerovnoměrnost v tréninkových cyklech a efektivní přípravě způsobená odlišnými prioritami mezi kluby, z nichž si národní tým vybral svoje soutěžící, a prioritami národního týmu. Pokusy zlepšit jakékoliv kondiční nedostatky nevyhnutelně znamenaly, že pohybová způsobilost, společně s kyslíkovou vytrvalostí, musela být považována za prioritu číslo jedna. Neuspokojivý výsledek soutěže byl tudíž způsoben tréninkovým cyklem a odrážel testované účinky tréninku.

Bylo také velmi překvapivé, že v průběhu hlavního olympijského cyklu (2000) sledované kondiční schopnosti ukázaly podobné výsledky, ačkoliv rychlost a rychlostní vytrvalost byly na trochu vyšší úrovni. To by mohlo být přisuzováno zvýšené motivaci a koncentraci, což je velmi přirozené před účastí na olympijských hrách.

*Klíčová slova: pozemní hokej, hráč, fyzická zdatnost, tréninková zátěž.*



## RELATIONS BETWEEN SOMATIC CHARACTERISTICS AND MOTOR EFFICIENCY (LOW AND HIGH) IN SCHOOL-AGED INDIVIDUALS

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The aim of the contribution is to determine relations between selected somatic characteristics and motor efficiency in school-aged boys and girls (8–9 and 12–13 years age respectively) who have considerably above-average and considerably below-average total score in the test battery UNIFITTEST (6–60) (Měkota, Kovář et al., 1995). While analysing measured somatic characteristics, in the samples of the same age and sex, but of different levels of motor efficiency (17–25 individuals in one group), we did not find any logically or statistically significant differences in body height. On the contrary, we found significantly higher values of body weight, BMI, and especially the amount of subcutaneous fat in the samples with low motor efficiency. In the samples with high motor efficiency, we found a closer relation to somatic characteristics (body weight, BMI, the amount of subcutaneous fat), which was expressed by significantly lower variability of the results compared to the low motor efficiency samples. The results confirm the necessity of somatic parameter determination in the selection of sports talented children. Concurrently, the show a tendency towards an ambiguous relation between the basic somatic characteristics and the low level of motor efficiency.

*Keywords: somatic characteristics, school-aged boys and girls, high and low motor efficiency.*

### INTRODUCTION

Somatic characteristics (various absolute sizes, related values and body composition) are one of the preconditions for motor efficiency. In particular, it determines the level of motor efficiency in school-aged individuals for activities mandating strength and speed requirements (Sukop, 1997).

Since the 1930's, specialists have been devoted to investigating the relation between somatic characteristics (especially body height and weight) and motor efficiency. Their findings allowed some researchers to elaborate motor efficiency evaluating norms based on the sex, age, body height and weight (Mydlarski, 1934; McCloy & Young, 1954; Trzesniowski, 1961, 1963; AAHPER, 1965; etc.) or the sex, age, and body height (Oehmisch, 1956) indicators. In the Czech Republic, Pávek (1980) developed norms of motor efficiency indicators that are equal to various figure types derived from the weight-height index (body weight/body height). He considered these norms to be the most efficient while testing pubescent individuals and also, quite useful for testing younger children and adolescents.

In the 1970's, Fleishman (1964) and other authors stopped using these norms due to their heterogeneity in relations between somatic characteristics and single motor efficiency test results. A compromise was published by Moravec et al. (1996) and Měkota, Kovář et al. (1995), suggesting an amendment to evaluating

individual motor efficiency only for individuals with extreme values of body height and weight.

Since the 1970's, considerable research on the relation between somatic characteristics and motor performance of Czech children and youth has been carried out (e.g., Štěpnička et al., 1976, 1987; Pávek, 1977; Riegerová, 1984; Chytráčková, 1996; Moravec et al., 1990; Měkota, Kovář et al., 1995; etc.). According to their published findings, we can see that somatic characteristics (especially at the pubescent age) are correlate to some extent with motor test efficiency, particularly in physical condition tests. Kovář et al. (1994), Moravec et al. (1996) and other authors state that the amount of subcutaneous fat is an important characteristic because it seems to be a highly negative limiting factor culminating in low motor efficiency.

Upon careful analysis of several publications, it is apparent that the hitherto established relations between the somatic characteristics and motor efficiency in school-aged children are not unambiguous and that the calculated extent of correlation coefficients is quite high. A comparison of these findings is complicated owing to the problematic assessment of the significance of calculated correlation coefficients. A calculated statistically significant difference does not necessarily relate to any logically significant difference, which is particularly valid for larger samples.

The aim of the study is to determine the relations between selected somatic characteristics and motor efficiency in school-aged boys and girls (8–9 and 12–13

years respectively) who have considerably above-average and considerably below-average total score in the test battery UNIFITTEST (6–60) (Měkota, Kovář et al., 1995). On the basis of analysis of the published findings of other researchers, we can hypothesise that the samples from pubescent children of identical sex and of different motor efficiency will significantly differ in somatic characteristics, when directly or indirectly related to the body weight (body weight, BMI and the amount of subcutaneous fat). Furthermore, we also suppose that in the samples with high motor efficiency, we expect to find a closer relation to the somatic characteristics, expressed as significantly smaller variability in all values than in the samples with low motor efficiency.

## METHOD

### Method of selecting subjects

Within the framework of our research on the basic motor efficiency in school-aged children, we opted for the standardised UNIFITTEST test battery (6–60). For pre-pubescent and pubescent individuals, it contains four motor tests – standing broad jump, sit-ups 60 seconds, endurance shuttle run or 12-minute run, and shuttle run 4 × 10 m. The total score of the battery is expressed by the sum of four point (sten) values (the extent is 4–40 points, the theoretical average value is 22 points and the standard deviation is 5 stens) (Měkota, Kovář et al., 1995).

The representative sample, which participated in the motor performance tests, consisted of 253 boys and 267 girls aged 8–9, 247 boys and 262 girls aged 12–13. All of them belonged to the Liberec region of the Czech Republic. Children having health problems or attending specialised sports schools were excluded. On the basis of all the participants' test results, we selected:

- Individuals with low motor efficiency. Their total test scores were 1.5 standard deviation (= SD) below the average value (14 points and less) – four samples contained 19–25 children.
- Individuals with high motor efficiency. Their total test scores were 1.5 SD above the average value (30 points and more) – four samples contained 17–23 children.

### Methods of data analysis

In all samples with either high or low motor efficiency, we measured thirteen basic somatic characteristics – body height, body weight, biacromial width, bispinal width, width of the distal humoral epiphysis, width of the distal femoral epiphysis, circumference of

the contracted arm, maximum circumference of the forearm, median circumference of the thigh, maximum circumference of the calf, suprailiac skinfold, triceps skinfold, and subscapular skinfold. The skinfolds were measured by a calliper of the Harpenden type (produced by SOMET, accuracy of measurement is 0.1 mm). The somatic characteristics were measured following standard procedures in accordance with the method of Martin and Saller (Martin & Saller 1957; Knussmann, 1988).

Subsequently, we calculated weight-height indices (BMI and Rohrer's index), the amount of subcutaneous fat and normalised indices. To assess the amount of subcutaneous fat, we used the sum of the three specified skinfolds and its subsequent comparison with the values of the five-point norms by Měkota, Kovář et al. (1995).

Owing to the quantity of the samples and the selection method, we used the so-called boxplots to project basic statistical characteristics graphically. A boxplot is a graph, the span of which is equal to 50 percent of all the cases and a graph in which the median value is presented.

The medians of the measured somatic characteristics of all the researched samples were compared with the normal values for the Czech population. It was done through the so-called normalised indices (= NI). The NI values for body height, body weight, BMI and Rohrer's index were calculated on the basis of the 5<sup>th</sup> nation-wide anthropologic research in 1991 (Lhotská et al., 1993). Other NI values for the remainder of the somatic characteristics were calculated on the basis of findings of the anthropologic research done during the Czechoslovak Spartakiada in 1985 (Bláha et al., 1986, 1987). All the calculated NI values were assessed according to Bláha et al. (1990) and entered into graphical grids – so called somatic profiles.

We used the Kruskal-Wallis test and supplemented it with a paired comparison for the testing of significance of the differences in the results of our samples. For graphical projection of the calculated percentage values, we used the column graphs.

Mathematical-statistical data processing was done using the software of EpiInfo version 5.01a (Centres for Disease Control, Atlanta, U.S.A. and WHO, Geneva, Switzerland, 1991) and S-PLUS version 4.0 (Data Analysis Products Division, Math Soft, Inc., Seattle, Washington, U.S.A., 1997). The data for somatic characteristics were processed through the anthropological software ANTROPO version 98.1 (author Pavel Bláha – ANTROBLA, 1998) and the software for monitoring growth and development of children RÚST2 (author Petr Lesný – NOVO NORDISK, 1997).



## RESULTS AND DISCUSSION

*Note – used abbreviations: M = prepubescent individuals (aged 8–9); S = pubescent individuals (aged 12–13); D = girls; CH = boys; V = high level of motor efficiency (the total score  $\geq 30$  points); N = low level of motor efficiency (the total score  $\leq 14$  points); K-W test = the Kruskal-Wallis test;  $\chi^2_{0.01;7}$  = chi-square (the 0.01 significance level; 7 degrees of freedom); NI = normalised index; SD = standard deviation.*

In the four bar plots (Fig. 1–4), we can see the result values of the N and V samples – body height, body weight, BMI and the sum of three skinfolds. Assessing the graph of body heights (Fig. 1), we can see there is a significant tendency towards higher variability of the values in the male samples and a lot of remote values in the pubescent samples, particularly in the SCHN sample. The graph also shows that, as we supposed, there are logically significant differences between the pre-pubescent and pubescent samples. On the other hand, considering the level of motor efficiency, we did not find any logically significant differences in the medians of body heights in both the younger and the older samples. This was statistically confirmed by the result of the K-W test ( $119.12 > \chi^2_{0.01;7}$ ) at the 0.01 level and by subsequent comparison of pair values (TABLE 1). The finding that body height is in no relation to the level of motor efficiency corresponds with the findings of the researches of children with average motor efficiency (Netolická, 1991; Moravec et al., 1996; and others).

The bar plot of the result values for body weight (Fig. 2) shows significant variability of the values in the pubescent samples, particularly in both the N samples. In the relation to the level of motor efficiency, in the pre-pubescent samples, there is no logically significant difference between the values of body weight of the N and V samples. On the other hand, in the pubescent samples, there is a logically significant difference in the median values for body weight in the relation to the different levels of motor efficiency (the boys' difference is 17.35 kg; the girls' difference is 12.90 kg and there are higher values in the N samples). Calculation of the K-W test ( $117.83 > \chi^2_{0.01;7}$ ) confirmed statistically significant differences between the samples at the 0.01 level. TABLE 2 shows that pair comparison of body weight values did not statistically confirm any logical difference between the SCHN and SCHV samples and between the SDN and SDV groups. We think this is due to the great variability of the values in the samples on the one hand and to the quite small number of participants in the samples on the other.

Similar findings relating to the body weight were also true for the BMI (Fig. 3). The bar plot shows considerable higher variability of the values in the N samples. In the relation between BMI and the level of motor efficiency, we did not find any logically significant differences of the BMI values in the pre-pubes-

cent samples. On the contrary, we found a logically significant difference of the mean BMI values of the pubescent N and V samples. In all the cases, there are higher values in the N samples (the boys' difference is  $5.23 \text{ kgm}^{-2}$ ; the girls' difference is  $4.28 \text{ kgm}^{-2}$ ). Calculation of the K-W test criterion ( $90.03 > \chi^2_{0.01;7}$ ) confirmed a statistically significant difference between the values at the 0.01 level. The table of pair comparison (TABLE 3) shows that there are no statistical significant differences of the BMI values between the SCHN and SCHV samples and between SDN and SDV samples. We again think it is due to the great variability of the values and to the quite small number of participants in the samples.

The bar plot of the sum of the 3 skinfolds (Fig. 4) apparently shows great variability in the values for the N samples, which corresponds to the above mentioned findings for the BMI values. Variability of the values considerably increases with the age; and additionally, in the SCHN and SDN samples, it reaches quite high values. On the contrary, in all the V samples, we recorded quite equal values of the sum of the three measured skinfolds. The bar plot apparently shows logically significant differences between the samples of identical age and sex, and different levels of motor efficiency (higher values were in the N samples). Calculation of the K-W test ( $113.09 > \chi^2_{0.01;7}$ ) confirmed statistically significant differences between the samples at the 0.01 level. According to the table of pair comparison (TABLE 4), we can see that in both age categories, there are statistically significant differences of the sums of the three skinfolds of the samples with different levels of motor efficiency in the boys' samples at the 0.01 level and in the girls at the 0.05 level. This finding corresponds with the findings of other researchers in that the amount of subcutaneous fat has a negative influence on school-aged children's level of motor efficiency (Moravec et al., 1996; and others). In contradistinction to the findings of Kovář et al. (1994), we found a negative limiting relation between the level of motor efficiency and the amount of subcutaneous fat even in the pre-pubescent samples.

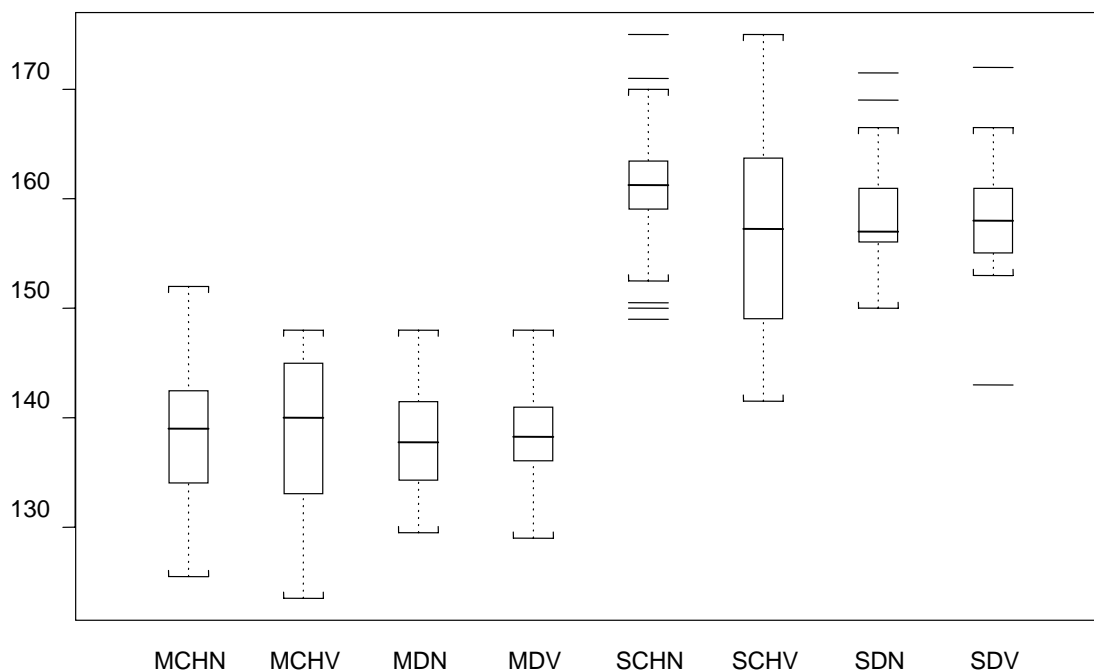
In Fig. 5 and 6, we can see percent occurrence of the N and V individuals in the categories of the five-grade norms of the sum of three skinfolds (Měkota, Kovář et al., 1995). Most of the results in all the V samples belong to the 3<sup>rd</sup> category of average values; and moreover, almost all the values belong to the interval from the 1<sup>st</sup> category (very small values) to the 3<sup>rd</sup> category (average values). The pre-pubescent N individuals have the highest relative frequency of their values in the 4<sup>th</sup> category of above-average values and the pubescent N individuals have it even in the 5<sup>th</sup> category of very high values. Almost all the values of the N samples belong to the interval between the 3<sup>rd</sup> to the 5<sup>th</sup> category of the five-grade norms. It means the older the N individuals are, the higher the values for the amount of subcutaneous fat.

Somatic profiles of the pre-pubescent and pubescent samples are presented in Fig. 7 and 8. According to the pre-pubescent individuals' somatic profiles, we can say that the majority of the assessed NI somatic characteristics belong to the band of average values. The NI values of the N samples are positive values for the average and the above-average bands. The NI values for the V samples belong to the whole band of average values, but the values for BMI and Rohrer's indices belong to the below-average band. As for the assessed characteristics, the measured pre-pubescent N and V samples are similar to the normal population, with the exception that there is a tendency for higher values of subcutaneous fat in the N samples. We have not established any inter-sexual differences between the median values of the somatic characteristics in the samples with the same level of motor efficiency.

The somatic profile of the pubescent samples (Fig. 8) shows significant differences in the NI somatic characteristics (excluding body height) of the N and V samples. The NI values of both the V samples also belong to the average band; however, in this case, it is much more significant than in the pre-pubescent samples because the average band is equal only to  $\pm 0.75$  SD.

The NI values of both the N samples are characterised by quite a large margin – the body height values belong to the higher value area of the average band, but the NI values of skinfolds are extremely above-average, especially in the male samples. As for the somatic characteristics, the measured pubescent V samples do not significantly differ from the population's values in the following characteristics: body weight, weight-height indices, width and circumference characteristics and especially the amount of subcutaneous fat (in all the cases, it is more significant in the male sample). We have not found any inter-sexual differences between the median values of both the V samples. In all the cases, there are lower NI values in the female V sample. In both the N samples, the NI values tend to be above-average (the only exception in both the cases being the average body height). Higher NI values are in the male N sample (compared to the female N sample). The NI values of the SDN sample belong to the above-average band, except for the considerably above-average values of skinfolds. On the other hand, the NI values of the SCHN sample are considerably above-average, except for the above average values for the biacromial width.

**Fig. 1**  
Bar plot for body height [cm]

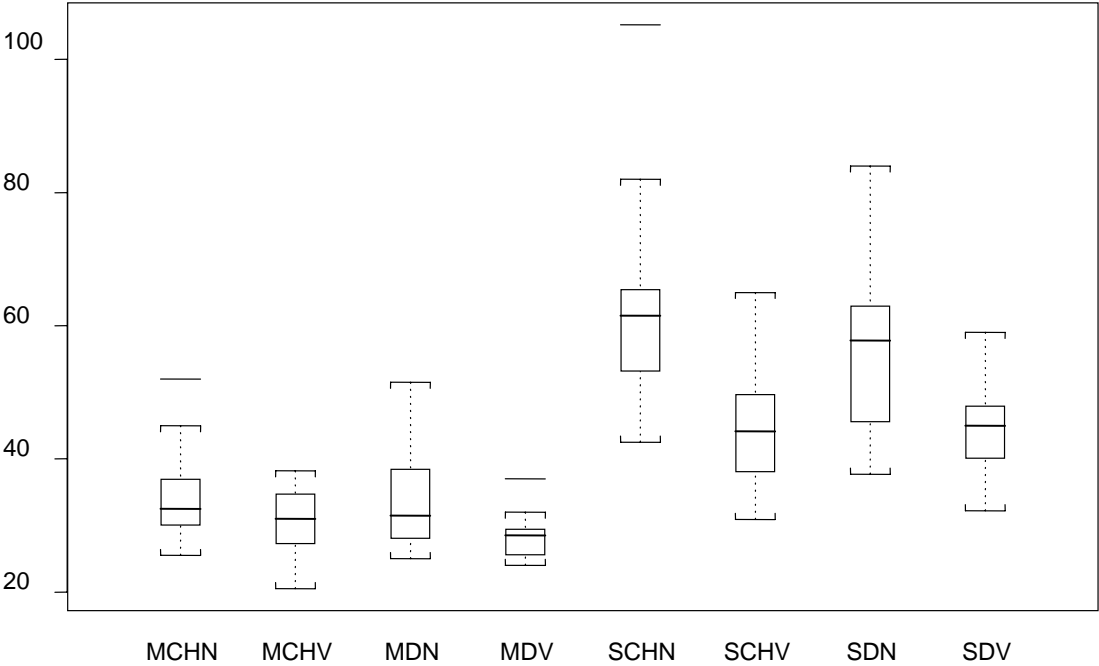


**TABLE 1**  
Paired comparison of the body height values (the Kruskal-Wallis test)

	MCHN	MCHV	MDN	MDV	SCHN	SCHV	SDN
MCHN							
MCHV							
MDN							
MDV							
SCHN	***	***	***	***			
SCHV	***	***	***	***			
SDN	***	***	***	***			
SDV	***	***	***	***			

Note: \*\*\* = the 0.01 significance level.

**Fig. 2**  
Bar plot of body weight [kg]

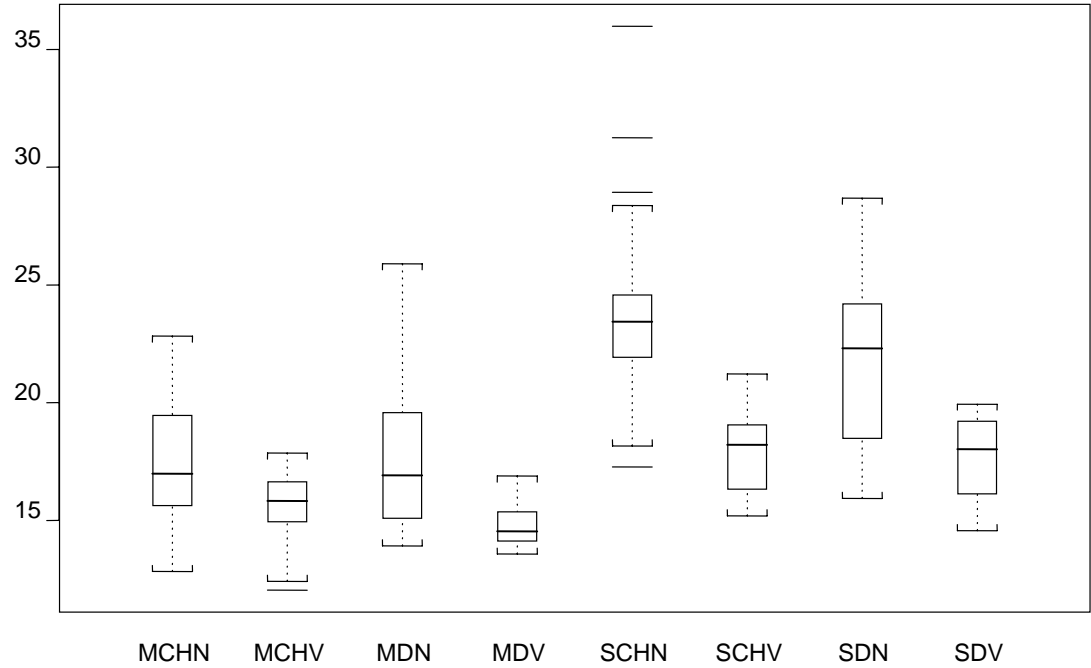


**TABLE 2**  
Paired comparison of the body weight values (the Kruskal-Wallis test)

	MCHN	MCHV	MDN	MDV	SCHN	SCHV	SDN
MCHN							
MCHV							
MDN							
MDV							
SCHN	***	***	***	***			
SCHV		**		***			
SDN	***	***	***	***			
SDV		**		***			

Note: \*\*\* = the 0.01 significance level; \*\* = the 0.05 significance level.

**Fig. 3**  
Bar plot of BMI [kgm<sup>-2</sup>]

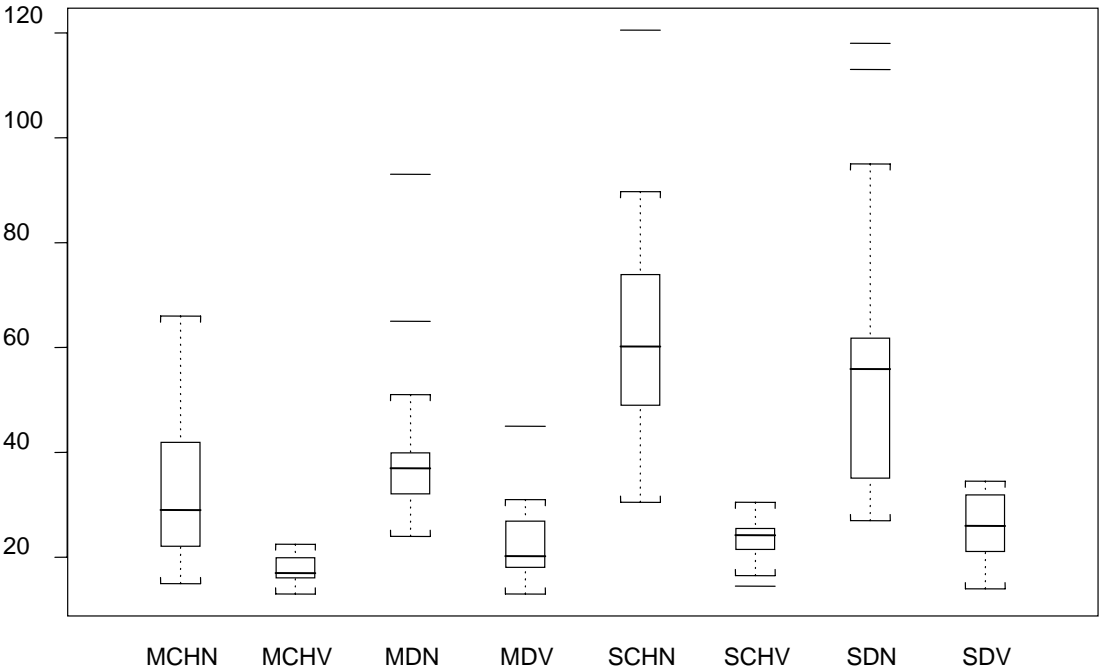


**TABLE 3**  
Paired comparison of the BMI values (the Kruskal-Wallis test)

	MCHN	MCHV	MDN	MDV	SCHN	SCHV	SDN
MCHN							
MCHV							
MDN							
MDV	*						
SCHN	***	***	***	***			
SCHV				**			
SDN		***	*	***			
SDV					**		

Note: \*\*\* = the 0.01 significance level; \*\* = the 0.05 significance level; \* = the 0.10 significance level.

**Fig. 4**  
Bar plot of the sum of three skinfolds [mm]

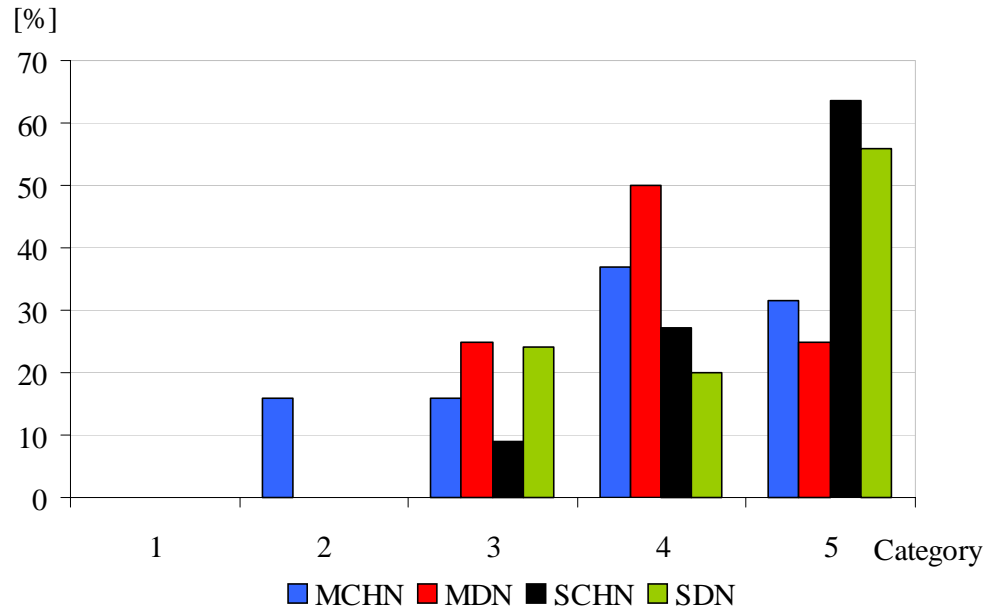


**TABLE 4**  
Paired comparison of the values of the sum of three skinfolds (the Kruskal-Wallis test)

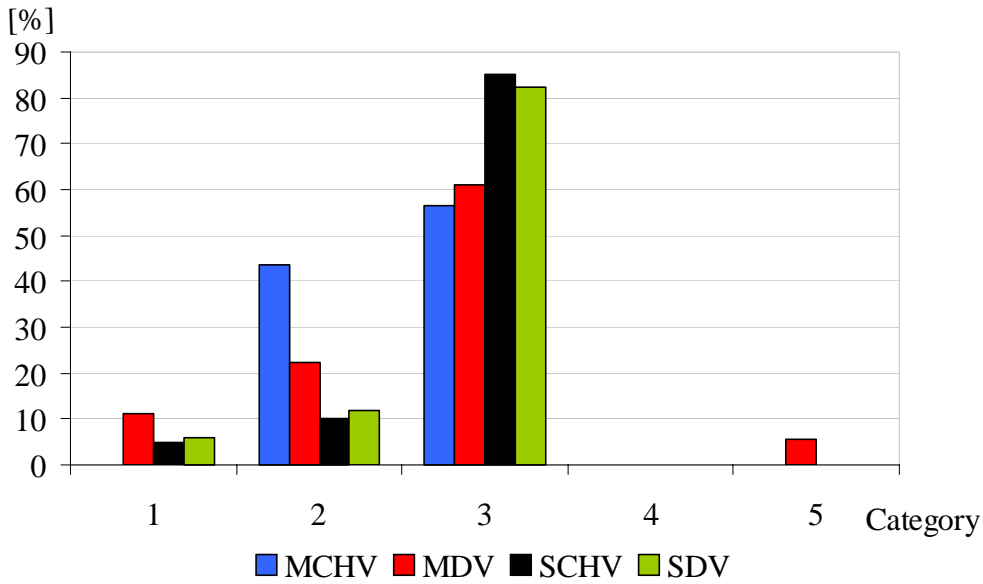
	MCHN	MCHV	MDN	MDV	SCHN	SCHV	SDN
MCHN							
MCHV	***						
MDN		***					
MDV			**				
SCHN	*	***		***			
SCHV			*		***		
SDN		***		***		***	
SDV					***		**

Note: \*\*\* = the 0.01 significance level; \*\* = the 0.05 significance level; \* = the 0.10 significance level.

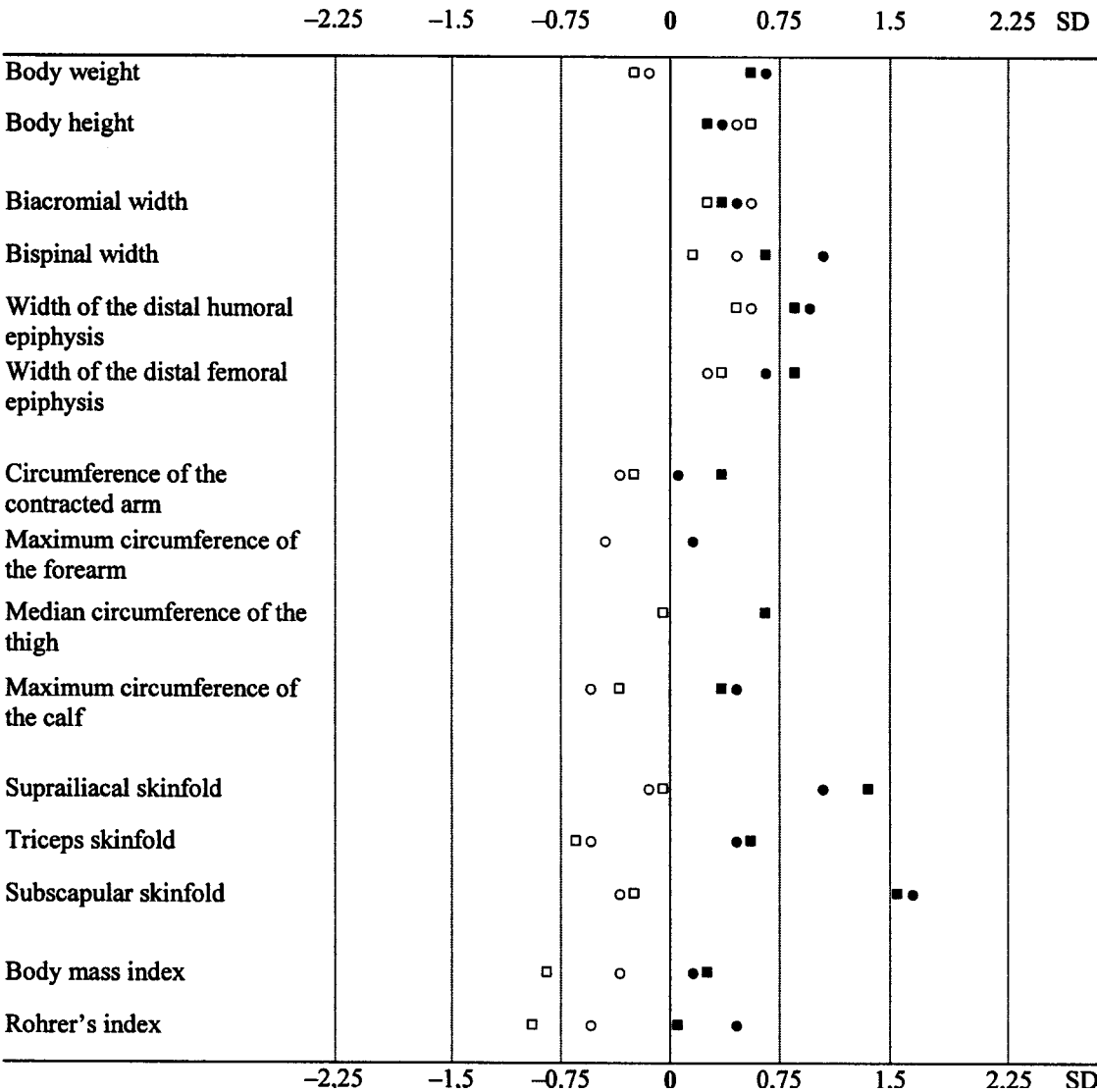
**Fig. 5**  
Distribution of low motor efficiency individuals in the categories of the norm of the sum of three skinfolds



**Fig. 6**  
Distribution of high motor efficiency individuals in the categories of the norm of the sum of three skinfolds

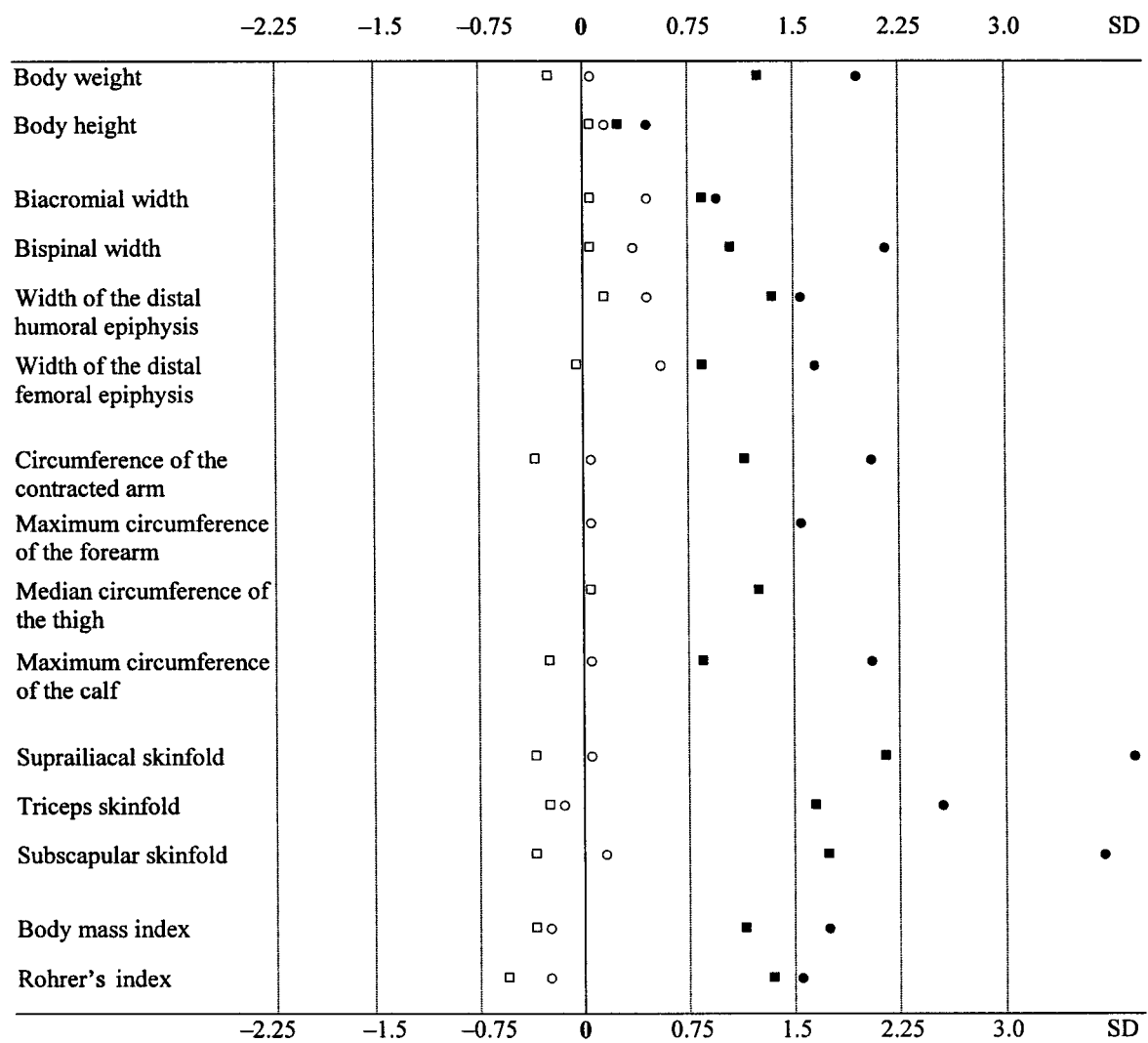


**Fig. 7**  
Somatic profile of pre-pubescent individuals with low and high motor efficiency  
(the normalised indices of the medians of body characteristics)



Note: ● = MCHN; ○ = MCHV; ■ = MDN; □ = MDV; SD = standard deviation.

**Fig. 8**  
Somatic profile of pubescent individuals with low and high motor efficiency  
(the normalised indices of the medians of body characteristics)



Note: ● = SCHN; ○ = SCHV; ■ = SDN; □ = SDV; SD = standard deviation.



## CONCLUSION

There are no logically and statistically significant differences in the values of body height between the samples of identical age and sex, and different levels of motor efficiency. As for the body weight and BMI, there are significantly higher values in the groups with low motor efficiency. The most logically and statistically significant differences are in the amount of subcutaneous fat. In all the cases, there are considerably higher values in the samples with low motor efficiency. Comparing all the samples, in the samples with high motor efficiency, we can find a closer relation to the somatic characteristics (body weight, BMI, and the amount of subcutaneous fat) than in the low motor efficiency samples. This is expressed by considerably lower variability of all the values. Finally, on the basis of all our findings, we confirm our hypothesis.

The results confirmed the necessity for somatic parameter determination in the selection of sports talented children. On the other hand, they showed us the tendency to an ambiguous relation between the basic somatic characteristics and the low level of motor efficiency.

## REFERENCES

- AAHPER. (1965). *Youth fitness test manual*. Washington: AAHPER.
- Bláha, P., et al. (1986). *Antropometrie československé populace od 6 do 55 let (Československá spartakiáda 1985). I./1, 2*. Praha: ÚV ČSTV a ÚNZ VS.
- Bláha, P., et al. (1987). *Antropometrie československé populace od 6 do 55 let (Československá spartakiáda 1985). II./1, 2*. Praha: ÚV ČSTV a ÚNZ VS.
- Bláha, P., et al. (1990). *Antropometrie českých předškolních dětí ve věku od 3 do 7 let. Díl 1*. Praha: ÚSM.
- Fleishman, E. A. (1964). *The structure and measurement of physical fitness*. Englewood Cliffs, NJ: Prentice-Hall.
- Chytráčková, J. (1996). The motor performance conditioned by selected physical characteristics of 6–14 years old children. *Antropomotoryka*, 14, 17–20.
- Knusmann, R. (1988). *Anthropologie: Handbuch der vergleichenden Biologie des Menschen*. Stuttgart-New York: Gustav Fischer Verlag.
- Kovář, R., et al. (1994). *Možnosti záměrného působení na jedince s výrazně podprůměrnou úrovní motorické výkonnosti v průběhu ontogeneze. Závěrečná zpráva o řešení grantového výzkumného úkolu MŠMT ČR č. 10-49-93/1*. Praha: FTVS UK.
- Lhotská, L., et al. (1993). *V celostátní antropologický výzkum dětí a mládeže 1991 (České země): Antropometrické charakteristiky*. Praha: SZÚ.
- Martin, R., & Saller, K. (1957). *Lehrbuch der Anthropologie. Band I*. Stuttgart: Gustav Fischer Verlag.
- McCloy, C. H., & Young, N. D. (1954). *Tests and measurements in health and physical education*. New York: Appleton-Century-Crofts.
- Měkota, K., Kovář, R., et al. (1995). UNIFITTEST (6–60) Tests and norms of motor performance and physical fitness in youth and in adult age. *Acta Univ. Palac. Olom. Gymn., Suppl. 1.*, 3–108.
- Moravec, R., et al. (1990). *Tělesný, funkčný rozvoj a pohybová výkonnosť 7–18 ročnej mládeže v ČSFR*. Bratislava: Šport.
- Moravec, R., et al. (1996). *EUROFIT – Tělesný rozvoj a pohybová výkonnosť školskej populácie na Slovensku*. Bratislava: Slovenská vedecká spoločnosť pre telesnú výchovu a šport.
- Mydlarski, J. (1934). *Sprawność fizyczna młodzieży w Polsce*. Warszawa: Przegląd Fizjologii Ruchu.
- Netolická, N. (1991). Příspěvek ke studiu motorické výkonnosti dětí 1. stupně ZŠ ve vztahu k jejich tělesnému typu. In J. Bokůvka (Ed.), *Tělesná kultura* (pp. 59–80). Olomouc: Univerzita Palackého.
- Oehmisch, W. (1956). Alter, Körpermasse und sportliche Leistung. *Theor. Prax. Körperkult.*, 8(7), 651–662.
- Pávek, F. (1977). *Tělesná výkonnost 7–19leté mládeže ČSSR*. Praha: Olympia.
- Pávek, F. (1980). *Hodnocení výkonnosti ve školní tělesné výchově*. Praha: Státní pedagogické nakladatelství.
- Riegerová, J. (1984). Hodnocení vývoje dětí ve vztahu k intenzivní pohybové činnosti (pomocí somatometrických parametrů a kritérií biologického-proporcionálního věku). *Teor. Praxe Těl. Vých.*, 32(3), 170–180.
- Sukop, J. (1997). Závislost vývojových změn svalové síly na somatickém rozvoji. *Těl. Vých. Sport Mlád.*, 63(3), 40–42.
- Štěpnička, J., et al. (1976). Somatotyp, držení těla, motorika a pohybová aktivita mládeže. *Acta Univ. Carol. Gymn.*, 14(2), 11–81.
- Štěpnička, J., et al. (1987). Vývoj tělesné výkonnosti, somatotyp a vztahová analýza motorických a somatických znaků. In B. Svoboda (Ed.), *Tělesná výchova v systému výchovy a vzdělání na školách všech typů* (pp. 222–239). Praha: Univerzita Karlova.
- Trzeźniowski, R. (1961). *Rozwój fizyczny i sprawność młodzieży polskiej*. Warszawa: Nasza Księgarnia.
- Trzeźniowski, R. (1963). *Miernik sprawności fizycznej*. Warszawa: Państw. wyd. szkol.

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**VZTAH MEZI  
SOMATICKÝMI CHARAKTERISTIKAMI  
A MOTORICKOU VÝKONNOSTÍ  
(NÍZKOU A VYSOKOU)  
U JEDINCŮ ŠKOLNÍHO VĚKU  
(Souhrn anglického textu)**

Cílem šetření bylo zjistit vztahy mezi vybranými charakteristikami tělesné stavby a motorickou výkonností u chlapců a dívek školního věku (8–9 a 12–13 let) s výrazně nadprůměrnými a výrazně podprůměrnými výsledky v celkovém skóre testové baterie UNIFIT-TEST (6–60) (Měkota, Kovář et al., 1995). Mezi soubory stejného pohlaví, věku a různé motorické výkonnosti (rozsah souborů byl 17–25 jedinců) jsme při analýze naměřených somatických parametrů nezaznamenali žádné věcné a statisticky významné rozdíly v hodnotách

tělesné výšky. Naopak v tělesné hmotnosti, v BMI a zejména v množství podkožního tuku jsme zjistili významně vyšší hodnoty u souborů s nízkou úrovní motorické výkonnosti. U souborů s vysokou úrovní motorické výkonnosti jsme zaznamenali těsnější vztah k somatickým parametrům (tělesné hmotnosti, BMI a množství podkožního tuku), vyjádřený významně nižší variabilitou hodnot, než u souborů s nízkou úrovní motorické výkonnosti. Výsledné hodnoty potvrdily nutnost zohledňování somatických ukazatelů při výběru sportovních talentů. Na druhou stranu ukázaly tendenci k nejednoznačným vztahům základních somatických charakteristik k nízké úrovni motorické výkonnosti.

*Klíčová slova: somatické parametry, chlapci a dívky školního věku, nízká a vysoká úroveň motorické výkonnosti.*

## FUNCTIONAL AND DYNAMIC ASYMMETRY IN 14 YEAR-OLD BOYS WITH MINOR MENTAL HANDICAP

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The level of laterality determines physical and motor human development. Poorly lateralised children are, in most instances, poorly proficient manually, less agile and have weaker movement co-ordination in comparison to children of the same age with clear laterality. Disorder of co-ordination gradually results in a decrease of speed and movement precision and bring the lack of economy and harmony of activities (Hurlock, 1985; Koszczyc, 1991; Spionek, 1961, 1985; Wieczorek, 1997; Zazzo, 1974). Research studies on the level of laterality of limbs of slightly handicapped children have proved that the process of laterality is retarded. The reason is that 2/3 of slightly mentally handicapped girls and boys did not have decisive supremacy of a limb and about 50 % of them formed homogenous supremacy of limbs (hand-leg) only during final school years. Research studies have also shown that general physical aptitude of slightly mentally handicapped children correlates with a level of limb laterality (Pańczyk, 1975). Basing on the bibliography of the very subject and considering its importance, the main objective of work is to learn the level of functional and activity asymmetry of slightly mentally handicapped boys aged 14. The results of performed research studies will allow to define the differentiation of functional and activity asymmetry of mentally handicapped pupils aged 14. Research studies were performed on a group of 32 slightly mentally handicapped boys. During the research there were used a test for direction of functional asymmetry and a test for proportions of activity asymmetry. The set of test had been developed by B. Sekita and T. Koszczyc. The results research showed that the process of laterality is retarded for dynamic asymmetry in a group of researched 14 year-old slightly mentally handicapped boys, while as far as functional asymmetry is concerned there are no disorders of the process.

*Keywords: lateralization, functional and dynamic asymmetry, slight mental handicap.*

### INTRODUCTION

The bibliography includes a lot of definitions of a mental handicap that is also called a mental deficiency or oligophrenia. At the present stage those definitions which are multi-aspect seem to be the most valuable. Lewicki gives the similar one in which "oligophrenia means a congenital or early acquired handicap or retardation of physical development, which often leads to disorders of social adaptation. It is characterised by considerable decrease in intellectual proficiency and efficiency, which becomes the bigger, the deeper is its level. It is connected with emotional and character disorders and, sometimes, with anomalies of a body build" (Lewicki, 1972, 282). In oligophrenia the retardation of intellectual development might be less or more deep; different degrees of mental deficiency depend on it. However, the classification of a mental handicap is as complex as its defining. The best-known and widespread psychological classifications are those which include measurement of an intellectual development level by an intelligence quotient (IQ). In Poland the classification developed by the WHO has become obligatory since January 1, 1968. It has introduced four levels of a mental handi-

cap: slight (67–52 IQ), moderate (51–36 IQ), significant (35–20 IQ) and deep (below 20 IQ). The IQ values between 68 and 83 had been treated as the borderland of a handicap, presently they are considered the bottom line of a wide norm (see Kirejczyk, 1981). Though an intelligence quotient is an objective criterion of evaluation of a level of intellectual development, this ratio is insufficient. It is the basis for social planning, but it cannot decide about child's needs how to help him or her. To diagnose a mental handicap, it is not enough to run a test analysis of intelligence and decide upon a low IQ. One should also learn something about social and emotional adaptation, a level of physical and psychomotor development characteristic for life age and environment.

In bibliography there is no rigid system of criteria or a classification of a mental deficiency. Any accepted system would be of doubtful value, might be dangerous and lead to a deceptive feeling of accuracy. A classification has to be optional because a mental deficiency is – to some extent – a social concept depending on a changeable level of social tolerance. Hence none system of division can be either satisfactory or constant.

# PHYSICAL AND PSYCHOMOTOR DEVELOPMENT OF SLIGHTLY HANDICAPPED CHILDREN

A mental handicap influences child's cognitive, social and psychophysical possibilities. As far as cognitive possibilities are concerned, the characteristic thing for slightly mentally handicapped children is a disorder of perception and ability for a sight analysis and synthesis. Their concentration is facultative, yet its level is lower than of children with correct mental development; it mostly depends on a level of attractiveness of a stimulus. These children have weaker logic memory, both short and long. There have not been noticed any differences in mechanical and associative memory. Hence, the conclusion is that a slight mental deficiency is – first of all – connected with a handicap of logic memory (Kostrzewski, 1984). These children have more modest vocabulary and passive vocabulary is richer than the active one. Disphaemia also influences emotional disorders which might intensify difficulty of verbal contact with the surrounding world. All research workers stress that the disorder of abstract thinking is the basis for a handicap both for children and adults handicapped in a slight degree. An object-image way of thinking is typical for them (Kirejczyk, 1981; Kostrzewski, 1978; Maszczak, 1991). These people are also characterised by underdevelopment of higher feelings, emotional instability, impulsiveness, aggression, anxiety, lack of control and self-evaluation mechanisms (Kostrzewski, 1984; Niedbała, 1977). A slight mental handicap is also connected with disorders of physical and motor development. Physical development proceeds more slowly and at the lower level. Though, it is much quickened at the final stage of maturing and children get close to the children of their age within an intellectual norm. Pańczyk's research (1975) on a level of development of motor features of slightly mentally handicapped children aged from 9 to 18 showed that these children were characterised by a significantly lower level of development of motor features. The biggest differences included speed and agility both of girls and boys, stamina for girls and the power of muscles of shoulders and abdomen for boys. However, in spite of a lower level of these features, there is some similarity of profiles of development of motor features. These similarities are not characteristic for girls only as far as the following features are concerned: suppleness, power of shoulder and agility. The children are also characterised by an unequal handicap of particular features of movement abilities measured according to Ozierecki's scale. The precision of movements, speed and the ability to make simultaneous movements are relatively most handicapped, while static co-ordination is relatively less (Kostrzewski, 1984).

The level of laterality is another rule of physical and motor human development. Poorly lateralised children are usually poorly manually proficient, less agile and have weaker movement co-ordination in

comparison to children of their age with clear laterality<sup>1</sup>. Disorder of co-ordination gradually cause the decrease of speed and movement precision and bring the lack of economy and harmony of activities. The high level of laterality influences cognitive process decides about efficient performance and conditions the proceeding of the very process of learning. Children with faulty proceeding laterality are characterised by disorders of development of speech, reading, writing, counting, recognising right and left side and space orientation (Hurlock, 1985; Koszczyc, 1991; Spionek, 1961, 1985; Wieczorek, 1997; Zazzo, 1974). After the process of laterality has been finished or if we research it in its given moment, we use a term of asymmetry. Sciences on physical culture consider the concept of asymmetry in three aspects, i.e: morphological asymmetry, functional asymmetry and dynamic asymmetry. Morphological asymmetry means the disturbance of symmetry of shapes of outer body at both sides of a middle area. Functional asymmetry includes a privilege given to movements of one side of a body to the disadvantage of the second one while performing everyday activities (more often use of one side of a body). Dynamic asymmetry expresses a level of difference which exists between limbs or organs on opposite sides of a human body, for example the difference in speed or stamina of upper or lower limbs (Wolański, 1975). Functional asymmetry can be described by its direction and a profile. The direction means the number of people within a given group or society characterised by given sidedness for upper limbs, lower limbs, eyes or ears (e.g. 85 % people in a population are right-handed). The profile of functional asymmetry – also called a model of partiality – is the system of partiality of an upper limb, a lower limb, an eye and an ear, that characterises some people (e.g. right-eyeness, right-earness, right-handedness, left-legness).

As far as the level of laterality of mentally handicapped children is concerned, the bibliography mentions various research results in this field. Kirejczyk (1981) says that left-handedness is characteristic for 18.5 % of mentally handicapped children at school age and only for 7.3 % of healthy pupils. It is also mentioned that supremacy of a right hand over the left one is minimal among mentally handicapped children, while this supremacy is much higher among children in norm. It is also shown that mentally handicapped children more often than children in an intellectual norm use a left hand.

Research studies on the level of laterality of limbs of slightly handicapped children have proved that the process of laterality is retarded. The reason is that 2/3 of slightly mentally handicapped girls and boys did not have decisive supremacy of a limb and about 50 % of them formed homogenous supremacy of limbs (hand-

<sup>1</sup> Spionek understands lateralization as a long-term process taking place in the whole body and leading to asymmetry, dominance or bilateral differentiation, one part of the body dominating another, on the opposite side (Spionek, 1985).

leg) only during final school years. Research studies have also shown that general physical aptitude of slightly mentally handicapped children correlates with a level of limb laterality (see Pańczyk, 1975).

All research results summarised with the help of Zazzo's test (1974) show that for 403 slightly mentally handicapped pupils aged 9–16, 40.6 % of girls and 37.4 % of boys have homogenous (right or left-hand) laterality of eyes, hands, legs, while for a control group which consisted of children of the same age from normal schools, percentage were as follows: 60.9 % for girls and 54.0 % for boys. Basing on the bibliography of the very subject and considering its importance, the main objective of work is to learn the level of functional and activity asymmetry of slightly mentally handicapped boys aged 14. The results of performed research studies will allow to define the differentiation of functional and activity asymmetry of mentally handicapped pupils aged 14. Various tests will enable to learn the problems connected with laterality of handicapped children better. These facts can help to improve or suggest new ways of working with a handicapped child at school, at home, so these children could better cope in their everyday life. Acquired objectives will enable to answer the following questions of the research:

1. What is the level of activity asymmetry for researched motor abilities?
2. Which features present the highest and the lowest level of activity asymmetry?
3. What is the profile and direction of functional asymmetry of a researched group of boys?

## MATERIAL AND METHODS OF RESEARCH

Research studies were performed on a group of 32 slightly mentally handicapped boys. Each child who on the day of research was 13 years and 6 months old and not over 14 years and 5 months was chosen for a researched group. The choice of research material was based on the fact that the process of laterality for 14 year-old children should have been finished, what the bibliography explicitly says about children in intellectual norm (Bogdanowicz, 1992, Spionek, 1985, Zazzo, 1974). Research studies were performed at four special schools: three in Wrocław and one in Łask. At these school physical training is realised in a similar way and conditions.

During the research there were used a test for direction of functional asymmetry and a test for proportions of activity asymmetry. The set of test had been developed by B. Sekita and T. Koszczyca at Wrocław Academy of Physical Training. These tests were many times verified during research studies of big population; their results confirm their high honesty, measurability and accuracy.

According to this set of tests, functional asymmetry is checked basing on observation of free choice of a hand, a leg, or an eye by a researched person to perform an ordered task. Then basing on quality analysis of a performed test there is described sidedness of the researched person for a hand, a leg and an eye.

For more precise analysis of functional asymmetry there were also developed the profiles of laterality for hand-leg-eye, basing on acquired data on directions of sidedness.

In the used test proportions of activity asymmetry are defined basing on the difference of results of the test done with right and left limb for two motor features: power and speed.

The test for proportions of activity asymmetry includes:

1. The speed of manual movements – test of tapping on roudlets.
2. The speed of movements of lower limbs – Fleishman's tapping test.
3. The power of muscles of upper limbs – throw of a 1-kg medicine ball while sitting.
4. The power of muscles of lower limbs – test for a jump with one leg from a standstill.

Firstly there was conducted a test for direction of functional asymmetry, secondly a test for proportions of activity asymmetry. Pupils were wearing sportswear. At the very beginning they were informed how to perform particular tests and there was a 10-minute warm-up. The gathered material was statistically interpreted at the Calculating Centre of Wrocław Academy of Physical Training. The following things were calculated: arithmetic average, standard deviation, and Pearson's *r* correlation ratio. To define non-directional dynamic asymmetry there was used the formula developed by Siniarska and Sarna (1980).

## FUNCTIONAL ASYMMETRY WITHIN A RESEARCHED GROUP OF BOYS

The general evaluation of sidedness of researched organs of movement and senses for 14 years-old slightly mentally handicapped boys shows that this feature is not differentiated. The right-hand side direction of functional asymmetry dominates over researched organs of movement and sense (TABLE 1).

The analysis of profiles – appearing within a group of boys – of functional asymmetry for an upper limb, a lower limb, an eye shows that in a researched group of boys there only appear profiles of functional asymmetry (TABLE 2). The right-hand profile definitely dominates over established homogenous profiles (56.2 %).

The existence of established profile only and the direction of functional asymmetry show that the process of laterality for researched boys – as far as their body functions are concerned – has been finished.

**TABLE 1**

Direction of sidedness for a researched group of boys (%)

RD – right-hand direction

LD – left-hand direction

Researched organ of movement or a sense	Researched group (n = 32)	
	RD	LD
Upper limb	<b>81.2</b>	18.8
Lower limb	<b>84.3</b>	15.7
Eye	<b>75</b>	25

**TABLE 2**

The profiles of laterality for an upper limb, a lower limb and an eye for a researched group (%)

Kinds of a laterality profile	Researched group of boys
Established homogenous	59.4
Established non-homogenous	40.6

**TABLE 3**

Characteristics of motor aptitude of researched boys

X – arithmetic average

S – standard deviation

Feature	Side	Researched group of boys	
Speed of movements of upper limbs [s]	R	X	15.70
		S	3.49
	L	X	15.73
		S	3.12
Speed of movements of lower limbs [s]	R	X	57.18
		S	10.75
	L	X	59.43
		S	11.20
Power of muscles of upper limbs [cm]	R	X	436.31
		S	158.56
	L	X	370.31
		S	86.97
Power of muscles of lower limbs [cm]	R	X	150.75
		S	45.16
	L	X	150.12
		S	34.13

**TABLE 4**

Dynamic asymmetry (non-directional) of researched boys

X – average value of dynamic asymmetry for a given feature

S – standard deviation of average

Feature   R-L	Researched group
Speed of hand movements	X 2.37
	S 1.47
Speed of leg movements	X 4.12
	S 2.91
Power of hand muscles	X 104.15
	S 89.57
Power of leg muscles	X 20.87
	S 28.63

**DYNAMIC ASYMMETRY WITHIN A RESEARCHED GROUP OF BOYS**

All measurements of features of motor aptitude – which had been done successively for the right and for left hand side of a body- prove the supremacy of a right side over the left side (TABLE 3). Statistically essential difference in acquired results had only appeared with reference to the power of muscles of upper limbs and the speed of movements of lower limbs.

Ratios of dynamic asymmetry (non-directional) were counted one by one for researched features of physical aptitude (TABLE 4). The highest level of dynamic asymmetry characterises the power of hand muscles and the speed of leg movements. During the test for the power of leg muscles, standard deviation had the value higher than the average one and thus made it impossible to directly interpret the result.

Calculated ratios of dynamic asymmetry show that the level of activity asymmetry is low for researched children. Only for two above-mentioned features there appears the significant level of this asymmetry.

**SUMMARY AND CONCLUSIONS**

Research studies on the level of laterality of limbs of slightly mentally handicapped children have proved that their process of laterality is retarded. Almost 67 % of slightly mentally handicapped girls and boys did not have decisive supremacy of a limb and about 50 % of them formed homogenous supremacy of limbs (hand-leg) only during final school years (hand-leg) (Kirejczyk, 1981; Pańczyk, 1975; Spionek, 1985).

Therefore, the results acquired during these studies agree with other authors' research studies only partially. They showed that the process of laterality is retarded for dynamic asymmetry in a group of researched 14 year-old slightly mentally handicapped boys, while as far as functional asymmetry is concerned there are no disorders of the process.

Basing on acquired research results it is possible to draw the following conclusions:

1. Right-hand side direction and established homogenous profile of functional asymmetry dominates within a researched group of 14-year-old slightly mentally handicapped boys.
2. The level of activity asymmetry is low in a researched group. Only for the power of hand muscles and the speed of leg movements there appear a statistically essential level of asymmetry.

**REFERENCES**

- Bogdanowicz, M. (1992). *Leworęczność u dzieci*. Warszawa: WSiP.
- Hurlock, E. B. (1985). *Rozwój dziecka*. Warszawa: PWN.
- Kirejczyk, K. (1981). *Pedagogika – upośledzenie umysłowe*. Warszawa: PWN.
- Kostrzewski, J. (1984). *Psychologia upośledzonych*. Warszawa: Zeszyty Naukowe WSPS.
- Lewicki, M. (1972). *Psychologia kliniczna*. Warszawa: PWN.
- Koszczyk, T. (1991). *Asymetria morfologiczna i dynamiczna oraz możliwości jej kształtowania u dzieci w młodszym wieku szkolnym*. Wrocław: AWF, Studies and papers, 27.

- Maszczyk, T. (1991). *Poziom rozwoju somatycznego i motorycznego dzieci upośledzonych umysłowo*. Warszawa: Workshops, AWF.
- Niedbała, T. (1977). *Samooceńa dzieci lekko upośledzonych umysłowo i normalnych w wieku 13–15 lat a powodzenia w nauce szkolnej*. Praca magisterska, WSPS, Warszawa.
- Olszowski, A. (1973). Zdolności ruchowe dzieci upośledzonych umysłowo. *Szkoła Specjalna*, 1.
- Pańczyk, J. (1975). *Rozwój i sprawność umysłowa dzieci upośledzonych umysłowo w stopniu lekkim*. Warszawa: IKKNI BO.
- Siniarska, A., & Sarna, J. (1980). Asymmetry of human body – a synthetic approach. *Studies in Human Ecology*, 4, 217–241.
- Spionek, H. (1961). *Powstawanie orientacji w prawej i lewej stronie schematu ciała w ontogenezie*. Warszawa: PWN.
- Spionek, H. (1985). *Zaburzenia rozwoju uczniów a niepowodzenia szkolne*. Warszawa: PWN.
- Wieczorek, M. (1997). *Szybkość uczenia się złożonych czynności ruchowych a asymetria funkcjonalna i dynamiczna dzieci 10-letnich*. Doctor's thesis, Academy of Physical Education, Wrocław.
- Wolański, N. (1975). *Rozwój biologiczny człowieka*. Warszawa: PWN.
- Zazzo, R. (1974). *Metody psychologicznego badania dziecka*. Vol. 1 & 2. Warszawa: Państwowy Zakład Wydawnictw Lekarskich.

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# **FUNKČNÍ A DYNAMICKÁ ASYMETRIE U ČTRNÁCTILETÝCH CHLAPCŮ S LEHKÝM MENTÁLNÍM POSTIŽENÍM** (Souhrn anglického textu)

Výzkumné studie zaměřené na stupeň schopnosti ovládat končetiny mírně mentálně postižených dětí prokázaly, že u této skupiny dětí je tento proces zpomalen. Téměř 67 % mírně mentálně postižených chlapců nedokázalo rozhodujícím způsobem ovládat určitou končetinu a přibližně u 50 % z nich se projevila schopnost stejným způsobem ovládat končetiny (ruka-noha) až na konci školní docházky.

Výsledky získané v průběhu těchto výzkumů souhlasí s výzkumy jiných autorů pouze částečně. Ukázaly, že proces schopnosti ovládat končetiny je ve skupině zkoumaných čtrnáctiletých mírně mentálně postižených chlapců zpomalen dynamickou asymetrií, u asymetrie funkční však nejsou v tomto procesu žádné nedostatky.

Vyjdeme-li tedy z výsledků získaných tímto výzkumem, je možné učinit následující závěry:

1. Strana pravé ruky a získaný homogenní profil funkční asymetrie převažuje ve zkoumané skupině čtrnáctiletých mírně mentálně postižených chlapců.
2. Úroveň aktivní asymetrie je ve zkoumané skupině nízká. Pouze v souvislosti se silou svalů na ruce a rychlostí pohybu nohou se objevuje statisticky významná asymetrie.

*Klíčová slova: lateralizace, funkční a dynamická asymetrie, lehké mentální postižení.*



## THE INFLUENCE OF CYCLE ERGOMETER INTERVAL EXERCISE TRAINING ON THE PHYSICAL CAPACITY IN PATIENTS AFTER CORONARY ARTERY BYPASS GRAFTING (CABG)

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A group of 40 male patients aged between 42 and 60 years ( $X = 51.3$ ) after CABG surgery and post myocardial infarction (3–5 prior to bypass surgery), was the subject of this research. All patients completed 16 exercise training cycles. The objective of the study was to evaluate the influence of controlled exercise on the overall physical capacity and on the patients' clinical status. The results of the exercise tests performed prior to and following each training cycle were analysed. 12 months of observation showed significant improvement in physical capacity, manifested by increased test time duration, the covered distance and the amount of work performed. Moreover, decreases in the resting and post-exercise heart rate, as well as in the arterial blood pressure, were noted.

*Keywords: interval exercise training, physical efficiency, coronary artery bypass grafting (CABG).*

### INTRODUCTION

The surgical procedure in patients with ischaemic heart disease has become a generally accepted and commonly performed method of treatment. The long-term observation of post CABG patients clearly indicates a significant improvement in their clinical status, and in most cases, a more comfortable and better quality of life (Adler et al., 1986; Cobb et al., 1982; Dennis, 1992; Green & Cameron, 1989; Lipkin, 1991). Along with an increasing number of CABG patients, the problem of creating an appropriate rehabilitation program for such patients needs to be addressed, in addition to the problem of assessing its efficiency (Bradsley et al., 1993; Mazurek et al., 1993; Wilklund, 1991). The objective of this study is to evaluate the influence of cycle ergometer interval exercise training on the overall physical capacity in patients with ischaemic heart disease after CABG.

### MATERIAL AND METHOD

A group of 40 male patients of the Institute of Cardiology in Warsaw, Poland was subjected to the study. They aged from 42 and 60 years with mean age value 51.4 (SD = 5.1). To be selected to the study group, a patient had to be diagnosed with ischaemic heart disease and subsequently with myocardial infarction. To satisfy another criteria of this study, a patient had to undergo at least one CABG procedure. The maximum number of grafts per patient in the group was 5, (average 3). The time interval between the infarction and the procedure was between 3 to 5

months. The above data are depicted in detail in TABLE 1 and Fig. 1.

All patients were duly informed on the goal and the nature of the study they were to undergo. Verbal consent was duly acknowledged.

The clinical status of the patients was taken into consideration at the beginning of the outpatients stage of the rehabilitation program. Therefore, the selection procedure was based also on the results of the non-invasive tests such as stress test, ultrasonocardiography, 24 hour Holter ECG test and coronarography. To improve objectivity of medical examination and to confirm the preliminary diagnosis, each patient had to be examined by another cardiologist.

The observation period lasted 12 months, from the moment of selection to the end of the exercise training. The patients commenced participation in the exercise sessions between the 1st and the 6th month from the day of the bypass procedure. This time discrepancy resulted from post-surgery complications such as some forms of complex ventricular arrhythmias and symptoms of cardiac insufficiency. Initiation of outpatient rehabilitation program was possible only after successful medicinal treatment or subsidence of symptoms of the above mentioned disorders.

Patients performed interval exercise training program. One training cycle consisted of 16 sessions conducted 3 times per week. A cycle ergometer was used in this test since the load can be easily adjusted. One session usually lasted from 35 to 40 minutes. The patients were required to perform 6 exercises (each lasting 4 minutes and the load measured in watts) and each single exercise was followed by 2 minutes of rest. Measurements of heart rate (HR) and arterial blood

pressure (ABP) were taken every two minutes during the exercise session. Depending on the obtained values for these parameters, each following interval started with the same or with an increased load.

Patient's general exercise tolerance was assessed on the basis of obtained HR and ABP values. These two parameters were measured before the training cycle (initial measurement) and after its completion (final measurement) with the use of submaximal treadmill stress test according to modified Bruce protocol (Braunwald, 1997). HR response to physical exercise at the time of initial measurement was essential as far as setting the training load was concerned, which was adjusted between 60–70 % (in subjects aged over 60) (Belardinelli et al., 1995; Killavouri et al., 1995; Killavouri et al., 2000; Meyer et al., 1997; Sturm et al., 1999) and 70–80 % (in subjects aged under 60) of HR increase value obtained in this measurement (Braunwald, 1997; European Heart Failure Training Group, 1998; Fletcher et al., 1990; Hambrecht, 2000; Reinhart, 1998; Willenheimer, 1998).

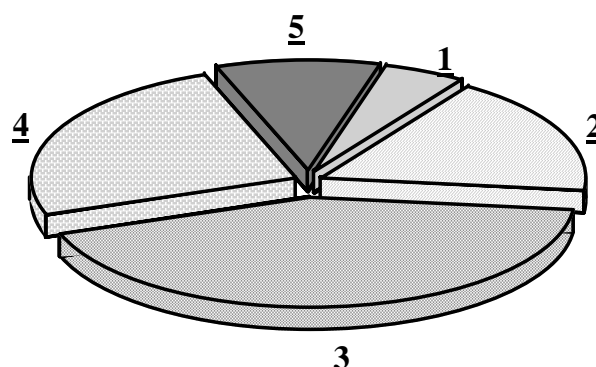
Values of HR (beat/min) and ABP (mmHg) were analysed. They were measured, together with ECG records at rest, at peak exercise (in the moment of interruption) and in the 3<sup>rd</sup>, 6<sup>th</sup> and 9<sup>th</sup> minute after completion of test. Where the changes in ECG record persisted for longer than 9 minutes, the control of HR and ABP was prolonged to the moment of their disappearance. Additionally, the values obtained at rest, at peak exercise and in the 9<sup>th</sup> minute after completion were taken. The covered distance (m), test time (min) and reasons for test interruption (physiologic and pathologic) were analysed as well. Data was collected by the Optimus computer compatible with treadmill unit and the entire procedure was supervised by an experienced hospital staff member. Each test was conducted in the presence of a cardiologist. The test team for all 40 patients did not change during entire study.

Both initial and final tests as well as all training sessions took place in the Department of Cardiac Rehabilitation, Institute of Cardiology, Warsaw, Poland. Training and measurement conditions were the same for each of the 40 patients.

The statistical analysis of the data collected during study began with the description of distribution types of measured parameters. For this purpose, two tests were adopted: the Kolmogorow-Smirnow test and the Shapiro-Wilk test. The results of both the tests were identical. However, some variables showed considerable statistical deviations from normal distribution. Later on, therefore, it was necessary to use nonparametric tests in relation to those variables. These tests included: the Wilcoxon test which is used to define the significance of difference between the initial and the final tests, and the R-Spearman test used for description of correlations. Their parametric equivalents were t-Student test for dependent data and Pearson Product-Moment Correlation, respectively.

**Fig. 1**

Share of subjects with various number of the coronary artery grafts in the studied group



**TABLE 1**

Number and proportions of subjects in individual age ranges [year], mean age and its standard deviation

Age range	Number	Percent
40 < x ≤ 45	7	17.5
45 < x ≤ 50	9	22.5
50 < x ≤ 55	15	37.5
55 < x ≤ 60	9	22.5
<b>Total</b>	<b>40</b>	<b>100</b>
<b>Mean age ± SD</b>	<b>51.4 ± 5.1</b>	

**TABLE 2**

Mean, maximal and minimal values, standard deviations and statistical level of heart rate (HR)[beat/min] at rest (Rest), at peak exercise (Peak) and after completion of the exercise (Final) in initial and final tests

HR	Initial test	Final test	p value
<b>Rest</b>	78.27 ± 21.42 57 – 102	72.97 ± 8.79 58 – 94	0.00251*
<b>Peak</b>	119.9 ± 16.68 91 – 159	122.82 ± 14.21 93 – 150	0.1162
<b>Final</b>	79.77 ± 11.51 59 – 105	72.67 ± 10.92 57 – 95	0.000037*

\* – differences statistically significant

Value p according to Wilcoxon test.

**TABLE 3**

Mean, maximal and minimal values, standard deviations and statistical level of systolic blood pressure (SBP)[mmHg] at rest (Rest), at peak exercise (Peak) and after completion of the exercise (Final) in initial and final tests

SBP	Initial test	Final test	p value
<b>Rest</b>	119.4 ± 15.90 90 – 160	111.37 ± 11.60 90 – 140	0.00013*
<b>Peak</b>	161.62 ± 23.46 105 – 210	157.87 ± 17.90 115 – 180	0.3217
<b>Final</b>	116.87 ± 10.60 90 – 140	110.37 ± 12.00 90 – 140	0.00049*

\* – differences statistically significant

Value p according to Wilcoxon test.

**TABLE 4.**

Mean, maximal and minimal values, standard deviations and statistical level of diastolic blood pressure (DBP)[mmHg] at rest (Rest), at peak exercise (Peak) and after completion of the exercise (Final) in initial and final tests

DBP	Initial test	Final test	p value
<b>Rest</b>	75.62 ± 7.78 60 – 95	73.12 ± 7.22 60 – 95	0.02023*
<b>Peak</b>	86.5 ± 12.26 60 – 110	84.75 ± 9.47 70 – 110	0.2346
<b>Final</b>	73.75 ± 8.90 55 – 95	69.5 ± 7.41 55 – 85	0.00164*

\* – differences statistically significant

Value p according to Wilcoxon test.

## RESULTS

All patients completed the planned study cycle. No aggravation of symptoms or other complications were observed in any of the 40 patients.

### Correlations

The evaluation of correlations between all observed parameters and patients age and as well as the number of grafted bypasses did not reveal any results which would be statistically significant. Therefore, it may be stated that the mentioned variables do not have any influence on the following statistical analysis of the data, despite diversity of the group.

### Heart rate

After completion of interval exercise training, statistically significant decreased values of HR at rest (78.27 versus 72.97;  $p = 0.00251$ ) and after training session (79.77 versus 72.67;  $p = 0.00037$ ) were noted. Maximal HR value increased as well though that increase was not of any statistical significance ( $p = 0.1162$ ) (TABLE 2).

### Blood pressure

Both systolic and diastolic blood pressure changes were similar to the HR variations. Their values decreased considerably at rest and after completion of exercise ( $p$  values from 0.00013 to 0.02023). Maximal blood pressure, both systolic and diastolic, decreased as well though the influence of interval exercise training did not seem to be significant here (respectively:  $p = 0.3217$  and  $p = 0.2346$ ).

*Exercise test time, covered distance, exercise load and reason for test interruption.*

Higher values of exercise test time (10.12 versus 12.74 min), covered distance (531.24 versus 730.9 m) and exercise load (127.02 versus 196.48 W) were the most statistically significant. The influence of interval exercise training was the most recognisable here. This conclusion was confirmed by very high values for substantial differences between the initial and the final test results (all  $p$  values  $< 0.00001$ ).

The reasons for test interruption were classified as physiologic and pathologic. Reaching the HR limit and fatigue were included in the group with physiologic limitations, whereas ECG abnormalities and ventricular and supraventricular ectopic contractions were included in the group with pathologic limitations. Differences in the proportion of both physiologic and pathologic limitations between the initial and the final tests were not statistically significant ( $p = 0.6432$ ) and they were shown in details in Fig. 2.

## DISCUSSION

Subsidence or considerable reduction in the pain symptoms, as well as increased level of physical activity and fewer limitations in daily activities are the results which are primarily experienced (within first few months) by postoperative patients. (Caine et al., 1991; Klonoff et al., 1989; Mayou, 1986; Mayou & Bryant, 1987; Sjoland & Caidahl, 1997).

Improved parameters, such as increased work load and time of stress test are the objective changes which may be observed in these patients. (Jenkins & Stanton, 1983; Ross et al., 1978; Sjoland & Caidahl, 1997; Stanton & Jenkins, 1984).

According to Caine et al. (1991), Klersy & Colarini (1997) and Sjoland & Caidahl (1997) the most considerable improvement in the quality of life and

**TABLE 5**

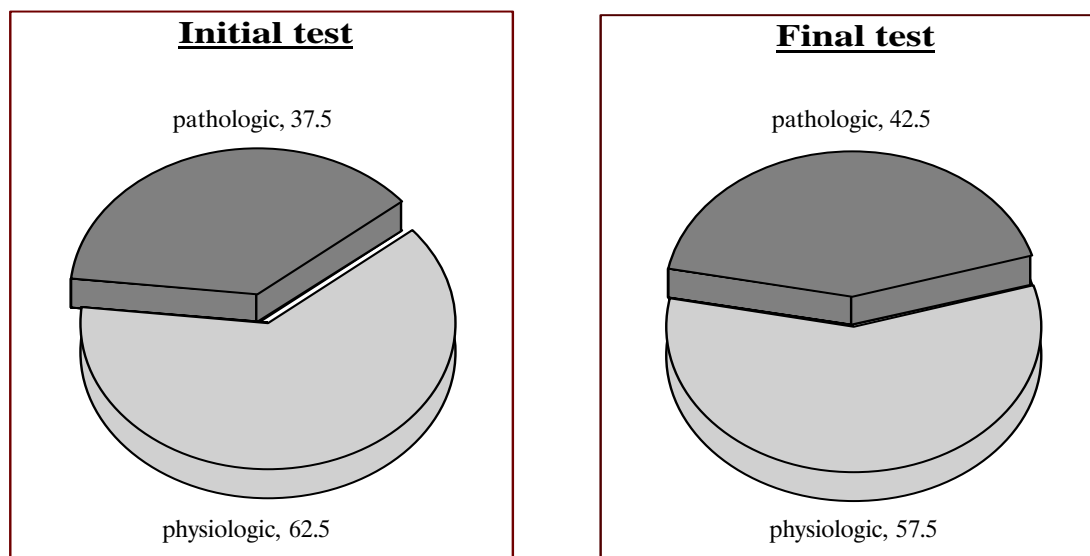
Mean, maximal and minimal values, standard deviations and statistical level of the time of the exercise test duration (Time)[min, sec], covered distance (Distance)[m] and work rate (Work rate)[W] in initial and final tests

Variable	Initial test	Final test	p value
Time	10.12 ± 2.50 4 – 15	12.74 ± 2.14 6 – 16	0.00000*
Distance	531.24 ± 168.58 180 – 875	730.90 ± 170.69 305 – 987	0.00000*
Work rate	127.02 ± 52.63 46 – 229	196.48 ± 51.26 64 – 312	0.00000*

\* – differences statistically significant  
Value  $p$  according to Wilcoxon test.

**Fig. 2**

The proportional share of the reasons for breaking the exercise in initial and final test.



functional capacity usually takes place between 2–3 month after surgery. Improvement observed after 6, 12 months and later is not substantial.

Performed assessment of patients' clinical status indicates clearly, that interval training used after surgery, facilitates improvement of exercise tolerance (time of stress test, covered distance, amount of work performed). Fletcher et al. (1990) used similar interval training during outpatient (phase 2) cardiac rehabilitation and also observed improved patients' clinical status and increased exercise tolerance (statistically relevant increment of work load and stress test time [METs]).

Meyer et al. (1990) observed, that the performance of interval training after surgery results in an improved functional capacity and heart function. Those changes were considerable in a number of stress tests terminated due to physiological reasons.

Decreased number of stress tests terminated due to pathological reasons was also observed in the present study during 12 months period, though that decrease was not statistically significant.

Mazurek et al. (1993) noted, that rehabilitation of post surgery patients affects favourably not only their functional capacity (stress test time, covered distance, amount of work performed [METs]), but also contributes to smaller number of episodes of complex forms of ventricular dysrhythmias, which often used to be the criteria for stress test termination.

According to Engblom et al. (1992, 1996) physical exercise performed on daily basis allows for achieve-

ment of higher maximum heart rate and also limits the number of angina pectoris episodes, particularly during intensive exercise.

Analysis of blood pressure response to physical effort is of great importance in the assessment of heart hemodynamics. Selzer (1978) proved, that such response is an objective indicator of left ventricle function, (fall in systolic blood pressure in response to increasing work load may indicate left ventricle impairment).

Studies performed by Theroux (1983) showed reduced time value of stress test performed by patients with post-infarction disturbances of heart muscle contractility. Additionally, these patients often present with lower values of peak systolic blood pressure, so the amount of tolerated work load by these patients is smaller. Results obtained in the present study revealed correct response of blood pressure to physical exercise. Pathological fall of blood pressure was noted in none of patients who participated in presented study.

Interval exercise training is an effective, safe, easy to conduct and more importantly, it successfully improves parameters of exercise tolerance. It allows for precise adjustment of exercise load in particular training sessions, it makes the adjustment easy, it enables to estimate an amount of work performed by patient at any moment of training process. This form of training also facilitates comparison of results and thus analysis of conclusions concerning evaluation of patient's clinical status, level of physical capacity and prognosis for future.

## CONCLUSION

The interval exercise training performed on regular basis by group of patients after a revascularization procedure is conducive to improvement of general fitness, physical capacity and thus the quality of patient's life. It has been found to be a favourable and a verified form of outpatient cardiac rehabilitation.

## REFERENCES

- Adler, D. S., Godman, L., O'Neil, A., Cook, E. F., & Mudge, G. (1986). Long term survival of more than 2000 patients after coronary bypass grafting. *Am. J. Card.*, 58, 195.
- Belardinelli, R., Georgiou, D., Scocco, V. et al. (1995). Low intensity exercise training in patients with chronic heart failure. *Am. Coll. Cardiol.*, 26, 975–82.
- Bradsley, W. T., Mankin, H. T., & Miller, T. D. (1993). *Cardiology – Fundamentals and Practise* (2<sup>nd</sup> ed.). Mayo Foundation, 23, 221.
- Braunwald, E. (1997). *Heart disease* (5<sup>th</sup> ed.). Philadelphia: Sanders W. B. Co.
- Caine, N., & Harrison, S. C. W. (1991). Prospective study of quality of life before and after coronary artery bypass grafting. *B. M. J., March*, 302, 511–516.
- Cobb, F. R., Williams, R. S., McEvan, P., & Jones, R. H. (1982). Effects of exercise training on ventricular function in patients with recent myocardial infarction. *Circ.*, 1, 100.
- Dennis, Ch. (1992). *Rehabilitation of patients with coronary artery disease. A textbook of cardiovascular medicine* (4<sup>th</sup> ed.). Philadelphia: Sanders W. B. Co.
- Engblom, E., Hietanen, E. K., Hämäläinen, H., Kallio, V., Inberg, M., & Knuts, L. R. (1992). Exercise habits and physical performance during comprehensive rehabilitation after coronary artery bypass surgery. *En. H. J.*, 13, 1053–1059.
- Engblom, E., Korpilahti, K., Hämäläinen, H., Pvuoka, P., & Rönnemaa, T. (1996). Effects of five years of cardiac rehabilitation after coronary artery bypass grafting on coronary risk factors. *Am. J. of Card.*, 78, 1428–1430.
- European Heart Failure Training Group (1998). Experience from controlled trials of physical training in chronic heart failure. Protocol and patients factors in effectiveness in the improvement exercise tolerance. *Eur. Heart J.*, 19, 166–75.
- Fletcher, G. F., Froelicher, V. F., Hartley, L. H., & Haskell, W. L. (1990). Exercise standards. A statement for health professionals from the American Heart Association. *Circ.*, 82, 2286.
- Green, G. E., & Cameron, A. A. (1989). Bilateral internal thoracic artery surgery. 17 year experience. *Eur. H. J.*, 10, 57.
- Hambrecht, R., Gielen, S., Linke A. et al. (2000). Effects of exercise training on left ventricular function and peripheral resistance in patients with chronic heart failure: A randomized trial. *JAMA*, 283, 3095–101.
- Jenkins, C. D., & Stanton, B. A. (1983). Coronary artery bypass surgery. *JAMA*, 250, 782–88.
- Killavuori, K., Toivonen, L., Naveri, H., & Leinonen, H. (1995). Reversal of autonomic derangements by physical training in chronic heart failure assessed by heart rate variability. *Eur. Heart J.*, 16, 490–95.
- Killavuori, K., Naveri, H., Salmi, T., & Harkonen, M. (2000). The effect of physical training on skeletal muscle in patients with chronic heart failure. *Eur. J. Heart Fail.*, 2, 53–63.
- Klersy, C., & Collarini, L. (1997). Heart surgery and quality of life: a prospective study on ischaemic patients. *Europ. Journal of cardio-thoracic surgery*, 12, 602–9.
- Klonoff, H., Campbell, C. et al. (1989). Two years follow up study of coronary bypass surgery. *J. Thorac. Cardiovasc. Surg.*, 97, 78–85.
- Lipkin, D. P. (1991). Is cardiac rehabilitation necessary? *Br. Heart. J.*, 65, 237.
- Mayou, R. (1986). The psychiatric and social consequences of coronary artery surgery. *Journal of psychosomatic research*, 30, 225–271.
- Mayou, R., & Bryant, B. (1987). Quality of life after coronary artery surgery. *Quarterly journal of medicine. New series, March*, 62, 239–48.
- Mazurek, K., Rudnicki, S., Rausińska-Nocny, L., & Rydzerska, E. (1993). Exercise stress test and evaluation of physical work capacity in young patients after myocardial infarction. *EuroRehab.*, 2, 77.
- Meyer, K., Lehman, M., Siunder, G., Kenl, J., & Weideman, H. (1990). Interval vs continuous exercise training after coronary bypass surgery: a comparison of training-induced acute reactions with respect to the exercise methods. *Clin. Cardiol.*, 13, 851.
- Meyer, K., Samek, L., Schwaibold, M. et al. (1997). Interval training in patients with severe chronic heart failure: analysis and recommendations for exercise procedures. *Med. Sci. Sports Exerc.*, 29, 306–12.
- Okin, P. M., Chen, J., & Klingfield, P. (1990). Effect of baseline ST segment elevation on test performance of standard and heart rate adjusted ST segment depression criteria. *Am. H. J.*, 119, 1280.
- Reinhart, W. H., Dziekan, G., Goebbels, U. et al. (1998). Influence of exercise training on blood viscosity in patients with coronary artery disease and impaired left ventricular function. *Am. Heart J.*, 135, 379–82.
- Ross, J. K., Diwell, A. E. et al. (1978). Wessex cardiac surgery follow-up survey: The quality of life after operation. *Thorax*, 33, 3–9.

- Selzer, A. (1978). On the interpretation of the exercise test. *Circ.*, 58, 193–95.
- Sjoland, H., & Caidahl, K. (1997). Impact of coronary bypass grafting on various aspect of quality of life. *Europ. Journal of cardio-thoracic surgery*, 12, 612–19.
- Stanton, B. A., & Jenkins, C. D. (1984). Functional benefits following coronary artery bypass graft surgery. *The annals of thoracic surgery*, 37, 4.
- Theroux, P. (1983). Exercise stress testing in the post myocardial infarction patient. *Am. J. Cardiol.*, 52, 664–667.
- Sturm, B., Quittan, M., Wiesinger, G. F. et al. (1999). Moderate- intensity exercise training with elements of step aerobics in patients with severe chronic heart failure. *Arch. Phys. Med. Rehabil.*, 80, 746–50.
- Wilklund, J. (1991). The relationship between exercise tolerance and quality of life in angina pectoris. *Clin. Cardiol.*, 204.
- Willenheimer, R., Erhardt, L., Cline, C. et al. (1998). Exercise training in heart failure improves quality of life and exercise capacity. *Eur. Heart J.*, 19, 774–81.

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**VLIV INTERVALOVÉHO TRÉNINKU  
NA BICYKLOVÉM ERGOMETRU  
NA TĚLESNOU VÝKONNOST PACIENTŮ  
PO OPERATIVNÍM PŘEMOSTĚNÍ  
AORTÁLNĚ-VĚNČITÝCH TEPEN  
(BY-PASS OPERACE)  
(Souhrn anglického textu)**

Výzkumu se zúčastnilo 40 mužů ve věku 42 až 60 let ( $X = 51,3$ ) po operaci přemostění aortálně-věničtých tepen (by-pass operace), kteří o 3 až 5 měsíců dříve byli hospitalizováni s infarktem myokardu. Pacienti zařazení do programu absolvovali cyklus 16 tréninků. Cílem studia bylo zhodnotit vliv kontrolované fyzické zátěže na všeobecnou výkonnost a klinický stav nemocných. Výsledky zátěžových testů, které byly prováděny před začátkem a po absolvování tréninkového cyklu, byly podrobeny analýze. Za dobu 12 měsíců bylo zjištěno, že po absolvování programu výkonnost sledovaných pacientů vzrostla, což se projevilo prodloužením doby trvání testu, délkou překonané tratě a zvětšením množství práce. Bylo zjištěno snížení tepové frekvence v klidu a po fyzické zátěži a také snížení hodnot arteriálního tlaku krve.

*Klíčová slova: tělesná výkonnost, intervalový trénink, by-pass operace.*





## TELEMETRIC DIAGNOSTIC SYSTEM FOR MEASUREMENT OF TIME PARAMETERS OF GAIT

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The authors present a hardware and software model of telemetric diagnostic system aimed at the measurement and evaluation of the time parameters of gait. The system comprises a sensor unit formed by specially adapted shoes, a radio transmitter and a receiver connected to a microcomputer via serial port COM 1 (2). Basic software equipment involves testing of sensors, measuring, calculation of time, spectral and statistic parameters. The system has been designed to monitor the load in the lower extremities during the course of various physical activities, for the purposes of evaluation of results of therapeutic rehabilitation, etc.

*Keywords: telemetric diagnostic system, parameters of gait, spectral analysis.*

### INTRODUCTION

Gait is one of the characteristic activities of man and its changes can therefore signal early or advanced disorders of the neuromuscular system. Early diagnosis of gait disorders enables us to predict the disease or to follow the course of the therapy. At present, a number of methods are available for analysis of gait, based on various physical principles and at varying costs.

The method of direct visual analysis of gait is considered to be the simplest diagnostic method, however, it harbours a subjective error and is unable to quantify precisely the degree of disorder. Therefore, modern methods incorporating computer analysis and covering various diagnostic problems attempt to cover such errors. These include the following:

- **time analysis of gait**
  - platforms, e.g. GAITMAT™ II ([www.gaitmat.com](http://www.gaitmat.com)), accuracy  $10^{-2}$  s, length 3.8 m; system UDS FTK UP Olomouc (Salinger et al., 1990), accuracy  $10^{-3}$  s, length 6 m and others,
- **force-time analysis of gait**
  - insoles, e.g. T&T MEDIOLOGIC ([www.medilogic.com](http://www.medilogic.com)), 64 sensors/insole, sampling frequency of 60 Hz; Novel (Pedar) ([www.novel.de](http://www.novel.de)), 128 sensors/insole, sampling frequency of 50 Hz; DINATO ([www.tuol.it/bat](http://www.tuol.it/bat)), 64 sensors/insole, sampling frequency of 70 Hz and others,
  - platforms, e.g. FOOTSCAN® system – 16384 sensors, length 2.07 m, sampling frequency of 400 Hz; KISTLER ([www.kistler.ch](http://www.kistler.ch)), 4 sensors

(3D), length 0.9 m, sampling frequency of 750 Hz; NOVEL EMED ST, 1500 sensors, length 0.5 m, sampling frequency of 100 Hz,

- **kinematic analysis of gait**
  - systems with manual or automatic image digitalization, e.g. COSTEL; ELITE; MIKROMAK ([www.mikromak.com](http://www.mikromak.com)); SIMIMOTION ([www.simi.net](http://www.simi.net)); VICON; FTK UP Olomouc (Janura et al., 1998) and others.

### MODEL ALGORITHMS FOR MEASUREMENT AND EVALUATION OF TIME PARAMETERS

The results of a survey show that the given accuracy of measured time intervals decreases with an increase in the number of sensors. To attain the postulated telemetric transmission of time intervals measured with an accuracy of  $\pm 1$  ms, the sole was divided to two parts – heel and toetip, each comprising appropriately placed switch sensors (see Fig. 1A). This setting gives eight basic time parameters in the course of the gait cycle, as shown in TABLE 1, which defines the sole position of individual lower extremities (left and right) in relation to the stance (floor contact) or swing (no floor contact) phase of the gait cycle.

In addition to the above basic parameters, the derived parameters are calculated, defining mainly the relationships between the extremities during individual phases of the gait. TABLE 2 presents some of the calculated time parameters.

**TABLE 1**

Survey of basic time parameters measured during a gait cycle

Parameter	Foot	Phase	Part of sole	Unit
LStT	left	stance	toetip	[s]
LSwT	left	swing	toetip	[s]
LStH	left	stance	heel	[s]
LSwH	left	swing	heel	[s]
RStT	right	stance	toetip	[s]
RSwT	right	swing	toetip	[s]
RStH	right	stance	heel	[s]
RSwH	right	swing	heel	[s]

**TABLE 2**

Definition of some calculated time parameters

Parameter	Foot	Phase	Part of sole	Unit
LSt	left	stance	toetip + heel	[s]
LSw	left	swing	toetip + heel	[s]
RSt	right	stance	toetip + heel	[s]
RSw	right	swing	toetip + heel	[s]

Mathematically, all the above given parameters represent time series which can be evaluated both in the time and the frequency domains. The time domain evaluation is conducted by calculating the basic statistic parameters, whereas in the frequency domain, the variations between the individual elements of the time series is estimated by spectral analysis, resulting in SPECTRAL and NOISE POWER in the following frequency band.

## DESCRIPTION OF THE DIAGNOSTIC SYSTEM

The system comprises as special shoes or special inner shoe lining with appropriately placed sensors (pressure-sensors) – see Fig. 1A, divided according to their function to the front part – toetip and the rear part – heel and enabling indication of the time parameters LStT, LSwT, LStH, LSwH, RStT, RSwT, RStH, RSwH, see TABLE 1.

Each of these parts of the shoes or insoles can contain as many as four sensors, interconnected electrically. The status of sensors is continually registered by the microprocessor and the corresponding time data are evaluated with an accuracy of  $\pm 1$  ms, which is provided by parallel connection of the individual shoe parts with an 8-bit data bus of the microprocessor. Each change in the status of the selected group of sensors brings registration about the time and the parameter in the form of a two-byte word is telemetrically transmitted to the receiver, along with the sensor status. The receiver is connected to a PC IBM-compatible computer via standard port COM 1 (2). A miniature UHF radio module type 70 TXRX-M,

manufactured by HM Funktechnik, Germany (www.hmradio.de), is used for the telemetric transmission.

Decoding of the transmitted information is realized with the help of a microcomputer which accepts the communication protocol of the transmitter and the receiver, decodes the status of the sensors and creates data files for further processing.

The software for the diagnostic system enables to monitor the function of sensors, regulates the examination process, performs the filtration of artifacts and evaluation of registered parameters in the time and the frequency domains together with the presentation of results in the form of tables and diagrams.

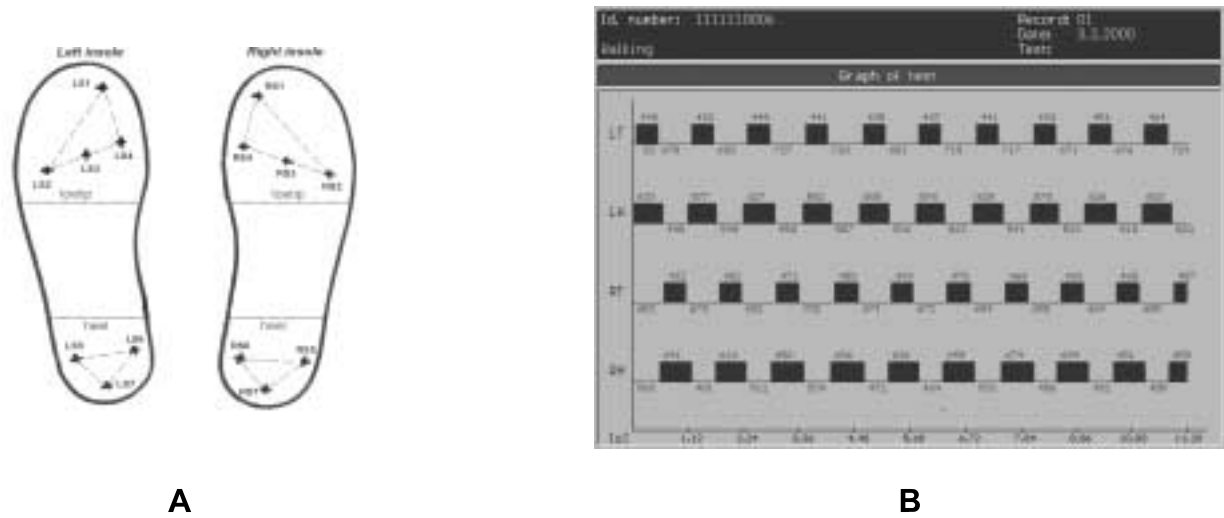
### Evaluation of gait parameters in the time-domain

The evaluation in the time-domain is presented as calculation of basic statistical parameters, the comparison of which allows to evaluate e.g. changes in the symmetry of lower extremities, parameter stability etc. An example of an outcoming protocol of parameters, including graphic depiction of the symmetry of the left and the right leg, rate histogram and scattergram of LSt parameter is given in Fig. 2.

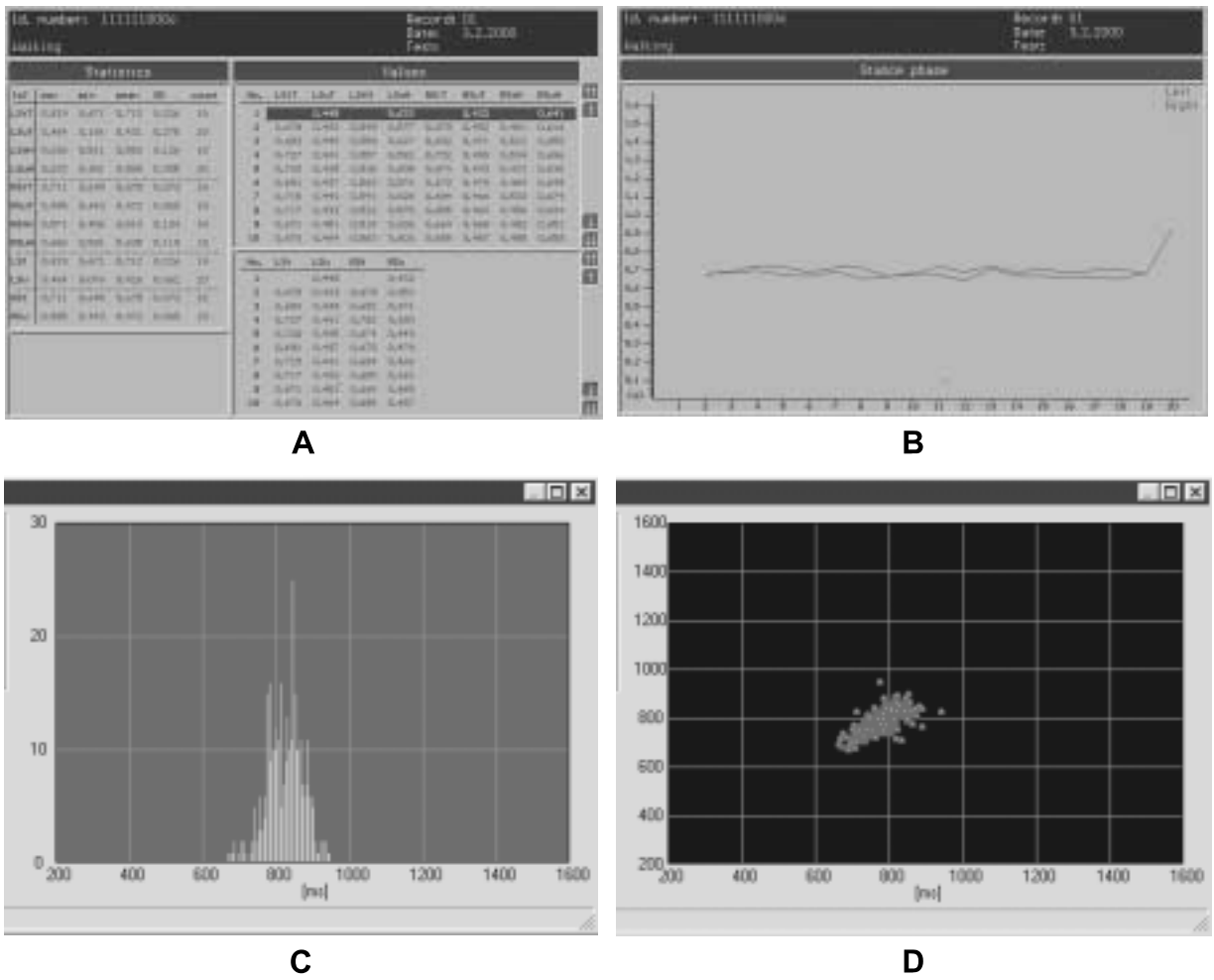
### Evaluation of gait parameters in the frequency-domain

The algorithm of the examination method is based on spectral analysis (SA) of short-term recording of time intervals. During pre-processing of data, the calculation of the time-series trend, i.e. the coefficients of the fourth order polynomial, is performed and the trend is removed. This non-equidistant time series may be interpolated via a third order function – cubic spline, and the data is then sampled at a sampling

**Fig. 1**  
A – Functional distribution of the insole (toetip, heel) and position of sensors, LS1-7, RS1-7 Sensors on Left (L) and Right (R) insole; B – Depiction of decoded time intervals



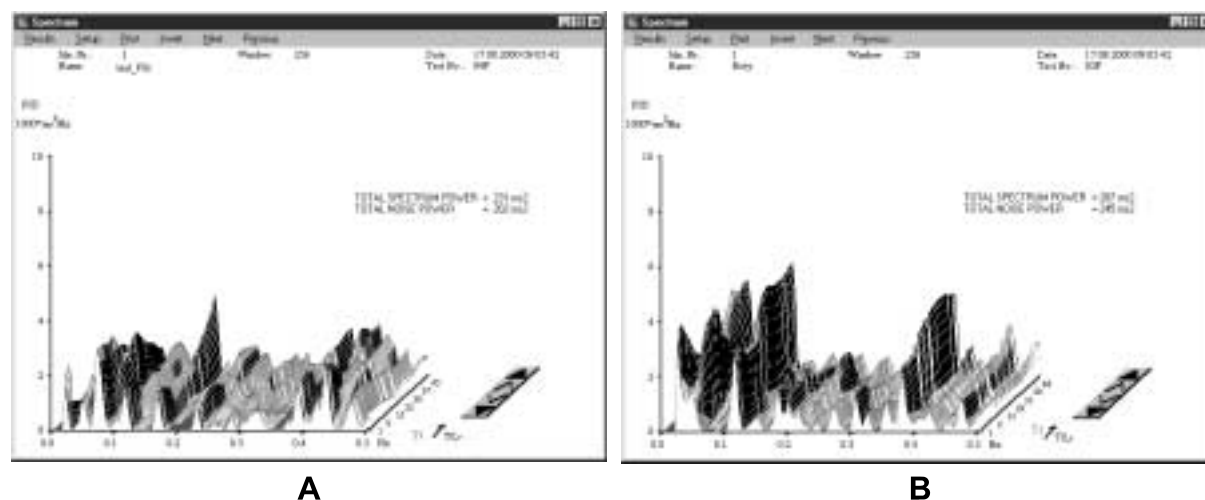
**Fig. 2**  
An example of outgoing protocols of gait examination in the time domain  
A – basic outgoing protocol, B – comparison of the left and the right leg (parameter LSt and RSt), C – histogram (parameter LSt), D – scattergram (parameter LSt).



**Fig. 3**

Three-dimensional graphic display of “short-term” spectral analysis of parameters of gait

A – spectral analysis of parameter RSt, B – spectral analysis of parameter LSt



frequency of 4 Hz. Such adjusted time series serve as function for mathematical processing. The calculation of the SA parameters is performed by the FFT method with a partially modified CGSA – “Coarse-Graining Spectral Analysis” (Yamamoto et al., 1991). This algorithm provides optimum suppression of non-harmonic and noise components of the analyzed (processing) signal particularly in the low frequency band (1/f component).

The basic calculated parameters of SAHRV are **TOTAL SPECTRUM POWER [ms<sup>2</sup>]** and **TOTAL NOISE POWER [ms<sup>2</sup>]**. An example of the three-dimensional graphic display of “short-term” SA of LSt and RSt parameters is demonstrated in Fig. 3A and Fig. 3B.

## CONCLUSION

A wide spectre of time parameters with a relatively high accuracy of time interval measurement enables specific evaluation of the gait problematics. Together with the application of telemetric transmission and the spectral analysis of time parameters of gait, it serves as an optimum diagnostic tool in various stages of examination. The realization of the diagnostic system established conditions for eventual modifications of the sensing part or software equipment, i.e. changes in algorithms of measured and evaluated parameters.

## REFERENCES

- Janura, M., Mayer, M., Elfmark, M., Murcková, P., Salinger, J., & Vaverka, F. (1998). Application of a 3D videography in the analysis of gait – basic information. *Acta Universitatis Palackianae Olomucensis Gymnica*, 28, 25–32.
- Salinger, J., Vaverka, F., Čepl, M., & Macháček, I. (1990). Universal microprocessor equipment for measurement of time intervals of various motor actions of man. In M. Nosek, D. Sojka, W. E. Morrison, & P. Sušanka (Eds.), *Proceedings of the VIII<sup>th</sup> International Symposium of the Society of Biomechanics in Sports* (pp. 305–310). Prague: CONEX Company.
- Salinger, J. et al. (1999). Microcomputer system for telemetric assessment of short term heart rate variability in time and frequency domain, type VariaCardio TF4. In A. Murray & S. Swiryu (Eds.), *Computers in Cardiology 1999* (pp. 599–602). Los Alamitos: The Institute of Electrical and Electronics Engineers (IEEE) Computer Society Press.
- Yamamoto, Y., & Hughson, R. L. (1991). Coarse-graining spectral analysis: next method for studying heart rate variability. *J. Appl Physiol*, 71, 1143–1150.

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# TELEMETRICKÝ SYSTÉM PRO DIAGNOSTIKU ČASOVÝCH PARAMETRŮ CHŮZE

(Souhrn anglického textu)

Autoři příspěvku předkládají hardwarové a softwarové řešení telemetrického diagnostického systému určeného k měření a hodnocení časových parametrů chůze. Systém se skládá ze snímací části tvořené speciálně upravenou obuví, dále z radiového vysílače a přijímače, který je propojen s mikropočítačem prostřednictvím sériového portu COM 1 (2). Součástí systému

je základní softwarové vybavení mikropočítače, zahrnující procedury testování, snímačů, měření, výpočet časových a statistických parametrů a zobrazení výstupních protokolů. Systém je určen pro monitorování zátěže dolních končetin v průběhu různých pohybových aktivit člověka, pro posuzování dosažených výsledků v průběhu prováděné léčebné rehabilitace apod.

*Klíčová slova: telemetrický diagnostický systém, parametry chůze, spektrální analýza.*



## INSTRUCTIONS FOR MANUSCRIPT FOR THE ACTA UPO GYMNICA

The Acta Universitatis Palackianae Olomucensis magazine Gymnica is an independent professional magazine. The content of the magazine is focused on presentation of research notifications and theoretical studies connected with the problems of kinanthropology. The Gymnica 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 on a diskette 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 FTK UP publication manual.

### Epilogue of the contribution

A reference summary, (see a brief from the FTK UP publication manual), 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).

We look forward to our further cooperation!

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