

**ACTA
UNIVERSITATIS PALACKIANAE OLOMUCENSIS
GYMNICA**

**Vol. 38
No. 1**

Editor in Chief

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

Managing Editor

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

Editorial Board

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**ACTA
UNIVERSITATIS PALACKIANAE OLOMUCENSIS
GYMNICA**

**Vol. 38
No. 1**

PALACKÝ UNIVERSITY OLOMOUC

2008

All contributions were reviewed anonymously.

Všechny příspěvky byly recenzovány anonymně.

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

Autoři odpovídají za obsah a jazykovou správnost prací.

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

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

© Vlasta Karásková, 2008

ISSN 1212-1185

CONTENTS

Relationship between sports activity, smoking and alcohol and marijuana abuse in elementary school children in Slovenia <i>Veronika Lucija Kropelj, Mateja Videmšek, Rado Pišot</i>	7
Overweight and obesity trends in Slovenian boys from 1991 to 2006 <i>Marjeta Kovač, Bojan Leskošek, Janko Strel</i>	17
Posture analysis using position detector DTP2 in senescent women after the application of a targeted exercise program <i>Jarmila Riegerová, Jakub Krejčí, Petr Kolisko, Miroslava Přidalová</i>	27
The height of the longitudinal foot arch assessed by Chippaux-Šmiřák index in the compensated and uncompensated foot types according to Root <i>Ivan Vařeka, Renata Vařeková</i>	35
The significance of sensorimotor response components and EMG signals depending on stimuli type in fencing <i>Zbigniew Borysiuk</i>	43
Load intensity in volleyball game like drills <i>Michal Lehnert, Pavel Stejskal, Pavel Háp, Miroslav Vavák</i>	53
An example of an e-learning community for lifelong learning by physical education teachers <i>Matej Majerič, Milan Žvan, Marko Kolenc</i>	59

OBSAH

Vztah mezi sportovní aktivitou, kouřením a užíváním alkoholu a marihuany u dětí na základních školách ve Slovinsku <i>Veronika Lucija Kropelj, Mateja Videmšek, Rado Pišot</i>	7
Tendence k nadváze a obezitě u slovinských chlapců v letech 1991–2006 <i>Marjeta Kovač, Bojan Leskošek, Janko Strel</i>	17
Analýza postury polohovým snímačem DTP2 u žen ve věku senescence po aplikaci cíleného cvičebního programu <i>Jarmila Riegerová, Jakub Krejčí, Petr Kolisko, Miroslava Přidalová</i>	27
Výška podélné nožní klenby stanovená metodou Chippaux-Šmiřák u kompenzovaných a nekompenzovaných typů nohy dle Roota <i>Ivan Vařeka, Renata Vařeková</i>	35
Význam komponentů senzomotorické responze a EMG signálů v závislosti na typu stimulů při šermu <i>Zbigniew Borysiuk</i>	43
Intenzita zatížení při herních cvičeních ve volejbalu <i>Michal Lehnert, Pavel Stejskal, Pavel Háp, Miroslav Vavák</i>	53
Příklad e-learningové komunity v celoživotním vzdělávání učitelů tělesné výchovy <i>Matej Majerič, Milan Žvan, Marko Kolenc</i>	59

RELATIONSHIP BETWEEN SPORTS ACTIVITY, SMOKING AND ALCOHOL AND MARIJUANA ABUSE IN ELEMENTARY SCHOOL CHILDREN IN SLOVENIA

Veronika Lucija Kropej*, Mateja Videmšek**, Rado Pišot*.***

*Institute for Kinesiology Research at the Science and Research Centre of Koper, University of Primorska, Koper, Slovenia

**Faculty of Sport, University of Ljubljana, Ljubljana, Slovenia

***Faculty of Education, University of Primorska, Koper, Slovenia

Submitted in June, 2007

Prevention is the most effective remedy against drug abuse. On the one hand, physical activity triggers a series of factors which compel us to adopt healthy dietary behaviours and, on the other, it constitutes drug abuse prevention, as it is itself a kind of body and mind stimulant. The research at hand aims at establishing the degree of familiarity with and abuse of narcotic drugs (such as, for instance, cigarettes, alcohol and marijuana) in pupils in relation to the frequency of their engagement in sports activities. The sample comprised 748 children, 194 male and 189 female fourth graders (with an average age of 10 years \pm 5 months) and 201 male and 164 female seventh graders (with an average age of 13 years \pm 4 months). The indicated data were obtained within the framework of the project "Physical/sports activity for health" carried out by the Institute for Kinesiology Research at the Science and Research Centre of Koper, University of Primorska, Slovenia. We have applied the IPAQ survey instrument (International Physical Activity Questionnaire), which we had tailored somewhat to the age and specific features of respondents. For the purposes of establishing the relationship between non numeric variables, we have applied correspondence analysis. For numeric variables, we have applied the analysis of variance and the independent samples t-test. All hypotheses were verified at the 5% statistical risk level ($p = 0.05$). The results attested to a statistically significant relationship between sports activity, smoking and alcohol and marijuana abuse in pupils. The fact is that the drug abuse problem cannot be remedied in its entirety, but we could, however, alleviate it substantially. One of the most relevant factors in decreasing drug abuse is therefore also the engagement of youth in appropriate sports activities (during leisure time, in particular), which should be directed and planned accordingly by parents and teachers.

Keywords: Sports activity, smoking, alcohol, marijuana, children.

INTRODUCTION

Sports activity is an important means to achieving healthy dietary behaviour, as it exerts significant positive effects on physical and mental health. Movement or physical activity triggers a series of factors which compel us to adopt healthy dietary behaviours and constitutes drug abuse prevention, as it is itself a kind of body and mind stimulant. Lack of physical activity constitutes an obvious health risk factor, closely related to the emergence of numerous diseases affecting both human body and human well-being.

Alcohol, tobacco, LSD, cocaine, heroin, inhalants, marijuana, and similar substances rank among the most harmful narcotic drugs. All drugs, including less harmful substances, such as coffee (caffeine) and true tea (teine), are psychoactive or psychotropic substances, which in fact means that they affect the nervous system. Frequent exposure to drug effects results in neuroadaptation or adaptation of the nervous system (Čebašek-Travnik, 2004). The said adaptation is related to drug

seeking behaviour and the development of drug tolerance. In principle, it holds true that the younger the organism when it first encounters drugs (nicotine, for instance) the faster it will become dependent or addicted (Stergar, 2004).

One should look for reasons for drug abuse in the interdependent triangle adolescent - environment - drugs. It is rather important whether an individual is an explorer or a timid person, whether or not he or she is risk driven. An important role in determining the risk of an individual becoming a regular smoker, habitual alcoholic, and the like, is played by genes (Madden, Bucholz, Martin, & Heath, 2000; Bierut, Schuckit, Hesselbrock, & Reich, 2000). Namely, epidemiological studies (Anthony & Echeagaray-Wagner, 2000) have confirmed the existence of hereditary factors related to the misuse of a respective drug.

A powerful catalytic effect in the development of drug addiction (to nicotine, alcohol, cannabis, and similar) is exerted by the environmental factors which allow for and maintain addictive behaviour. It is of great

consequence whether or not an individual is born into a family where, for instance, tobacco is an every day fact of life (Stergar, 2004). Also ranking among the environmental factors are the low prices of and easy access to tobacco products and alcohol, further, smoking as an acceptable form of behaviour (among the young, in particular), and non compliance with legislation governing smoking reduction (Čebašek-Travnik, 2004). According to the researchers' opinion, traumatic events and stressful experience also contribute to the development of dependence or addiction (Little, 2000).

The consumption of any drug on a regular basis may lead to the consumption of any other drug. Alcoholism is ten times more frequent in smokers than in non smokers. Researchers have found also that alcoholics are frequently smokers, and vice versa (Istvan & Matarazzo, 1984; Glassman, 1990). In part, the causes there of are also genetic, however, thus far, it has not been discovered why does there exist a genetic connection between smoking and alcohol dependence (Madden, Bucholz, Martin, & Heath, 2000).

The World Health Organization has published the list of ten selected risk factors (WHO, 2002). It is evident there from that tobacco ranks first among the said risk factors, alcohol third and illicit drugs eighth.

If we consider the problem from the point of view of multiplicity, we see that the process of development into a nicotine addict takes the shape of a funnel. All children go through the initiation phase. A somewhat smaller number of children light their first cigarette and thus overstep the line that separates the inexperienced from the experienced. Fewer children persevere and continue with their smoking excursions. An even lesser number of adolescents persist further and continue practising smoking and only the smallest number of children turn into nicotine dependents (Stergar, 2004). The speed with which an individual drug takes effect determines the intensity of its potential for the development of dependence or addiction. Drinking or alcohol consumption affects the activity of opioid peptides, which consequently enhances the feeling of pleasure (Roberts, McDonald, Heyser, Kieffer, Matthes, Koob, & Gold, 2000). In addition to activating opioid peptides, alcohol consumption activates a specific serotonin receptor (responsible for regulation and control of mood, sleep, body temperature, appetite, etc.) which stimulates the activity of dopamine in the brain (a pleasure causing key element in the development of alcohol dependence) and thus contributes to the feeling of pleasure. Other drugs (marijuana, cocaine, morphine) have similar effects on the human organism. The consumption of alcohol and other drugs results also in altered mental disposition (anxiety, depression, drug craving). The intensity of psychological disturbances can be greater than that of physiological ones and the symptoms there of last longer than the physiological symptoms, there by increasing

the motivation for the reabuse of drugs (National Institute on Alcohol Abuse and Alcoholism, 2000).

Prevention is the most effective means of fighting drug abuse. In principle, it holds true that people who do not start taking drugs prior to the age of 25 will not have any serious problems in combating them later on in their lives (Hanson, 2002). National Institute on Drug Abuse, is of the opinion that in terms of drug abuse prevention there exist the so called risk and protective factors (Cire, 2002). The following are protective factors: strong and positive ties, parent control over the activities engaged in by children and their peers, clear rules applicable within the family, inclusion of parents in the lives of their children, school performance, strong ties between institutions (e.g. between school and religious organizations), and knowledge of principles regarding drug abuse. As for the risk factors, the following fall within the group: chaotic domestic environment (parents taking stimulants or parents suffering from mental illnesses), ineffective parenting or upbringing (in cases of problematic children, in particular), lack of ties between parents and children, inappropriate timid and aggressive behaviour in school, poor school performance, poor ability to establish contacts and poor social skills, socializing with peers inclined to deviant behaviour, and witnessing of drug use approval by family, school, working environment, peers and the broader social environment.

This research is aimed at establishing the degree of familiarity with and abuse of narcotic drugs (such as, for instance, cigarettes, alcohol and marijuana) of and by pupils in relation to the frequency of their engagement in sports activities.

METHODS

Participants

The sample of respondents was intentionally selected, namely, in such a manner as to cover as wide a spectrum of geographical areas in Slovenia as possible (stratified sampling). The sample comprised 748 children, 194 male and 189 female fourth graders (with an average age of 10 years \pm 5 months) and 201 male, 164 female seventh graders (with an average of 13 years \pm 4 months). The indicated research data were obtained within the framework of the target research project "Physical/sports activity for health" carried out by the Institute for Kinesiology Research at the Science and Research Centre of Koper, University of Primorska, Slovenia.

Instruments

We have applied the IPAQ survey instrument (International Physical Activity Questionnaire), which we had tailored somewhat to the age and specific features of respondents. The questionnaire contained 26 questions

relating to smoking, alcohol and drugs as well as a set of questions relating to a child's physical/sports activity. The answers to the questions were provided by the children. Prior to and following the completion of the questionnaire, the assistants provided help to the children by guiding them through individual questions.

Procedure

We have processed the data with the use of the statistical computer programme SPSS (Statistical Package for the Social Sciences), version 13.0. For numeric variables, we have applied, on the one hand, the method for verifying the assumption as to the difference between two arithmetic means (two groups) and, on the other, the analysis of variance (several groups), i. e. in addition to the basic statistics of variables. For the purposes of establishing the relationship between non numeric variables, we have applied correspondence analysis. All hypotheses were verified at the 5% statistical risk level ($p = 0.05$).

RESULTS

Smoking

The results have shown that children of this age group smoke very rarely. Namely, only a minimum share of children stated that they smoke occasionally (1%) or regularly (0.1%). We have established no significant gender and age differences between pupils with regard to the frequency of smoking. The results attested to a statistically significant relationship between sports activity and pupils' smoking habits.

It is evident from Fig. 1 that among the non smoking children attending the fourth and the seventh grades of primary school there are 55% of children who engage in sports activities frequently, 40% of those who engage in sports activities occasionally, and 5% of those who never engage in sports activities. Among children who smoke occasionally, all are frequently physically active. Among children who smoke regularly, 25% engage in sports activities frequently and 25% occasionally and there are as many as 50% of those who never engage in sports activities. Regarding the fact that there is insignificant number of subjects in the group of children who smoke frequently, it is not possible to come to any objective conclusion about the sports activity of these children.

We have established a statistically significant relationship also between the smoking habits of 13 year olds and the frequency of their engagement in sports activities with friends ($p = 0.022$).

It is evident from Fig. 2 that among the non smoking seventh graders there are 38% of children who frequently engage in sports activities with their friends, 47% of those who engage in sports activities occasionally, and

15% of those who never engage in sports activities. Among children who smoke regularly, none engages in sports activities with friends frequently or occasionally. All 100% declared they never engage in sports activities with friends.

Similar findings were established by Videmšek et al. (2002), namely girls who smoke only on special occasions engage in sports activities more frequently than girls who smoke all the time. The findings show that pupils from non smoking families generally engage in sports activities more frequently than pupils from smoking families. Ažman (2004) established that individuals who have smoked on several occasions engage in sports activities less frequently (67.1%) than those who have not (78.5%).

Alcohol

The majority of children have already tried alcoholic beverages (71% of seventh graders and 55% of fourth graders); in terms of statistical significance, a greater number of seventh graders than fourth graders have tried alcohol ($p = 0.000$). We have established that a greater number of boys (67%) than girls (58%) have tried alcohol ($p = 0.014$).

Among the fourth graders, 2% drink alcohol every day and as much as 7% at weekends. Among the seventh graders, nobody drinks alcohol on a daily basis and 4% drink alcohol at weekends. It was rather interesting to find that children drink alcohol most often in a domestic environment (82%), while 13% of children drink in the company of their friends and 5% of them alone without any company what so ever.

It is evident from Fig. 3 that, on average, children who have never tried alcohol spend daily more time walking (41 min/day) than children who have already tried alcohol (34 min/day); these differences are statistically significant ($p = 0.02$), even more so in fourth graders ($p = 0.028$).

Marijuana

We have established that 3% of children aged 10 and 13 have already tried drugs and that 0.2% of children have tried it on several occasions. We have established no statistically significant differences according to age and sex. Research results have shown a statistically significant relationship between drug use and engagement in sports activities.

It is evident from Fig. 4 that among children who have never tried drugs, 55% engage in sports activities frequently, 40% occasionally and 5% never. Among children who have tried drugs on a single occasion the majority (70%) engages in sports activities frequently, 30% occasionally and 0% never. However, regarding the small number of subjects in the group of children who take drugs frequently, these results can be spurious.

We have established a statistically significant relationship also between engagement in sports activities with friends and drug use ($p = 0.015$). Among children who have tried drugs on a single occasion, 52% engage in sports activities with friends frequently; further, among children who have never tried drugs, only 34% engage in sports activities with friends frequently; and among children who have taken drugs on several occasions, none engages in sports activities with friends.

The results have shown a statistically significant relationship also between drug use and the number of hours spent sitting during the week ($p = 0.027$); children who have tried drugs on several occasions spend significantly more time sitting (6.5 hours) than other children; it is interesting that children who have tried drugs on a single occasion spend the least time sitting during the week (3 hours) (Fig. 6).

Research results have shown a statistically significant relationship also between drug use and running ($p = 0.005$). We have established that, on average, it is children who have tried drugs on a single occasion that run most frequently (51 min/day), while children who have never tried drugs spend the least time running (27 min/day). On average, children who have taken drugs on several occasions spend running 30 minutes daily (Fig. 7). The results obtained for seventh graders are somewhat different (Fig. 7). On average, it is again children who have tried drugs on a single occasion that run most frequently (56 min/day). On average, seventh graders who have never tried drugs spend running 27 minutes daily. None of the seventh graders who have taken drugs on several occasions run.

The findings are both interesting and unexpected. It might be that curiosity, or a desire to try new things, or experimenting is the underlying cause of drug use on a single occasion in children who engage in sports activities most frequently. Gradually, one can establish the behavioural pattern of a child who has merely tried drugs on a single occasion and the behavioural pattern of a child who has taken drugs on several occasions. It seems that the former engages in sports activities on a much more frequent basis (even if compared to a child who has never tried drugs) and is perhaps even more restless. However, a child who has taken drugs on several occasions reflects entirely opposite characteristics: such a child is physically inactive and it is only logical that he/she spends more time sitting (either doing nothing or working/playing on a computer).

It is obvious that it is children who have tried drugs on a single occasion that stand out, as it is them who engage in sports activities most frequently, spend the most time running and the least time sitting during the week. Similarly, we can infer from the data that they are sociable, since it is they who most frequently engage in sports activities with friends (i. e. if compared to chil-

dren who have never tried drugs and children who have taken drugs on several occasions). Similar findings have been established by Čurković (2002) whose research studied the degree to which addicts engage in sports activities before becoming addicts (i. e. in the period from age 10 to age 17). The author aimed at establishing the difference between addicts and non addicts on a sample comprising of 3300 males aged between 18 and 25. The results have shown that in the period between the ages of 10 and 17 addicts engaged more frequently in organized sports activities than non addicts. On average, addicts spent more time engaging in sports activities on a daily and weekly basis than non addicts.

DISCUSSION

The finding that children who do not smoke engage in sports activities more frequently, both in general and with friends, than children who smoke, was expected. We are of the opinion that the reason thereof might be the fact that children who smoke have entirely different habits and interests than children who do not smoke. Sport gives an individual a sense of pleasure and strength, for which reason it constitutes a significant counterweight to smoking. In addition to the effects that are harmful to health, the smoking problem in adolescents is reflected also in the company that a child keeps. According to our opinion, it is a child's company that determines whether or not a child will engage in sports activities or experiment with stimulants during his/her leisure time. If a child's company engages in sports activities, the criteria are set primarily on the basis of peer performance level in individual sports. The best performing individual is a leader and an example followed by his/her peers.

The smoking problem in children is reflected in their deteriorated health status. In adolescents, smoking causes disturbed lung growth, early deterioration of lung function, cough, impaired breathing and asthma. Passive smoking is also harmful to children. In children, passive smoking increases the risk of infection of the respiratory system, aggravates asthma, gives rise to the occurrence of asthma and asthma related symptoms, and is related to recurring inflammation of the middle ear. According to the data of the World Health Organization, passive smoking constitutes a cause of from one third to one half of the syndromes of sudden infant death. In addition, smoking has long term consequences, as smokers most frequently die of cancer, lung diseases and cardiovascular diseases (Koprivnikar, 2005).

Another smoke or drug related problem occurs in the company that a child keeps or in a group with which a child interacts on a frequent basis. In school children, peer influence only increases with time, as it

Fig. 1
Frequency of engagement in physical/sports activity in relation to smoking

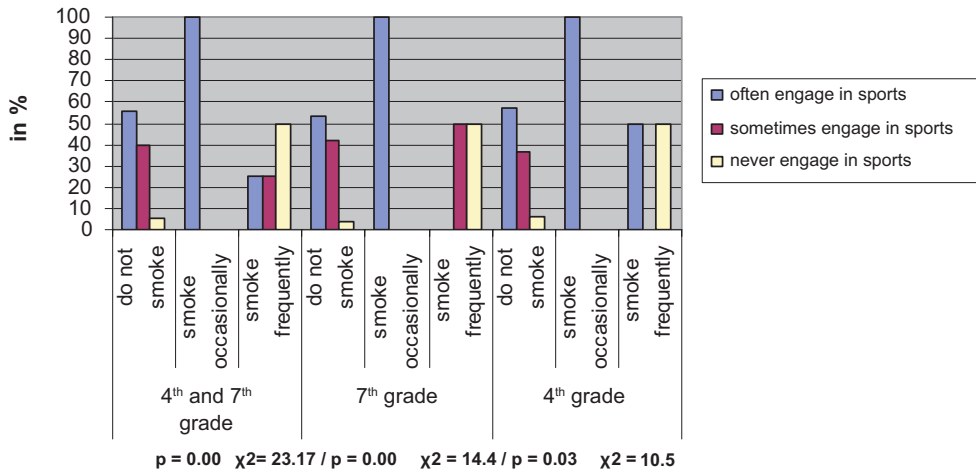


Fig. 2
Frequency of engagement in sports activities by seventh-graders with their friends in relation to smoking

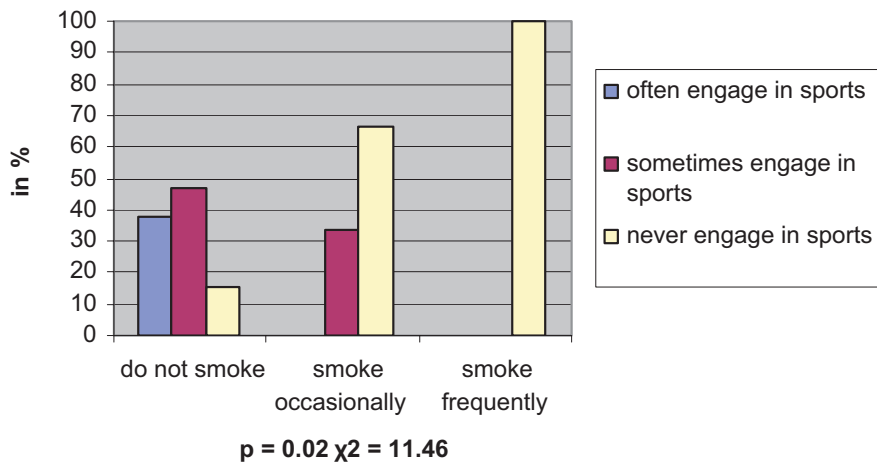


Fig. 3
Walking habits in relation to alcohol consumption

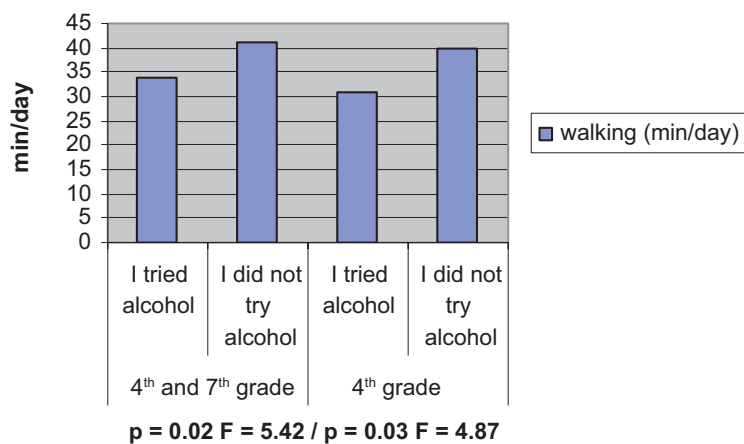


Fig. 4
Engagement in sports activity in relation to drug use

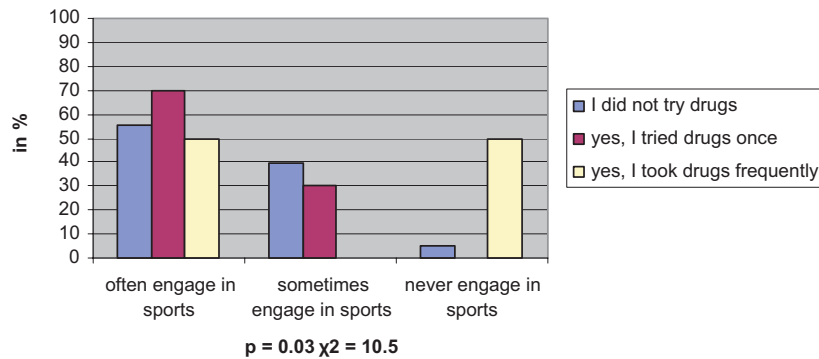


Fig. 5
Engagement in sports activity with friends in relation to drug use

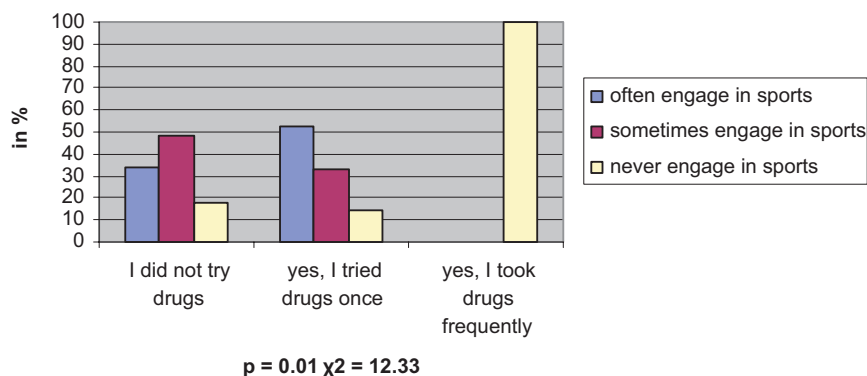
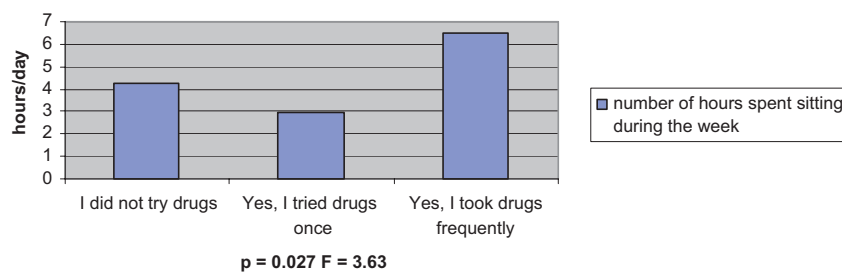


Fig. 6
Number of hours spent sitting during the week in relation to drug use

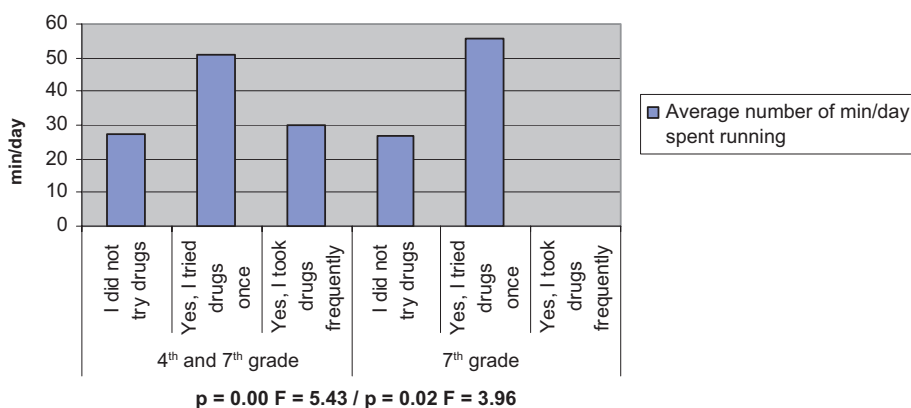


is extremely important for children to be part of a group that accepts them as equals (but in turn demands from them to abide by its specific principles and rules). If it is a question of a smoking group, a child will light his/her first cigarette sooner or later. However, at that point, the problems only begin, since such a group will not content itself with smoking, but will, almost simultaneously, indulge also in more harmful substances. At this point, we should stress that it is not a golden rule that every group succumbs to drugs sooner or later; however, it is a general rule that every group has its own specific

set of rules or principles and should an individual fail to abide by them or observe them, the group will, without fail, exclude such an individual from its midst (Bierman, Smooth, & Aumiller, 1993; Coie, 1990). The criteria for the formation or separation of groups are different, e. g. sporting interests, academic interests, racial characteristics, social status, drug abuse and delinquency (Brown, Mounts, Lamborn, & Steinberg, 1993; Eckert, 1989; Schofield, 1981).

The school system does prohibit smoking in school, but it has no influence whatsoever during the time

Fig. 7
Running in relation to drug use



a child spends outside school. After the classes, a child is left to his/her own devices and decides himself/herself what he/she will do during leisure time. For this very reason, educators, both parents and teachers, should motivate and encourage children to participate in various organized special interest activities. A teacher should serve as an example to children and provide them with support. Regretfully, though, more and more teachers break the rules and, which is even worse, in front of the children. The research carried out by Videmšek et al. (2002) has established that there are more than 15% of primary school gym teachers whom the pupils know to be smokers. Gym teachers are undoubtedly the very persons who should serve as an example to children, as an embodiment of a healthy lifestyle.

The research has shown that children who have not tried alcohol spend more time walking daily than children who have already tried alcohol. The finding that children who do not drink alcohol spend more time walking is not surprising; most likely, they are also more active in general. Why does a child start drinking alcohol? The reasons thereof could be found in the company that forces a child to drink alcohol or the environment that fails to provide a child with the possibilities to engage in healthy play, sports and pastime. They may be found in the domestic environment itself. It may be that a child drinks only occasionally, but it may also be that the overall picture is much more terrifying. Children who are witnesses to alcoholism bear the consequences thereof on their shoulders if they are not provided with proper support and guidance by someone else.

According to the opinion of Karpljuk et al. (2003), alcoholism in the family causes disputes and forces children to witness verbal and physical violence between parents, for which reason they are confused and often feel torn between the two parents to whom they are emotionally attached. As they miss the feeling of safety and

security which normally stems from the love between parents and a steady home, their emotional development cannot follow a normal course. Razboršek and Krištof (1988) believes that behavioural disturbances, or the so called lack of discipline syndrome, can be perceived in the majority of children of alcoholics. Such children are disobedient, rebellious and mendacious and they tend to skip school and run away from home, and so on. They fail to develop basic work habits and a sense of order, while their disturbing behaviour and people's reaction to it are causes of great concern. When a child is no longer able to cope with the pressures of the social environment, he/she starts coping with distress in his/her own way. It all begins with simple evasion or withdrawal, roving and/or pilferage. A child's school performance deteriorates and inappropriate behaviour in school becomes ever more frequent. As the school no longer tolerates such behaviour, parents exert an even greater pressure on their child and thus the tragedy continues. A child moves on from petty to grand larceny, prostitution and/or drugs. Rugelj (2000) believes that such adolescents see the solution to their problems in alcoholic stupor. However, as stupors, irrespective of their kind, never solve anything and only postpone the problems, the hurt and to stupor accustomed adolescents are, so to speak, again forced to drown their distress in alcohol. Regular intoxication is no longer a mere condition for the development of alcoholism, but also a very certain and obvious sign that such people are already alcoholics, even though in the early period of alcoholism.

The aim of our research was also to establish whether or not there exists a relationship between a child's engagement in sports activities and drug consumption. If we summarize the findings, we can say that children who have tried drugs (e.g. marijuana) on a single occasion engage in sports activities more frequently than children who have never taken any drugs. One of the

reasons thereof may be that more active and vivacious children tend to be fascinated by new things in their lives, one of them being drugs. However, we are of the opinion that such experimenting stems only from curiosity, for which reason it does not lead to addiction. We should emphasize that our analysis showed only a minimum share of children who have tried drugs on a single occasion (3%), while 0.2% of children have taken drugs on several occasions. Other children have had no experience with drugs.

We believe that a lively and curious child is more likely to try drugs if presented with an opportunity than a less vivacious and less inquisitive child. We have found that children who have tried drugs on a single occasion engage in sports activities more frequently than other children. This fact points to the finding that such children run more and sit less during the week than other children. For this reason, we suppose that their energy levels are higher. The finding that children who have tried drugs on a single occasion engage more frequently in sports activities with their friends attests to their sociable character. They crave the company of their peers. Quite to the contrary, among children who have taken drugs on several occasions (0.2% within the framework of our research), none engages in sports activities with friends. This means that drug abuse leads to asocial behaviour. However, in our opinion, the use of drugs on a single occasion stems from childish curiosity which, in most cases, has no consequences. This assumption was confirmed also by the research carried out by Videmšek et al. (2000). Although the research (Videmšek et al., 2006) which studied the relationship between drug abuse (alcohol, cigarettes, marijuana) and frequency of engaging in sports activities by 14 year olds failed to establish a statistically significant relationship, it nevertheless emphasizes that the provision of adequate physical/sports activities constitutes one of the most decisive factors in reducing drug abuse.

The young are impressionable and as they learn through imitation, they often imitate the example of teachers, representatives of the environment in which a child lives and grows up. However, it is not only school teachers and parents who embody the said environment, but older peers and advertisements in (mass) media as well. In the majority of developed countries, the promotion of cigarettes and alcohol is either prohibited or very limited. The television and film industries are the only two media where the tobacco industry can still advertise and promote its products. The world of fashion and film exerts a significant influence on a great mass of people all around the globe. Studies have shown that after seeing a film in which famous stars smoke cigarettes, American teenagers are 2.5 times more likely to start smoking (Institute of Public Health Kranj, 2005). This finding is thoroughly exploited by the tobacco industry which has chosen the most widespread medium, i. e.

the world of film and fashion, with a view to reaching potential smokers.

CONCLUSION

The main findings of the research were that children who do not smoke engage in sports activities more frequently, both in general and with friends, than children who smoke. The second finding was that children who have not tried alcohol spend more time walking daily than children who have already tried alcohol. The last finding was that children who have tried marijuana on a single occasion engage in sports activities more frequently than children who have never taken any drugs. One of the reasons thereof may be that more active and vivacious children tend to be fascinated by new things in their lives, one of them being drugs. However, we are of the opinion that such experimenting stems only from curiosity, for which reason it does not lead to addiction.

Although dissuasion, prevention and prohibition in the area of drug abuse undoubtedly constitute the measures which might contribute to the decrease in these vicious habits, we believe that the young could be dissuaded from drug abuse mainly by a well organized quality lifestyle. Individuals with steady employment most likely satisfy their needs by engaging in activities that correspond to their wants, for which reason they do not feel such a great need for various "substitutes". The fact is that the drug abuse problem cannot be remedied in its entirety, but we could, however, alleviate it substantially. One of the most relevant factors in decreasing drug abuse is therefore also the engagement of youth in appropriate sports activities, during leisure time, in particular, which should be directed and planned accordingly by parents and teachers alike.

REFERENCES

- Anthony, J. C., & Echeagaray-Wagner, F. (2000). Epidemiologic analysis of alcohol and tobacco use. Patterns of cooccurring consumption and dependence in the United States. *Alcohol Research & Health*, 24(4), 201-208.
- Ažman, D. (2004). Kajenje in šport v prostem času pri osnovnošolcih in srednješolcih. In R. Pišot, V. Štemberger, J. Zorc, & Obid, A. (Eds.), *Otrok v gibanju: Zbornik izvlečkov in prispevkov: 3. mednarodni simpozij* (pp. 44-45). Koper: Univerza na Primorskem, Znanstveno-raziskovalno središče.
- Bierman, K. L., Smoot, D. L., & Aumiller, K. (1993). Characteristics of aggressive rejected, aggressive (non rejected), and rejected (non aggressive) boys. *Child Development*, 64, 139-151.

- Bierut, L. J., Schuckit, M. A., Hesselbrock, V., & Reich, T. (2000). Cooccurring risk factors for alcohol dependence and habitual smoking: Results from the collaborative study on the genetics of alcoholism. *Alcohol Research & Health*, 24(4), 233-241.
- Brown, B. B., Mounts, N., Lamborn, S. D., & Steinberg, L. (1993). Parenting practices and peer group affiliation in adolescence. *Child Development*, 64, 467-482.
- Cire, B. (2002). NIDA Conference reviews advances in prevention science, announces new national research initiative. *NIDAnotes*, 16(6), 44-46.
- Čebašek-Travnik, Z. (2004). *Kajenje kot bolezen odvisnosti*. *Vita. Strokovna zdravstveno vzgojna revija. Psihiatrična klinika Ljubljana*. Retrieved 4. 5. 2005 from the World Wide Web: http://www.revija-vita.com/Vita_43/Kajenje_kot_bolezen_odvisnosti/kajenje_kot_bolezen_odvisnosti.html
- Coie, J. D. (1990). Toward a theory of peer rejection. In S. R. Asher & J. D. Coie (Eds.), *Peer rejection in childhood* (pp. 365-401). Cambridge, England: Cambridge University Press.
- Eckert, P. (1989). *Jocks and burnouts: Social categories and identity in the high school*. New York: Teachers College Press.
- Glassman, A. H., Helzer, J. E., Covey, L. S., Cottler, L. B., Stetner, F., Tip, J. E., & Johnson, J. (1990). Smoking, smoking cessation, and major depression. *Journal of the American Medical Association*, 264, 1546-1549.
- Hanson, G. R. (2002). New vistas in drug abuse prevention. *NIDAnotes*, 16(6), 42-43.
- Institute of Public Health Kranj. (2005). *31. maj 2003: svetovni dan brez tobaka*. Retrieved 11. 8. 2005 from the World Wide Web: http://www.gov.si/zzvkr/dejavnosti_zdravstvena_vzgoja_zdr_aktivnosti.htm#brez_tobaka
- Istvan, J., & Matarazzo, J. D. (1984). Tobacco, alcohol and caffeine use: A review of their interrelationships. *Psychological Bulletin*, 95, 301-326.
- Karpljuk, D., Videmšek, M., & Zajc, M. (2003). *Možnost povezovanja športnih in zdravstvenih vsebin v osnovni šoli*. Ljubljana: Univerza v Ljubljani, Fakulteta za šport.
- Koprivnikar, H. (2005). *Posledice kajenja in ukrepi za zmanjševanje kajenja*. Retrieved 10. 8. 2005 from the World Wide Web: http://www.ivz.si/ivz/aktualno/novica.php?ivz_id=249
- Little, H. J. (2000). Behavioural mechanisms underlying the link between smoking and drinking. *Alcohol Research & Health*, 24(4), 215-224.
- Madden, P. A. F., Bucholz, K. K., Martin, N. G., & Heath, A. C. (2000). Smoking and the genetic contribution to alcohol dependence risk. *Alcohol Research & Health*, 24(4), 209-214.
- National Institute on Alcohol Abuse and Alcoholism (2000). Alcohol, the brain, and behaviour: Mechanisms of addiction. *Alcohol Research & Health* 24(1), 12-16.
- Razboršek, V., & Krištof, M. (1988). *Kaj vem o alkoholizmu in drugih zasvojenostih*. Ljubljana: Delavska enotnost.
- Roberts, A. J., McDonald, J. S., Heyser, C. J., Kieffer, B. L., Matthes, H. W. D., Koob, G. F., & Gold, L. H. (2000). Opioid receptor knockout mice do not self-administer alcohol. *Journal of Pharmacology and Experimental Therapeutics*, 293(3), 1002-1008.
- Rugelj, J. (2000). *Pot samouresničevanja*. Ljubljana: Samozaložba Slovensko društvo terapevtov za alkoholizem, droge, odvisnosti in pomoč ljudem v stiski.
- Schofield, J. W. (1981). Complementary and conflicting identities: Images and interaction in an interracial school. In S. R. Asher & J. M. Gottman (Eds.), *The development of children's friendships* (pp. 53-90). Cambridge, England: Cambridge University Press.
- Stergar, E. (2004). *(Ne)kajenje med mladimi je velik problem*. *Vita: Strokovna zdravstveno vzgojna revija*. Retrieved 30. 4. 2005 from the World Wide Web: http://www.revija-vita.com/Vita_43/_Ne_kajenje_med_mladimi_je_vel/_ne_kajenje_med_mladimi_je_vel.html
- Videmšek, M., Karpljuk, D., & Debeljak, D. (2000). Sport activities and the smoking habits of the 14 year old male and female. *International journal of physical education*, 37(1), 29-34.
- Videmšek, M., Rešetar, V., Karpljuk, D., Štihec, J., Kondrič, M., & Furjan-Mandić, G. (2002). Smoking habits and sport. In D. Milanović & F. Prot (Eds.), *3rd International scientific conference Kinesiology new perspectives: proceedings book* (pp. 175-178). Zagreb: Faculty of kinesiology, University of Zagreb.
- Videmšek, M., Skubic, M., Karpljuk, D., & Štihec, J. (2006). Correlation between sport activity and drug taking among 14 year old primary school male and female pupils in Slovenia. *Acta Universitatis Palackianae Olomucensis. Gymnica*, 36(1), 7-14.
- World health organization (2002). *The world health report 2002: Reducing risks, promoting a healthy life*.

**VZTAH MEZI SPORTOVNÍ AKTIVITOU,
KOUŘENÍM A UŽÍVÁNÍM ALKOHOLU
A MARIHUANY U DĚTÍ
NA ZÁKLADNÍCH ŠKOLÁCH VE SLOVINSKU
(Souhrn anglického textu)**

Prevence představuje nejúčinnější prostředek proti užívání drog. Na jedné straně vytváří tělesná aktivita řadu faktorů, které vedou k přijetí zdravých stravovacích návyků, na druhé straně představuje prevenci užívání

drog, protože sama o sobě určitým způsobem stimuluje tělo i mysl. Cílem provedeného výzkumu bylo stanovit stupeň obeznamenosti s návykovými látkami a jejich užíváním (například cigarety, alkohol a marihuana) u dětí ve vztahu k frekvenci jejich zapojení do sportovních aktivit. Vzorek obsahoval 748 dětí, z čehož bylo 194 žáků a 189 žáků čtvrtých tříd (jejichž průměrný věk byl 10 let \pm 5 měsíců), a 201 žáků a 164 žáků sedmých tříd (jejichž průměrný věk byl 13 let \pm 4 měsíce). Uvedené údaje byly získány v rámci projektu „Tělesná/sportovní aktivita pro zdraví“ probíhajícího v Ústavu kinesiologického výzkumu ve Vědeckém a výzkumném středisku Primorske univerzity ve slovinském Koperu. Použili jsme dotazník IPAQ (International Physical Activity Questionnaire), který jsme poněkud upravili pro věk a specifické vlastnosti respondentů. Pro stanovení vztahu mezi nečíselnými proměnnými jsme použili korepondenční analýzu. Pro číselné proměnné jsme použili analýzu variance a t-testy nezávislých vzorků. Všechny hypotézy byly ověřovány s 5% statistickou úrovní rizika ($p = 0,05$). Výsledky potvrdily u žáků statisticky významný vztah mezi sportovní aktivitou, kouřením a užíváním alkoholu a marihuany. Faktem je, že i když problém užívání drog nemůže být zcela odstraněn, mohli bychom ho zásadním způsobem redukovat. Jedním z nejdůležitějších faktorů pro snižování užívání drog je proto rovněž zapojení mládeže do vhodných sportovních aktivit (zvláště ve volném čase), což by mělo být řízeno a plánováno rodiči a učiteli.

Klíčová slova: sportovní aktivita, kouření, alkohol, marihuana, děti.

Veronika L. Kropelj, Ph.D.



University of Primorska
Science and research
centre of Koper
Garibaldijeva 1
6000 Koper
Slovenia

Education and previous work experience

She defended her Ph.D. thesis at University of Ljubljana, Faculty of Sports. Now she works at the Institute for kinesiology research at the Science and research centre of Koper, Slovenia. Her research activities are focused on: kinesiology, environment impact (motor/sport activity, factors of healthy living) on the child's holistic (biological, psychological and social) development.

First-line publications

- Kropelj, V. L., & Videmšek, M. (2002). Parents and sport activity of their preschool children. *Kinesiologia Slovenica*, 8(1), 19-24.
- Kropelj, V. L., Škof, B., Milić, R., & Pišot, R. (2005). The factors associated with achievement of VO_2 plateau in trained boys. *Annales Series Historiae Naturalis*, 15(1), 137-142.
- Kropelj, V. L., Škof, B., & Milić, R. (2005). The influence of aerobic and anaerobic characteristics of children of different age on achievement of VO_2 plateau. *Biology of Sport*, 22(1), 67-79.
- Pišot, R., & Kropelj, V. L. (2006). Correlation between perceived quality of life and healthy environment in youth. *Facta Universitatis. Series, Physical education and Sport*, 4(2), 115-123.
- Kropelj, V. L. (2002). Sport activity of preschool children and family environment. In R. Pišot, V. Štemberger, F. Krpač, & T. Filipčič (Ed.), *Otrok v gibanju: Zbornik prispevkov - proceedings* (pp. 133-138). Ljubljana: Pedagoška fakulteta.
- Pišot, R., & Kropelj, V. L. (2005). Relations between physical activity, life style and life quality indices of children and youth. In J. Novotný (Ed.), *Sport a kvalita života: sborník článků a abstrakt mezinárodní konference konané v Brně* (pp. 1-16). Brno: Masarykova univerzita.
- Kropelj, V. L., Pišot, R., & Šimunič, B. (2005). Where do children get information about healthy lifestyle? In D. Milanović & F. Prot (Ed.), *4th International scientific conference on kinesiology* (pp. 297-300). Croatia, Zagreb: Faculty of Kinesiology, University of Zagreb.

OVERWEIGHT AND OBESITY TRENDS IN SLOVENIAN BOYS FROM 1991 TO 2006

Marjeta Kovač, Bojan Leskošek, Janko Strel

Faculty of Sport, University of Ljubljana, Ljubljana, Slovenia

Submitted in October, 2007

The study examined a group of overweight and obese Slovenian boys aged seven to eighteen with the use of an annually repeated cross sectional study. The study lasted from 1991 to 2006 and was based on the body mass index according to the IOTF norms. The results show that the proportion of overweight boys in this period increased by 40% (from 13.5% to 18.8%), whereas the proportion of obese boys more than doubled (from 2.8% to 6.1%). The prevalence of overweight and obesity is highest in childhood and early adolescence since it is more than twice as high than at the age of eighteen. Trends and the prevalence of obesity and overweight are similar to those in other countries and in compliance with Slovenia's geographical position in Europe. In recent years, it has been noticed that the 11 to 13 years age group represents the largest proportion of overweight boys. This is a year earlier than seen with past results; the numbers start to decrease after the age of 13. It is interesting to note that the age category with the biggest proportion of overweight boys describes the physically most active population, which is exposed to three hours of physical education per week under the guidance of specialist teachers. In addition, boys of this age most often participate in extracurricular sports activities. This anomaly of the BMI distribution found on the studied population is also characteristic of other populations. It can be concluded that excessive weight in this age period is more a result of physical development and less of external conditions; in other words, the reference values of the IOTF for this specific age group are not particularly suitable.

Keywords: Body mass index, overweight, obesity, boys, Slovenia.

INTRODUCTION

The lifestyle of young people at the present time usually consists of passive and unvarying mental activity and unhealthy habits which, among others, alarmingly include a sedentary lifestyle and unsuitable eating habits.

Various modern media are changing the behavioural patterns of young people, who enjoy fleeting entertainment in multicinema complexes or in front of TV and computer screens. The personal contacts of young people are being transferred to the virtual world of the internet; their desire for sensations and unusual scenarios is being fulfilled by viewing reality shows. In the study "Health behaviour in school aged children" (HBSC) Slovenian researchers have found that the number of hours young people in Slovenia spend in front of a computer has grown enormously in the last five years. In contrast, the time spent with friends has decreased, consequently resulting in the reduced communication and social competency of young people (Jeriček, 2007).

It is a common practice for children to go to school after having had a very poor breakfast or without eating one at all; further, fast food and sweet carbonated drinks are often consumed (Blenkuš, 2001). At weekends many young people enjoy themselves at parties

where alcohol, cigarettes and drugs are nothing unusual (Jurak, 2006).

Unsuitable eating habits and a lack of movement result in overweight and obesity that are reaching epidemic proportions in the developed world (James, 2004). Excessive weight is becoming one of the most common diseases of children, according to experts of the World Health Organisation. In 2003, the WHO reported more than 1 billion overweight people globally, with at least 300 million of them being obese (WHO, 2003). Out of this population, 17.6 million were children under the age of five. Over the last decade the prevalence of obesity in western and westernising countries has more than doubled (James, 2004). It is estimated that 400,000 extra children are becoming overweight or obese each year in the population of the new European community. In Canada, Australia and parts of Europe 1% of all children are becoming overweight each year; 25% of children in the USA are overweight and 11% are obese (Lobstein, Baur, & Uauy, 2004). The WHO data for Europe for 2004 show that in the 13 to 15 year old population 12% of boys and 7% of girls were overweight and 2% of boys and 1% of girls were obese (Andersen, Froberg, Kristensen, & Möller, 2007).

About 70% of obese adolescents grow up to become obese adults (Parsons, Power, Logan, & Summerbell,

1999). Obese children under three years of age without obese parents are at a low risk of obesity in their adulthood but, among older children, obesity is an increasingly important predictor of adult obesity regardless of whether one's parents are obese (Whitaker, Wright, Pepe, Seidel, & Dietz, 1997).

There are several consequences of obesity. Along with increased mortality, obesity is a risk factor for a range of chronic diseases such as Type 2 (adult onset) diabetes, coronary heart disease, some types of cancer, osteoarthritis and back pain (Andersen, Froberg, Kristensen, & Møller, 2007). Some childhood obesity consequences – hyperinsulinaemia, poor glucose tolerance and a raised risk of Type 2 diabetes, hypertension, sleep apnoea, social exclusion and depression – onset already in childhood, while other obesity epidemic diseases emerge in adulthood (Lobstein, Baur, & Uauy, 2004).

There are also social and psychological consequences – including stigmatisation, discrimination and prejudice. Researches have linked obesity with a low self image, low self confidence and depression (Cash, 2002; Goni & Zulaka, 2000; Lobstein, Baur, & Uauy, 2004).

The mechanism of obesity development is not fully understood and is believed to be a disorder with multiple causes. Genetic factors influence the susceptibility of a given child to an obesity conducive environment. However, environmental factors, lifestyle preferences and the cultural environment seem to play big roles in the rising prevalence of obesity worldwide. It is confirmed that obesity occurs when energy intake exceeds energy expenditure, suggesting a proper diet and physical activity are the key strategy for controlling the current epidemic of obesity (Dehghan, Akhtar-Danesh, & Merchant, 2005).

There is a wide variety of definitions of child obesity and no commonly accepted standard has yet emerged. Although less sensitive than skin fold thickness, the body mass index (weight/height²) is widely used in adult populations and a cut off point of 25 kg/m² and 30 kg/m² is recognised internationally as a definition of adult overweight and obesity (Malina & Katzmarzyk, 1999). The International Obesity Task Force (IOTF) proposed age and sex specific cut off points from 2–18 years which are internationally based and should help provide internationally comparable prevalence rates of overweight and obesity in children (Cole, Bellizzi, Flegal, & Dietz, 2000).

A number of studies on the prevalence of obesity in European children and adolescents in different years after 1990 was reviewed by Lobstein, Baur and Uauy (2004) and Brettschneider and Naul (2004). The prevalence (percentage) of overweight (including obese) children aged around 7–11 years using the IOTF cut off points was especially high in southern Europe (Italy 36%, Spain 34%, Greece 31%), and substantially lower in

northern Europe (Holland 12%, Denmark 15%, Germany 16%). Among adolescents aged around 14–17 years, the prevalence ranged from below 10% (Slovakia, Czech Republic, Russia) to above 20% in some southern countries (Cyprus 23%, Greece 22%, Spain 21%). There are differences between boys and girls, e.g. in Great Britain the prevalence of excessive weight and obesity in 5 to 10 year olds from 1984 to 2002–2003 is much higher in girls (Stomatakis et al., 2005), whereas the WHO data (Andersen, Froberg, Kristensen, & Møller, 2007) show that the proportion of 13 to 15 year old overweight boys is significantly larger than that of their girl counterparts in all but one country. Similarly, the proportion of obese boys is larger than that of girls in the majority of countries. The biggest differences between genders are noticed in Mediterranean countries such as Spain, Italy, Portugal, Greece and Malta. With adults, the proportion of overweight European women (with a BMI above 30) is between 10 to 25% which is slightly more than the proportion of overweight men (10 to 20%) (Andersen, Froberg, Kristensen, & Møller, 2007). Authors also warn about the poor effect of interventional actions designed to reduce excessive weight in adults; therefore, it is even more important for countries to establish efficient strategies for decreasing the excessive weight of young people.

For Slovenia, according to the IOTF cut off points, the prevalence of excessive weight among five year old children in 2004 was 12.5% and 16.7% for boys and girls, respectively. The obesity criteria are fulfilled by 4.1% of boys and 4.7% of girls. Among adolescents, between the years 2003–2005, 18.9% of boys and 16.7% of girls were overweight and 3.5% of boys and 3.4% of girls were obese (Avbelj et al., 2005). The percentage of 7 to 19 year old overweight and obese girls and boys, as shown in cross sectional (Bučar-Pajek, Strel, Kovač, & Pajek, 2004; Strel, Kovač, & Jurak, 2007) and longitudinal studies of children and youth (Strel, Kovač, & Rogelj, 2006), jumped up dramatically from 1983 to 2003, especially in younger age groups.

The present study used data from the fitness evaluation system Sports Educational Chart, which has been carried out in all Slovenian schools annually since 1991 (Strel et al., 1997). Because of the huge amount of data only the results for boys are analysed and presented in this article. The data regarding girls is available upon request to interested readers by directly contacting the authors of this article.

METHODOLOGY

Sample of measured subjects

The sample (TABLE 1) consists of all boys who participated in measurements as part of the fitness evaluation system Sport Educational Chart (Strel, Kovač,

& Rogelj, 2006; Strel et al., 1997; Šturm et al., 1990) from 1991 to 2006. Measurements were held annually in April during the usual physical education lessons in all Slovenian schools. Only healthy boys who were not exempt from physical education for health reasons and whose parents had given their written consent to participate in the measurements were included.

Slightly more than 90% of primary school boys below the age of 15 were measured, whereas the proportion of older boys (16 to 19 years) is between 60–84%, depending on the type of high school (Strel, Kovač, & Rogelj, 2006). High school education is not compulsory in Slovenia; nevertheless, the number of those attending high schools is growing every year and has in the last decade included more than 90% of all young people. In addition, the proportion of young people entering four year high school programmes has also been increasing and those entering two and three year programmes decreasing, thus providing more data about the 17 and 18 year old population.

In the first year of school (seven year old children) an apparent increase in the number of boys is noted between the years 2000 and 2004. In that period, a gradual transition to the then new nine year long compulsory education started in Slovenia, which meant that children entered schools earlier. The transition to nine year long compulsory education was gradual so that between 2000 and 2005, six and seven year old pupils were entering their first year of primary school. A smaller number of boys is noticed in other years as a result of the birth rate having decreased by more than a third (Statistical office of the Republic of Slovenia, 2006).

Data analysis

Data were analysed with the use of the SPSS 15.0 statistical package. The prevalence of excessive weight (excluding obesity) and obesity as such were determined according to the IOTF cut off points (Cole et al., 2000) separately for age (7 to 18 year old boys, ± 6 months) and the year of measurement (1991 to 2006). Confidence intervals for the proportions were computed using the Collett formula (Collett, 1991).

RESULTS

The prevalence of overweight and obesity in 7 to 18 year old boys from 1991 to 2006 is shown in TABLE 2 and 3. A 95% confidence interval width for the overweight proportion ranges from 1.1% to 3.2%, but is only wider than 2% for seven year old boys. A 95% confidence interval width for the obese proportion ranges from 1.1% to 3.2% and rarely exceeds 1.5%. The confidence interval width for the proportion of overweight and obese boys is never higher than 20.6% and 37.8%, respectively, of its point estimate. As the sample used in this study is not a probability sample, the listed confidence intervals should only be considered for descriptive purposes.

When the entire sample is considered irrespective of the age of boys, the proportions of overweight and obese boys are almost steadily growing from 1991 to 2006. In the observed period the percentage of obese boys more than doubled – from 2.8% in 1991 to 6.1% in 2006,

TABLE 1

Sample sizes by age of boys and year of measurement

Year	Age											
	7	8	9	10	11	12	13	14	15	16	17	18
1991	2867	11886	12647	13053	13298	13921	13691	13168	12391	9850	8564	6533
1992	2706	11888	12197	12799	13353	13797	14006	13739	12718	11187	10034	7763
1993	2653	11955	12096	12356	13048	13685	13880	13986	13420	11403	10833	8348
1994	2814	11364	12315	12326	12626	13455	13792	13803	13782	12229	11102	9363
1995	2792	11541	11365	12280	12300	12753	13383	13591	13254	11908	11320	9180
1996	2608	12049	11909	11593	12567	12602	12820	13323	13026	10596	10644	9179
1997	2295	10724	11813	11497	11276	12209	11994	12100	11547	8710	8600	7486
1998	2267	10200	10878	11808	11632	11327	12163	11838	11331	9392	8709	7705
1999	2113	10150	10378	10944	11945	11696	11305	11934	11112	8982	8361	7302
2000	2655	9247	10335	10478	11083	12007	11576	11143	11198	9078	8535	7563
2001	3216	9365	9409	10276	10414	10955	11741	11257	10394	9038	8418	7347
2002	4284	8897	9445	9453	10287	10413	10865	11537	10534	8167	8137	7279
2003	5688	9022	9018	9495	9510	10377	10349	10820	10917	8592	7692	7240
2004	8642	8935	9111	9026	9502	9492	10287	10320	10209	8957	8288	6895
2005	8391	8814	8989	9160	9135	9619	9481	10296	9695	8184	8159	7192
2006	8142	8329	8667	8789	8982	8918	9370	9247	9174	6525	7062	6715

TABLE 2

Prevalence of overweight (excluding obesity) in Slovenian boys (in %) from 1991 to 2006

Year	Age											
	7	8	9	10	11	12	13	14	15	16	17	18
1991	12.0	12.4	12.7	13.6	14.0	14.0	13.7	13.3	13.1	14.6	13.7	14.0
1992	10.9	11.4	12.2	12.4	13.2	13.1	12.3	11.7	11.3	12.6	12.6	11.4
1993	11.5	12.1	13.8	14.0	14.4	15.1	14.5	13.0	12.5	13.4	13.8	12.6
1994	12.1	11.9	13.5	15.3	15.5	15.6	15.3	13.9	13.7	14.3	13.8	13.5
1995	13.0	12.9	13.9	14.9	15.8	16.3	15.2	14.5	13.4	14.6	14.4	12.8
1996	12.5	13.1	14.6	14.9	16.0	16.8	16.0	14.4	14.5	15.5	14.9	14.0
1997	12.7	13.3	14.7	15.5	15.5	16.1	15.6	14.9	13.7	15.6	14.4	13.9
1998	13.0	13.9	15.6	15.6	16.7	16.6	15.9	15.1	14.8	15.1	15.3	14.5
1999	12.9	13.0	15.6	17.2	16.6	17.5	16.5	15.0	14.9	15.1	14.5	14.7
2000	12.4	14.4	16.2	17.4	18.4	17.3	17.7	16.0	15.1	15.8	15.5	14.1
2001	13.4	14.3	16.5	18.0	19.0	18.7	17.7	17.3	15.5	15.8	15.5	15.4
2002	12.3	14.1	16.1	17.5	17.8	19.1	18.2	16.6	16.1	15.8	14.9	14.4
2003	11.1	14.3	16.5	17.3	18.8	18.6	18.1	16.9	15.7	15.6	15.5	14.9
2004	12.5	14.9	17.8	19.0	19.5	19.4	19.2	17.8	17.0	17.7	16.5	16.5
2005	12.5	14.8	17.9	19.2	19.6	20.8	19.7	18.2	17.3	18.5	18.5	16.9
2006	13.4	15.8	18.3	19.7	21.0	21.1	20.7	19.5	18.6	19.5	19.2	18.6

TABLE 3

Prevalence of obesity in Slovenian boys (in %) from 1991 to 2006

Year	Age											
	7	8	9	10	11	12	13	14	15	16	17	18
1991	3.7	3.6	3.6	3.2	3.1	3.0	2.8	2.2	2.2	2.2	2.0	1.2
1992	3.3	3.2	3.0	2.7	2.7	2.5	2.4	2.0	1.9	1.6	1.5	1.1
1993	4.0	4.1	3.6	3.6	3.2	3.2	2.8	2.5	2.1	2.1	1.6	1.2
1994	4.2	4.4	4.2	3.9	3.7	3.6	3.4	2.8	2.4	2.2	1.9	1.3
1995	3.7	4.5	4.6	4.3	4.0	3.9	3.5	3.4	2.8	2.8	1.9	1.8
1996	5.9	4.9	5.0	4.6	4.5	4.0	4.0	3.3	3.2	3.0	2.1	1.9
1997	5.0	5.5	4.6	4.6	4.1	4.1	3.7	3.4	2.8	3.1	2.6	1.7
1998	5.4	5.7	5.5	4.8	4.8	4.3	4.2	3.3	3.2	3.2	2.8	1.8
1999	4.6	5.5	6.1	5.5	5.0	4.7	4.2	3.8	3.2	3.7	2.7	2.1
2000	6.5	5.2	5.4	5.4	5.6	5.1	4.5	3.9	3.5	3.5	3.1	2.1
2001	6.7	6.5	6.0	5.6	5.6	5.7	4.9	4.5	3.8	3.9	3.0	2.6
2002	5.7	6.5	6.2	5.4	5.3	5.4	5.1	4.1	4.0	3.8	3.3	2.2
2003	5.6	6.0	6.2	5.7	5.0	4.9	5.0	4.3	4.0	3.8	3.2	2.2
2004	5.4	5.9	6.5	6.1	6.1	5.7	5.0	5.0	4.4	4.1	3.3	2.5
2005	6.6	7.0	6.4	6.9	6.9	6.8	5.9	5.1	4.8	4.9	3.7	2.9
2006	6.7	7.3	7.6	6.9	7.1	7.1	6.9	5.5	4.9	5.0	4.5	2.9

whereas the percentage of overweight (excluding obese) boys grew from 13.5% in 1991 to 18.8% in 2006.

Although the overall prevalence of overweight and obese boys was continuously growing from 1991 to 2006, the pattern of changes (Fig. 1 and 2) remained almost the same. The percentage of overweight children has the highest values between the ages of 11 and 13

and then steadily decreases until the age of 15. At the age of 16 it slightly increases again and then gradually decreases until the age of 18, whereas the percentage of obese children only increases from the age of seven to nine and until the age of 18 it decreases to less than half of its maximal value.

Fig. 1

Proportion of overweight and obese boys in Slovenia from 1991 to 2006

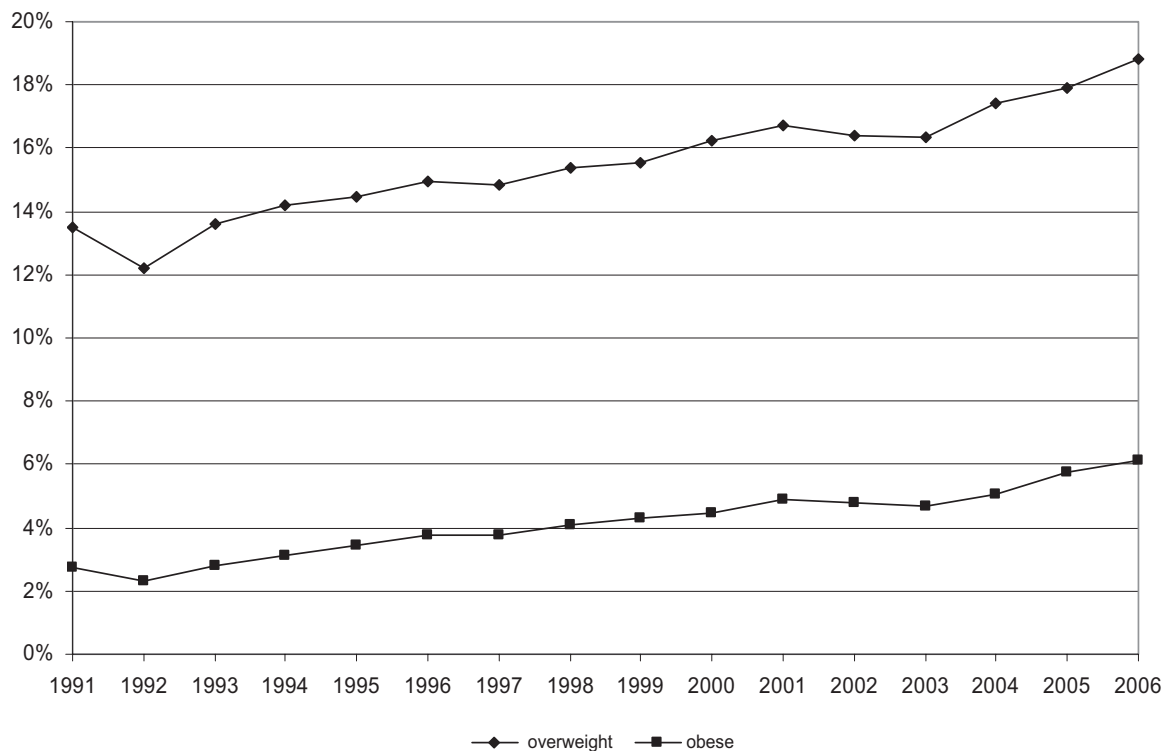


Fig. 2

Proportion of overweight boys at different ages in Slovenia from 1991 to 2006

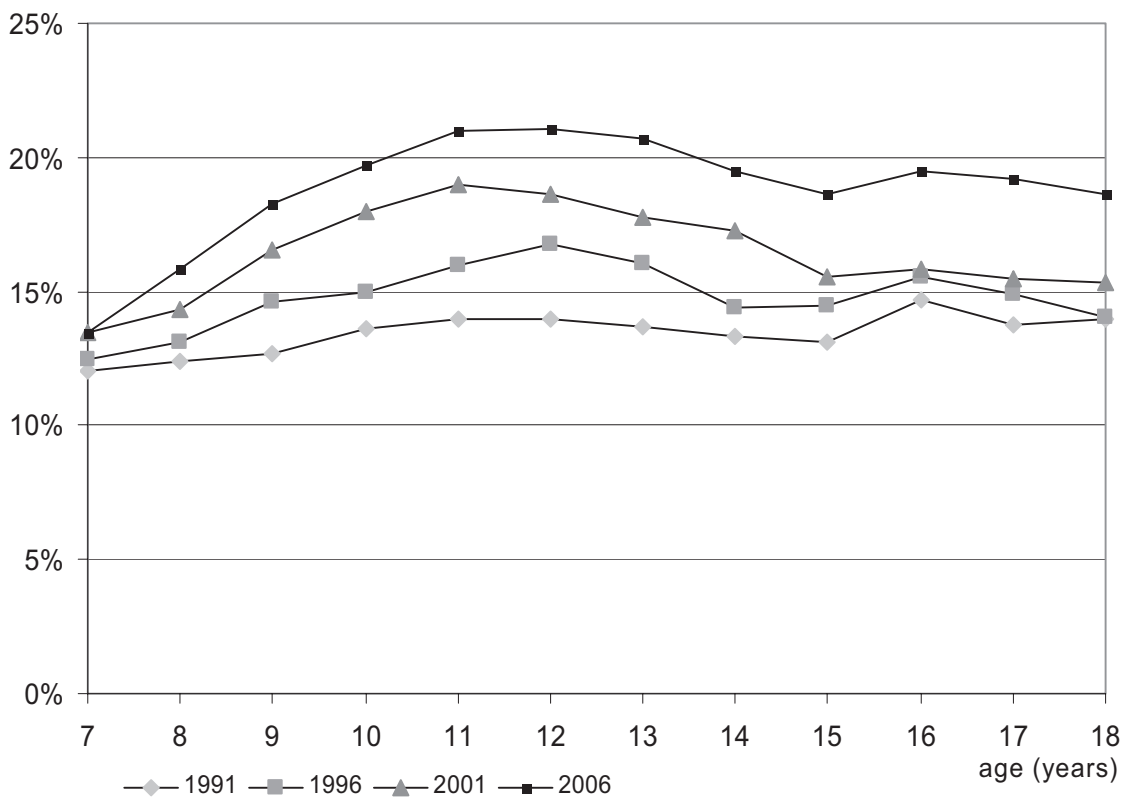
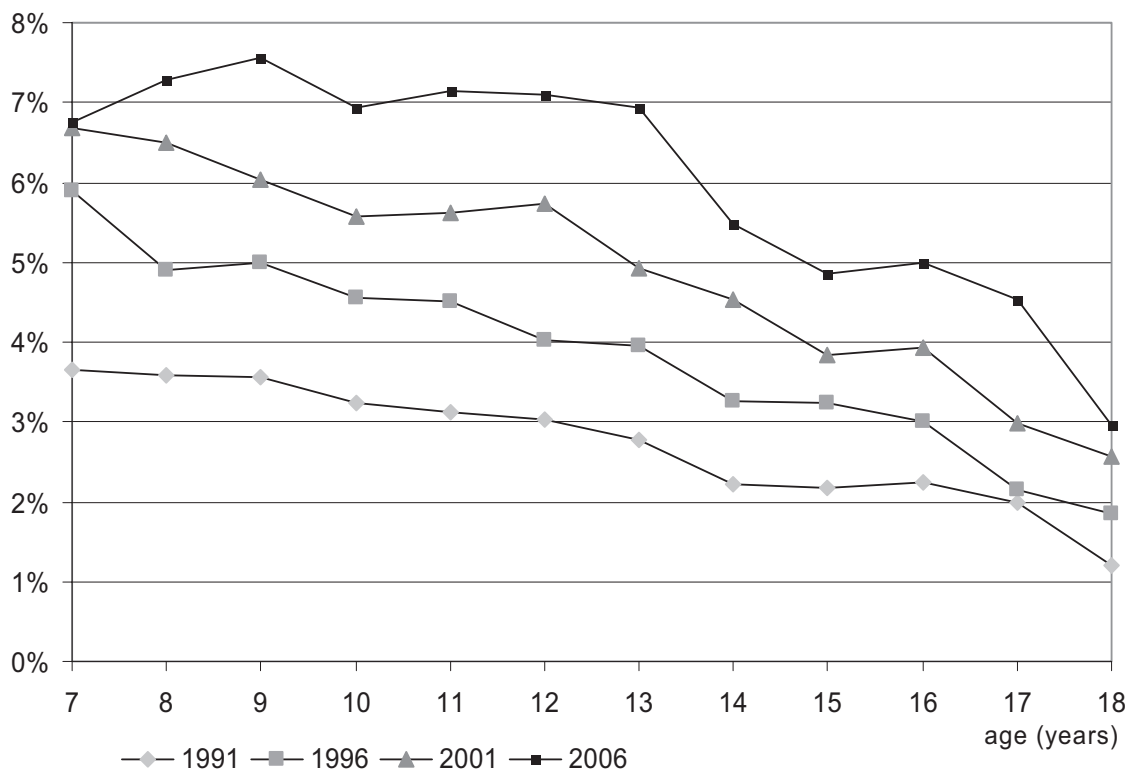


Fig. 3

Proportion of obese boys at different ages in Slovenia from 1991 to 2006



DISCUSSION

There are some limitations of the study. Although the sample is large, it is not a probability sample of all boys aged 7–18 years in Slovenia. Namely, since 1996 (when new education legislation was passed) only healthy boys who have the written consent of their parents are included. Nevertheless, the same limitations apply even with probability sampling; further, the sampling procedure was the same throughout the study. Therefore, there is no reason for the described trends not to apply to the entire population. There are some reasons to believe that the prevalence of overweight and particularly obesity within the population is in fact higher than described in the article as obese pupils are less inclined to participate. These limiting factors have also been described in similar studies by others (Andersen, Froberg, Kristensen, & Møller, 2007).

Undoubtedly the prevalence of overweight and obesity is taking on epidemic proportions. The percentage of overweight and obese boys in Slovenia was rising almost constantly every year from 1991 to 2006. The only exception is the beginning of the studied period (in 1992), which is probably due to establishment of the new state of Slovenia in 1991. In that year an important migration of the population occurred; also the introduction of a new currency, the loss of important markets in parts

of former Yugoslavia and the transition from a socialist to a capitalist economic system resulted in economic instability; further, some novelties were introduced into the education system. A decrease in the proportion of overweight and obese population is also noticed in other countries going through similar changes or in times of economic recession (such as Russia, Croatia, Poland and Czech Republic) (Andersen, Froberg, Kristensen, & Møller, 2007).

The trajectories for the five year periods (1991–1996–2001–2006) show a smaller increase in the proportion of overweight children at the age of seven and then a faster increase in the proportion in the preadolescent period between the ages of 9 and 14. Whereas in the period between 1991 and 1996 the biggest proportion of overweight children was noticed for 12 year olds, in the last decade this proportion is highest in 11 year old children. Further, in 2006 the proportion of overweight children decreased more slowly and less steeply than previously. It can be concluded that excessive weight in this age period is more a result of physical development and less of external conditions; in other words, the reference values of the IOTF for a specific age group are not particularly suitable. This anomaly of the BMI distribution found on the studied population is also characteristic of other populations (Rolland-Cachera, Cole, Sempe, Tichet, Rossignol, & Charraud, 1991).

Also worrying is the status of the population older than 15 years; namely, in 2006 a considerable increase in the proportion of overweight young people was noticed in comparison to previous periods.

Obesity is rising at higher rates than excessive weight as it has more than doubled in just 15 years. The proportion of overweight boys increases between the ages of 7 and 13 and then gradually decreases until the age of 18. The proportion of the obese population has been decreasing from around 7 year old to 18 year old boys, with an exception in 2006 where an increase was shown from the ages 7 to 9, followed by a first dip at the age of 10 and a partial stagnation until the age of 13; afterwards the decrease until the age of 18 is slightly larger than in other periods.

It should be mentioned that the proportion of the measured population is slightly lower in high schools compared to primary school and that it also depends on the type of school involved. In gymnasium programmes it included over 85% of the population, whereas in vocational schools this value stands at around 60% (Strel, Kovač, & Rogelj, 2006). Particularly vocational schools show a larger proportion of overweight and obese boys (Brettschneider & Naul, 2004; Kovač, Strel, & Leskošek, 2007; Kristensen, Wedderkopp, Möller et al., 2006) as these boys come from families with a lower social status and it can be presumed that the actual proportion of young people with excessive weight is higher than shown.

The age period between 11 and 18 years is marked in the Slovenian education system by the introduction of specialised physical education teachers; the results of motor tests significantly improve (Strel et al., 2003) due to the better working conditions of this age group (a smaller number of children in a group, lessons carried out in sports halls and other specialised places – dance and fitness studios, etc.) and sports teachers' better knowledge about systematic work and the selection of suitable contents and work loading. It is surprising to notice that the proportion of children with excessive weight is highest particularly in the period between the ages of 11 and 13, when young people have the best conditions available for sports activities in schools and still show an interest in free time sports participation in sports clubs. It can be concluded that the excessive weight seen in this period is connected with the transition to puberty, where an accelerated increase of height is still not noticed although the body mass is already increasing (Strel, Kovač, & Rogelj, 2006).

The prevalence of overweight and obesity, its secular trends and pattern of changes from childhood to adolescence in Slovenia are similar to those in many other countries in Europe and the rest of the world. Although the data are not directly comparable with recent studies in other European countries reviewed

by Lobstein and Frelut (2003) due to methodological and other differences, it seems that the prevalence of overweight children in Slovenia is in conformity with the country's geographical position in Europe. As an example, in 2000 the prevalence of overweight (including obese) 7–9 year old boys in Slovenia was 20.4%, while the prevalence of overweight children (Lobstein & Frelut, 2003 – did not report the results separately for boys and girls) of the same age and in a similar period (most studies were carried out in 1997–2001) were around 30–35% in Mediterranean countries and around 20% in other countries. With 14 to 17 year old boys, the equivalent prevalence in Slovenia was 19.1%, while in Europe it ranged from 8–23%.

The increase in the proportion of both (overweight and obese) groups in developed countries is a result of the different ways young people spend their free time; their characteristics are mainly motor inactivity and incorrect diets (energy rich food and unsuitable eating habits). The way young people spend their free time has changed in recent years. Most studies show that the volume of free time physical activities gradually decreases with age (Brettschneider & Naul, 2004; Jurak et al., 2003; Riddoch et al., 2004). A review of several European studies (Currie et al., 2004; Engström, 2002) shows that physical activity significantly decreases with age – 3% per annum for boys. Data from the HBSC research for Slovenian boys show that only every second Slovenian boy is moderately to intensively active at the age of 11; the information is also valid for 41% of 13 year olds and every third 15 year old boy (Stergar, Scagnetti, & Pucelj, 2006). These results indicate that the physical activity of Slovenian boys is above the average of other countries included in the HBSC study, nevertheless, it is far from satisfactory as it has been noticed that in recent years the proportion of the physically active population has been shrinking (Jurak, 2006; Jeriček, 2007).

Unfortunately it has been noted (Gabrijelčič Blenkuš, 2001; Stergar, Scagnetti, & Pucelj, 2006) that the number of overweight and obese boys in the period of adolescence is also a result of unhealthy eating habits. In the Slovenian part of the HBSC study the authors state that 8% of boys were found to follow some kind of diet; at the same time only 64% of boys were happy with their body weight (Stergar, Scagnetti, & Pucelj, 2006). The proportion of people who think of themselves as overweight is also increasing among boys. Although they did not follow any diet, 20% of boys (and 33% of girls) were convinced that they needed to lose weight.

With young people and particularly with boys, a "shallow" approach to nutrition is being noticed instead of enjoying healthy meals (Stergar, Scagnetti, & Pucelj, 2006). Presumably, this is a result of the easier access to various snacks (Drummond, Crombie, & Kirk, 1996). Gabrijelčič Blenkuš (2001) found that pupils in

Ljubljana eat irregularly (leaving out breakfast and dinner) and do not have regular eating patterns. Particularly exposed are pupils from vocational schools whose meals are also of the poorest quality. According to the HBSC data 42% of boys always eat breakfast, on the other hand 30% of boys never have breakfast at all. From year 5 of primary school to year 1 of high school the proportion of boys having breakfast decreases by 7.5%. Boys more often than girls have at least three meals a day, however, the quality of their meals is poorer as they do not eat enough fruit and vegetables and consume too many sweet drinks (Stergar, Scagnetti, & Pucel, 2006).

The health consequences of excessive weight during childhood are less clear but a systematic review shows that childhood obesity is strongly associated with risk factors of cardiovascular disease (CVD) and diabetes, orthopaedic problems and mental disorders (Andersen, Froberg, Kristensen, & Møller, 2007; Dietz, 1998). The number of children with health problems is also on the rise in Slovenia, particularly among the youngest children (Brcar, 2005). An increased tendency has been noted for diseases of the muscular-skeletal system and mental and behavioural disorders.

An unhealthy lifestyle in the adult population is another reason for the increase in the proportion of men dying from cardiovascular diseases. This is also one of the reasons why Slovenian men have a significantly lower life expectancy (68.9 years) than women (77.8 years) (Statistical office of the Republic of Slovenia, 2006).

CONCLUSION

Clearly the prevalence of overweight and obesity is also taking on epidemic proportions in Slovenia (Bučar Pajek, Strel, Kovač, & Pajek, 2004; Strel, Kovač, & Jurak, 2007). The percentage of overweight and obese boys in Slovenia rose almost constantly every year from 1991 to 2006, with the only real exception at the beginning of the period (in 1992). Obesity is growing at higher rates than overweight, as it has more than doubled in just 15 years.

The proportion of overweight boys is increasing nearly constantly between the ages of 7 and 18, whereas the proportion of obese boys decreases with age. It is interesting to notice the biggest increase in the 15 year period was noted for boys aged 10 to 13 as this period is marked with specialised PE teachers and the best available conditions in schools, as well as the largest participation in extracurricular sports programmes. The results for the high school population are slightly better; nevertheless, the proportion of overweight and obese boys is twice as high as in girls (Strel, Kovač, & Jurak, 2007).

Warnings about these negative trends have already been issued for a longer period; unfortunately the government does not listen to health and sports experts. Particularly in the last two years a reduction in the hours for physical education lessons has occurred in high school programmes (Kovač, 2006), with this being one of the biggest mistakes of educational policy makers. Therefore, sports pedagogues and health workers are calling for an increase and not a decrease in the number of physical education lessons and improved access to free extracurricular sports programmes; however, it is also vital that parents ensure healthy eating habits and limit children's time spent in front of TV and computer screens.

REFERENCES

- Andersen, L. B., Froberg, K., Kristensen P. L., & Møller, N. C. (2007). Physical activity and physical fitness in relation to cardiovascular disease in children. In W. B. Brettschneider & R. Naul (Eds.), *Obesity in Europe: Young people's physical activity and sedentary lifestyles* (pp. 57–100). Frankfurt am Main: Peter Lang.
- Avbelj, M., Saje-Hribar, N., Seher-Zupančič, M., Brcar, P., Kotnik, P., Iršič, A., Bratanič, N., Kržišnik, C., & Batelino, T. (2005). Overweight and obesity prevalence among 5 year old children and 15 to 16 year old adolescents in Slovenia. *Zdravstveni vestnik*, 74, 753–759.
- Brcar, P. (2005). Health of children and youth of both genders. In A. Črnak-Meglič (Ed.), *Otroci in mladina v prehodni družbi: Analiza položaja v Sloveniji*. Maribor: Ministrstvo za šolstvo in šport, Urad Republike Slovenije za mladino. Retrieved 4. 9. 2007 from World Wide Web: http://www.ivz.si/javne_datoteke/datoteke/856-ZdravjecotrokCcmadostnicincmladostnikovcPOLONAcBRCARcmarecc2006.doc
- Brettschneider, W. B., & Naul, R. (2004). *Study on young people's lifestyle and sedentariness and the role of sport in the context of education and as a means of restoring the balance*. Paderborn: University of Paderborn and Council of Europe.
- Bučar-Pajek M., Strel, J., Kovač, M., & Pajek, J. (2004). Expansion of the prevalence of overweight and obese schoolchildren, aged 7 to 10: A new epidemic risk factor? In R. Pišot, V. Štemberger, J. Zurc, & A. Obid (Eds.), *Abstracts and proceedings of 3rd International symposium Child in Motion*. Koper: Univerza na Primorskem & Znanstveno raziskovalno središče.
- Cash, T. F. (2002). Cognitive behavioral perspectives on body image. In T. F. Cash & T. Pruzinsky (Eds.), *Body images: A handbook of theory, research and clinical practice* (38–46). New York, London: Guilford Press.

- Cole, T. J., Bellizzi, M. C., Flegal, K. M., & Dietz, W. H. (2000). Establishing a standard definition for child overweight and obesity worldwide: International survey. *British Medical Journal*, 320, 1240–243.
- Collett, D. (1991). *Modelling binary data*. London: Chapman and Hall.
- Currie, C., Roberts, C., Morgan, A., Smith, R., Settertobulte, W., Samdal, O. et al. (2004). Young people's health in context: Health behaviour in school aged children (HBSC) study – international report from the 2001/2002 survey. *Health Policy for Children and Adolescents*, 4. Copenhagen: World Health Organization regional office for Europe.
- Dehghan, M., Akhtar-Danesh, N., & Merchant, A. T. (2005). Childhood obesity, prevalence and prevention. *Nutrition Journal*, 4, 24.
- Dietz, W. H. (1998). Health consequences of obesity in youth: Childhood predictors of adult disease. *Paediatrics*, 101, 518–525.
- Drummond, S., Crombie, N., & Kirk, T. (1996). A critique of the effects of snacking on body weight status. *European Journal of Clinical Nutrition*, 50, 779–783.
- Gabrijelčič Blenkuš, M. (2001). Some eating habits of high school pupils in Ljubljana with a stress on the difference between genders. *Zdravstveno varstvo*, 40, 135–143.
- Goni, A., & Zulaka, L. (2000). Relationship between physical education classes and the enhancement of fifth grade pupils' self concept. *Perceptual and motor skills*, 91, 246–250.
- James, P. T. (2004). Obesity: The worldwide epidemic. *Clinics in Dermatology*, 22(4), 276–80.
- Jeriček, M. (2007). *Presentation of the results of the study Health related behaviour in the academic year 2006*. Ljubljana: Inštitut za varovanje zdravja RS, Center za promocijo zdravja.
- Jurak, G. (2006). Sports vs. the cigarettes & coffee lifestyle of Slovenian high school students. *Anthropological Notebooks* 12(2), 79–95.
- Jurak, G., Kovač, M., Strel, J., Majerič, M., Starc, G., Filipčič, T. et al. (2003). *Sports activities of Slovenian children and young people during their summer holidays*. Ljubljana: University of Ljubljana, Faculty of Sport.
- Kovač, M. (2006). When social becomes biological: The effect of different physical education curricula on the motor and physical development of high school girls. *Anthropological Notebooks*, 12(2), 97–112.
- Kovač, M., Strel, J., & Leskošek, B. (2007). Morphological characteristics and motor abilities of boys following different secondary school programmes. *Kinesiology*, 39(1), 62–73.
- Kristensen, P. L., Wedderkopp, N., Møller N. C., Andersen, L. B., Bai, C. N., & Froberg, K. (2006). Tracking and prevalence of cardiovascular disease risk factors across socio-economic classes: A longitudinal sub study of the European youth heart study. *Public Health*, 6, 20.
- Lobstein, T., Baur, L., & Uauy, R. (2004). Obesity in children and young people: A crisis in public health. *Obesity Reviews* 5(1), 1–104.
- Lobstein, T., & Frelut, M. L. (2003). Prevalence of overweight among children in Europe. *Obesity Reviews* 4(4), 195–200.
- Malina, R. M., & Katzmarzyk, P. T. (1999). Validity of the body mass index as an indicator of the risk and presence of overweight in adolescents. *American Journal of Clinical Nutrition*, 70, 131–116.
- Parsons, T. J., Power, C., Logan, S., & Summerbell, C. D. (1999). Childhood predictors of adult obesity: A systematic review. *International Journal of Obesity*, 23, 1–107.
- Riddoch, C. J., Andersen, L. B., Wedderkopp, N., Harro, M., Klasson-Heggebo, L., Sardinha, L. B. et al. (2004). Physical activity levels and patterns of 9 and 15 year old European children. *Medicine & Science in Sports & Exercise*, 36, 86–92.
- Rolland-Cachera, M. F., Cole, T. J., Sempe, M., Tichet, J., Rossignol, C., & Charraud, A. (1991). Body mass index variations: Centiles from birth to 87 years. *European Journal of Clinical Nutrition* 45, 13–21.
- Stregar, E., Scagnetti, N., & Pucelj, V. (2006). *Health related behaviour*. Ljubljana: Inštitut za varovanje zdravja.
- Stomatakis, E., Primatesta, P., Chinn, S., Rona, R., & Falaschetti, E. (2005). Overweight and obesity trends from 1974 to 2003 in English children: What is the role of socio-economic factors? *Archives of Disease in Childhood*, 90, 999–1004.
- Strel, J., Ambrožič, F., Kondrič, M., Kovač, M., Leskošek, B., Štihec, J., & Šturm, J. (1997). *Sports educational chart*. Ljubljana: Ministry of Education and Sport.
- Strel, J., Kovač, M., & Jurak, G. (2007). Physical and motor development, sport activities and lifestyles of Slovenian children and youth – changes in the last few decades. In W. D. Brettschneider & R. Naul (Eds.), *Obesity in Europe: Young people's physical activity and sedentary lifestyles* (pp. 243–264). Frankfurt am Main: Peter Lang.
- Strel, J., Kovač, M., Jurak, G., Bednarik, J., Leskošek, B., Starc, G., Majerič, M., & Filipčič, T. (2003). *Certain morphological, motor, functional and health parameters of children and youth in Slovenia in the period 1990 to 2000*. Ljubljana: Fakulteta za šport, Inštitut za kineziologijo.
- Strel, J., Kovač, M., & Rogelj, A. (2006). *Data collection sports education chart – report for the academic year 2005/2006 and some comparisons with the academic year 2004/2005*. Ljubljana: Fakulteta za šport.

- Šturm, J., Strel, J., Ambrožič, F., Leskošek, B., Strojnik, V., & Krpač, F. (1990). An information system for evaluation of motor abilities and morphological characteristics of the youth in the Republic of Slovenia. *Teorie a praxe tělesné výchovy*, 38(7), 431–437.
- Whitaker, R. C., Wright, J. A., Pepe, M. S., Seidel, K. D., & Dietz, W. H. (1997). Predicting obesity in young adulthood from childhood and parental obesity. *New England Journal of Medicine*, 337, 869–873.
- WHO. *Obesity and overweight*. Retrieved 11. 7. 2007 from World Wide Web: http://www.who.int/hpr/NPH/docs/g_s_obesity.pdf
- Statistical office of the Republic of Slovenia (2006). *Statistične informacije - Rapid reports No. 188. Prebivalstvo - Population (21. 11. 2006)*. Ljubljana: Statistični urad Republike Slovenije. Retrieved 11. 9. 2007 from World Wide Web: <http://www.stat.si/doc/statinf/05-si-021-0602.pdf>

**TENDENCE K NADVÁZE A OBEZITĚ
U SLOVINSKÝCH CHLAPCŮ
V LETECH 1991–2006**
(Souhrn anglického textu)

Studie zkoumala skupinu slovinských chlapců ve věku od sedmi do osmnácti let trpících nadváhou nebo obezitou, a to s použitím každoročně opakovaného průřezového výzkumu. Výzkum, probíhající od roku 1991 do roku 2006, byl založen na měření indexu tělesné hmotnosti podle norem Mezinárodní asociace pro studium obezity (IOTF). Výsledky ukazují, že podíl chlapců s nadváhou v tomto období vzrostl o 40 % (ze 13,5 % na 18,8 %), přičemž podíl obézních chlapců se více než zdvojnásobil (ze 2,8 % na 6,1 %). Rozšíření nadváhy a obezity je nejvyšší v dětství a rané adolescenci, kdy je více než dvojnásobné v porovnání s věkem osmnácti let. Trendy a prevalence obezity a nadváhy jsou podobné jako v ostatních zemích a odpovídají zeměpisné poloze Slovinska v Evropě. V posledních letech bylo zaznamenáno, že nejvyšší počet chlapců s nadváhou patří do vě-

kové skupiny 11 až 13 let. Věk se v porovnání s výsledky z minulosti snížil o jeden rok. Počet začíná klesat po 13. roku. Zajímavé je, že věková kategorie s nejvyšším výskytem chlapců s nadváhou zahrnuje rovněž fyzicky neaktivnější populaci, která má tři hodiny tělesné výchovy týdně pod vedením specializovaných pedagogů. Kromě toho se chlapci v tomto věku velice často účastní mimoškolních sportovních aktivit. Tato anomálie v distribuci BMI, kterou jsme u zkoumané populace konstatovali, je charakteristická také pro jiné populace. Lze tedy učinit závěr, že nadměrná váha v tomto období je spíše výsledkem tělesného vývoje než vnějších podmínek. Jinými slovy, referenční hodnoty IOTF nejsou pro tuto konkrétní věkovou skupinu zcela vhodné.

Klíčová slova: index tělesné hmotnosti BMI, nadváha, obezita, chlapci, Slovinsko.

Ass. prof. Marjeta Kovač, Ph.D.



University of Ljubljana
Faculty of Sport
Gortanova 22
10000 Ljubljana
Slovenia

Education and previous work experience

Graduated from physical education, worked in primary and secondary school, member of Department of Sport Didactics at the Faculty of Sport in Ljubljana.

Scientific orientation

Mostly interested in problems of physical development, children and youth lifestyles and assessment of physical education. Co-author of all Slovenian curricula for physical education.

First-line publications

Author of about 60 scientific articles and books.

POSTURE ANALYSIS USING POSITION DETECTOR DTP2 IN SENESCENT WOMEN AFTER THE APPLICATION OF A TARGETED EXERCISE PROGRAM

Jarmila Riegerová, Jakub Krejčí, Petr Kolisko, Miroslava Přidalová

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

Submitted in November, 2007

During the years 2005, 2006, and 2007, we studied changes in the posture and spinal shape in three groups of younger female seniors (mean age 61, 63, and 66 years) using the diagnostic device DTP2 following the interventional procedure of a targeted exercise program (the Chinese therapeutic exercise known as “Hui chun gong”). The exercise influenced mainly the pelvic area; the trends suggesting improved posture and stability did not reach statistical significance in all cases. Since the exercise technique is technically difficult, improperly performed positions resulted in a zero effect rather than improvement.

Positive changes were always found in terms of improved stance stability and significant shift of the thoracic kyphosis towards the vertical axis, which suggests improved posture. Shoulder position showed a certain degree of inconsistency in terms of changes in shoulder asymmetry. Pelvic position also responded to the intervention procedures by shifting the asymmetry of the spinal angles after the 1st and 2nd phases of exercise, while a statistically significant offset of the left sided asymmetry was achieved after the 3rd phase. We found a reduced extent of titubation of the axial skeleton, which was evaluated to be an accompanying effect of the improved stance stability. In total, best results were manifested following the intervention in 2007, when the extent of titubation was decreased in the direction of both the x and y axes, a statistically significant positive change was found in the adjustment of symmetry of the posterior superior iliac spine, and a materially significant trend of a decrease in the axial values of lordoses and thoracic kyphosis was observed. The reasons for these changes can be found in an increased emphasis on the proper performance of exercise techniques and thus adjustment of muscle imbalances.

Subjective feelings of the senior patients were very beneficial, as they evaluated very positively the feeling of improved stance stability.

Keywords: Posture, DTP2, women, senescence, targeted exercise program Hui Chun Gong.

INTRODUCTION

Upright posture can be considered to be an individual postural program which came into existence in the course of human evolution. “Bad” posture can usually be seen in individuals lacking the disposition towards variability of postural and motor variations. We can also find it in probands who are forced to assume long term unchanging or repeatedly identical positions in their occupations. Bad posture is usually a source of various functional disorders of the postural system, which, in the case of frequent occurrence, may even lead to structural changes. Clinical pictures of poor bodily posture in the elderly are very diverse. They usually involve disorders of the postural arrangement of the spinal elements with sagittal or lateral axial deviation, displacements of the spinal sectors as compared to the head and support base, kyphotic posture, or disorders associated with rotation. This study is focused on establishing changes in the shape of the spine and in bodily posture before and after the application of therapeutic

exercises performed for a period of three and six months in women of early senior age (senescence). We chose a Chinese therapeutic exercise called “Hui chun gong” to correct posture and flexibility. It involves precisely targeted, slowly led movements that are designed to affect the whole body. The exercise is also known as “the rejuvenation exercise of the Chinese emperors” and it is claimed to have considerable therapeutic effects by the non professional public. Imagination and laughter are important to establish mental balance.

OBJECTIVE AND METHOD

The objective of the work was to verify the presumed changes in posture and spine shape using the DTP2 diagnostic device after an intervention procedure of the selected targeted exercise program (Chinese therapeutic exercise). The women exercised in a continuous time sequence of three months during the year 2005 and six months during the years 2006 and 2007. The exercise

was done on a weekly basis for 1½ hours, and in addition the probands observed a home exercise program for at least 15 minutes a day. Once the intervention had been completed, this regular program was no longer followed.

The research group comprised 20 female probands in the year 2005, 23 senior patients in the year 2006 and 21 female probands in the year 2007, who underwent examination at baseline and at the end of the experiment. The exercise was always started by 30 women. The 2006 group included 52, 17% of whom were women who had already exercised in the first year of research. The 2007 group, included 42.86% of women who had already exercised in the second year of research. This communication has the character of a pilot study given the numbers of probands.

Standard anthropometric methods and instrumentation were used for somatometric measurements, while the DTP2 diagnostic system (somatographic method) was used for the examination of spinal shape and body statics.

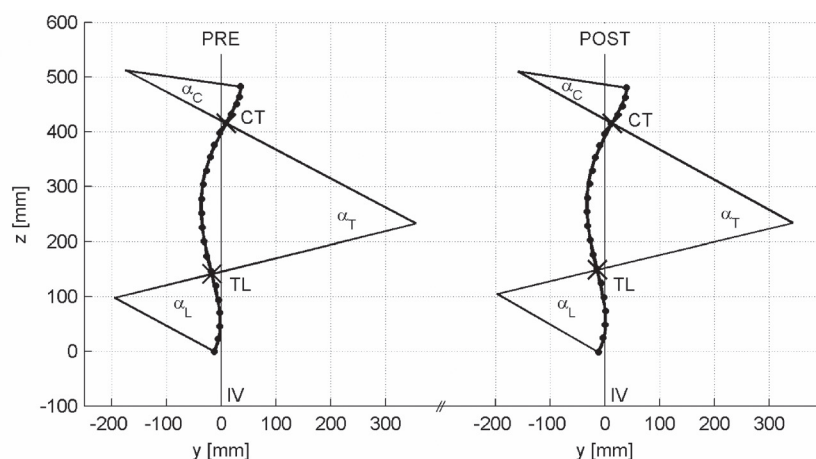
The DTP2 device was developed in cooperation with the Department of Biomechanics and Technical Cybernetics and the Functional Anthropology and Physiology Department at the FPC PU, Olomouc (Kolisko et al., 1995, 2003, 2005). It enables a graphic and numeric analysis of selected points on the body surface in the 3D Cartesian system of coordinates against the zero vertical

axis (the zero vertical axis is a vertical line leading from the centre between the proband's heels). Each of the detected points is thereby determined by three coordinates as follows – x coordinate – sagittal distance of the point from the zero vertical, y coordinate – ventral (dorsal) distance from the zero vertical, z coordinate – height of the point cranially from the first caudally measured points on the spine.

After marking the points on the proband's body, each position in a free stance was measured repeatedly three times. Skin projections of the C₃-L₅ spinous processes were used (22 points). In addition, we measured the position of the acromion as well as the position of the posterior superior iliac spine in the pelvic region. To identify the spinal shape, which is defined by the projection of the marked points against the ideal vertical axis, we determined the mean spinal shape. The latter was used as a basis for determination of the polynomial coefficient of the 6th degree, which expresses the character of the spinal shape curve in the frontal and sagittal plane with a sufficient precision (Krejčí, 2007). To obtain a more precise interpretation of changes in the spinal shape curve in the sagittal plane, we used angle values that characterize the angles of cervical, thoracic, and lumbar segments. An example of the graphic representation is shown in Fig. 1, while data is summarized in TABLE 4.

Fig. 1

Mean angle parameters of spinal shape curves in the sagittal plane – the third stage of examination



Legend:

PRE - examination before the application of the exercise program
 POST - examination after the application of the exercise program
 ● - average position of the spinous process
 CT - cervicothoracic junction
 TL - thoracolumbar junction

α_C - cervical lordosis angle
 α_T - thoracic kyphosis angle
 α_L - lumbar lordosis angle
 IV - ideal vertical axis

Basic statistical characteristics were used to evaluate mean changes in the spinal shape expressed in quantitative data; differences were tested by a paired t-test at the 0.05 level of significance. The mean values of the defined points provide information on the potential trends of changes in body posture; angular characteristics of the curvature peaks in the sagittal and frontal planes characterize the shape of the sagittal and lateral curvature of the spine; mean standard deviation values of repeated measurements inform about the titubation of the spine.

RESULTS AND DISCUSSION

TABLE 1

Basic statistical characteristics of selected anthropometric parameters in women - examination in the years 2005 (n = 20), 2006 (n = 23), and 2007 (n = 21)

Parameters	Baseline examination		Final examination	
	\bar{x}_1	s_1	\bar{x}_2	s_2
Age (2005) (n = 20)	61.35	3.87	61.65	3.87
Weight	70.05	8.85	68.95	8.61
Height	163.79	4.49	163.83	4.21
BMI	26.19	3.81	25.77	3.76
Age (2006) (n = 23)	63.26	4.88	63.78	4.87
Weight	66.37	10.20	67.11	10.26
Height	161.90	4.94	161.89	5.02
BMI	25.30	3.97	25.63	3.86
Age (2007) (n = 21)	65.69	4.94	66.06	4.93
Weight	68.00	11.69	68.80	12.11
Height	161.40	3.95	161.30	3.98
BMI	28.06	4.27	26.38	4.37

TABLE 1 shows basic statistical characteristics of selected anthropometric parameters in the group of women of senescent age, obtained during the initial and final examination.

The mean body weight and height of women were within the range of normal values for the Czech population (Bláha et al., 1986). BMI and analysis of body composition indicate a more robust constitution and slight overweight.

We used spinal curves of all the probands in both frontal and sagittal planes to calculate the average spinal curvature. Based on the comparison of the average spinal curvature before and after the application of the targeted exercise program, we observed differences in the position of the x, y, and z points and in stance stability (Fig. 2).

When analyzing the results of research in the year 2005, a significant accentuation of the axial system shift to the left of the zero vertical was found in the frontal region in the case of 65% of probands while no change was observed in the remaining 35%. The average range of ellipses - titubations (SD) - was reduced by 0.7 cm in both the x and y axes (TABLE 2), which falls within the level of an allowed measurement error. The limit of 1.0 mm has been set for a material significance of the difference. In a subjective evaluation the probands emphasized an improvement in their stance stability.

After the completion of the research in 2006, a shift of the spinal curve towards the vertical axis was observed in the frontal plane in 50% of probands, and peak of the thoracic kyphosis also came nearer to the zero vertical axis (22.22% of probands). The average range of titubations increased from the mean 1.1 mm in the x axis and 0.2 mm in the y axis, which - as a matter of fact - is negligible.

The 2007 results are similar to the trends found in the 1st stage of the examination. The range of titubations was reduced by 1.1 mm in the x axis and 0.3 mm in the y axis.

TABLE 2

Changes in standard deviation of the mean range of ellipses - variance from axis x and axis y

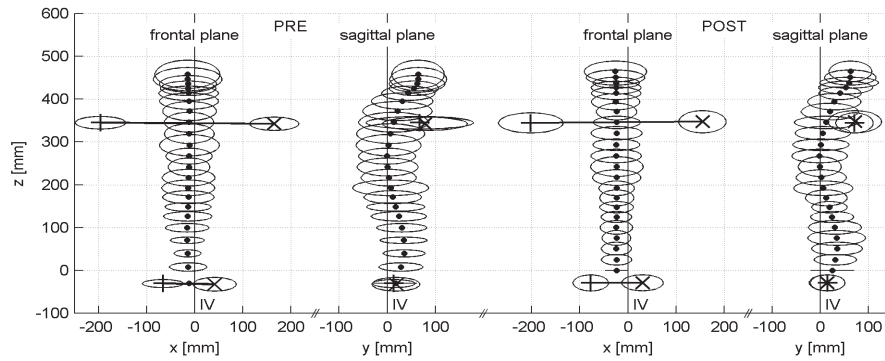
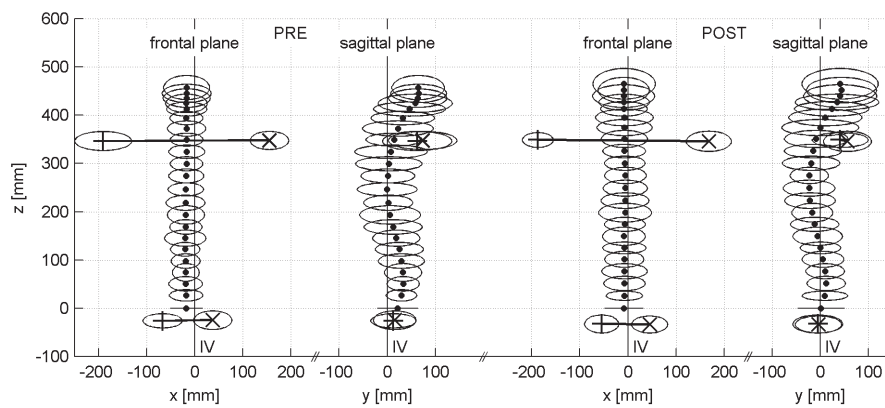
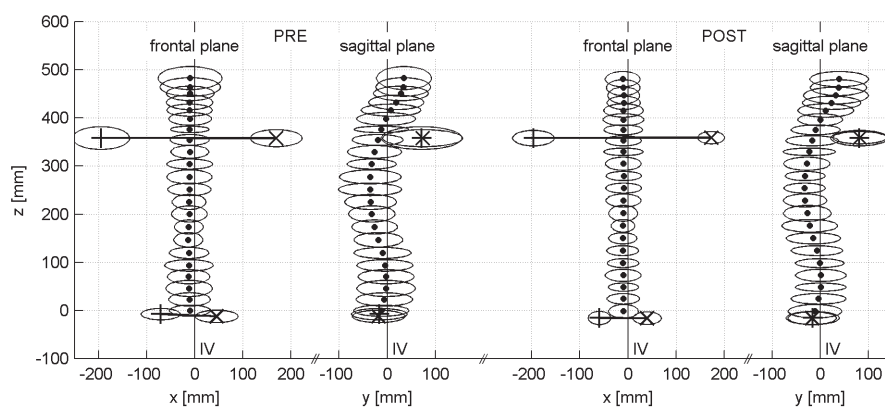
Year	Mean C ₃ -L ₅			
	Pre		Post	
	SDx (mm)	SDy (mm)	SDx (mm)	SDy (mm)
2005	5.2	5.9	4.5	5.2
2006	3.8	5.9	4.9	6.1
2007	4.6	5.7	3.5	5.4

Mean values of changes in acromial and posterior superior iliac spine angles from the horizontal plane laid through these angles are shown in TABLE 3.

In the frontal plane, we examined a change in the position of acromia and the position of the left and right posterior superior iliac spine compared to the horizontal plane laid through them. Shoulder position was characterized by a certain degree of inconsistency. Mean angle values suggest minor side shifts of shoulder asymmetry (1 degree means approximately 5 mm in the shoulder area and 2 to 3 mm in the pelvic area). During the first stage of research in the year 2005, a statistically significant difference was found involving a shift from left sided asymmetry to right sided asymmetry; the difference after recalculation was approximately 3.15 mm. The position of the pelvis also responded to the intervention procedure in both the 1st and the 2nd phases by shifts in the asymmetry of the spinal angles. After the third phase in the year 2007, we again reported a shift from the left sided asymmetry to the right sided asymmetry in

Fig. 2

Evaluation of the average spinal curvature in the frontal and sagittal planes depicting the stability of the individual points on the spine (ellipses) in the stance (1st to 3rd stage of research, years 2005, 2006, and 2007). Standard deviations (ellipses) are shown in 10 times magnification.

1st stage**2nd stage****3rd stage****Legend:**

PRE - examination before the application of the exercise program

POST - examination after the application of the exercise program

+ - mean position of the left acromion and left posterior superior spine, respectively

× - mean position of the right acromion and right posterior superior spine, respectively

● - mean position of the spinous process

○ - standard deviations of the spinous process (10 times magnification)

IV - ideal vertical axis

TABLE 3

Basic statistical characteristics of the acromial and spinal angles (expressed in degrees)

Year	Acromial angle					Posterior superior spine angle				
	pre		post		dif.	pre		post		dif.
	\bar{x}	s	\bar{x}	s		\bar{x}	s	\bar{x}	s	
2005	-0.36	1.36	0.48	1.80	0.86*	-0.80	3.32	0.11	2.27	0.91
2006	0.15	1.75	-0.47	1.93	-0.63*	0.70	2.40	-0.45	2.51	-1.15
2007	-0.03	1.65	0.13	1.55	0.16	-2.35	3.82	-0.23	2.99	2.12*

Note:

Negative value means the left shoulder is higher, while positive value means the right shoulder is higher.

TABLE 4

Mean angular values for cervical and lumbar lordosis and thoracic kyphosis

Year	Cervical lordosis angle α_c			Thoracic kyphosis angle α_r			Lumbar lordosis angle α_l		
	\bar{x} pre	\bar{x} post	dif.	\bar{x} pre	\bar{x} post	dif.	\bar{x} pre	\bar{x} post	dif.
2005	29.83	40.10	10.27*	50.36	51.78	1.43	33.73	31.41	-2.31
2006	43.79	51.57	7.79	53.55	52.66	-0.89	33.29	34.84	1.55
2007	23.08	20.87	-2.21	45.95	45.73	-0.22	45.01	46.06	1.05

the shoulder posture and both a statistically and factually significant difference suggesting an improved pelvic posture wherein left sided asymmetry was reduced by 2.12° (4.24 mm). Postural corrections were generally found to be the best after the third phase. We explained these findings by an increased emphasis on the accuracy of exercise technique and in the individual findings of muscle imbalance. Some exercises in the exercise set are technically demanding. Their incorrect or incomplete performance – in the event of muscular imbalance – could negatively affect the muscle coordination in the region of the shoulder girdle and cause variations in the symmetry of shoulder posture. Pelvic posture also responded in the context of effects of movement chains. Positive trends towards the subjective perception of an improved stance stability were observed.

During the evaluation of angles that characterize the spinal curvature, we found a significant change in the angle of cervical lordosis, namely an increase by 10.27°, after the phase 1 intervention exercise. Concerning the angles characterizing the thoracic and lumbar spine, we found a factual increase by 1.43° in thoracic kyphosis and decrease in the depth of lumbar lordosis by 2.31°. No significant correlations were found between the change in the spinal curvature and range of titubation. In the second phase, only a factual increase in the angle values were found for lordoses, namely by 7.79° (cervical lordosis) and 1.55° (lumbar lordosis), while the mean angle of thoracic kyphosis responded by a suggested trend towards correction of kyphotic posture by 0.90°. In the third phase, we reported a positive change for cervical lordosis and thoracic kyphosis (2.21° and 0.22°,

respectively), while a suggested deepening by 1.05° was found for lumbar lordosis. These differences were not statistically significant (TABLE 4).

As we already mentioned, these women evaluated the subjective feeling of improved stance stability very positively. A detailed case analysis of the results of the individual probands revealed that the postural system responded on an individual basis according to its setting and observance of the exercise techniques. Therefore changes in the response of the axial system to the chosen intervention manifested both as positive corrections and also zero changes.

Previous analysis provides a certain response to the thoughts of Vařeková et al. (2007), who raised the question as to whether a high frequency of muscular shortening and weakening is the norm in older age. Known anatomical principles pertaining to “ageing” of the muscular apparatus require a regular, target oriented musculoskeletal activity, which shall become a basis for further positively tuned structural and physiological settings. The entire age spectrum of our society should be educated in terms of primary care and healthy movement.

CONCLUSIONS

The study groups of women of a young senior age had their mean body weight and height within the range of normal values for the Czech population. BMI and analysis of body composition indicated a more robust constitution and slight overweight.

When evaluating the changes in the average spinal curvature in the frontal plane after the completion of the exercise program in the years 2005, 2006, and 2007, a shift of the axial system was found towards the zero vertical axis and primarily a reduction in the mean range of tibulations. This condition manifested by a subjective feeling of improved stance stability.

With respect to the shoulder posture, a fluctuation was found, namely a shift in the shoulder asymmetry. Pelvis posture also responded to the interventional exercise by shifting the asymmetry of spinal angles, and after the 3rd phase, a significant compensation of the left sided asymmetry.

When evaluating the angles characterizing the spinal curvature, we reported variability of the response in the sense of a factual increase or decrease in the depth of lordoses. The best results were achieved after the 3rd phase of research, when increased emphasis was placed on proper technique of performance of individual exercises. Their improper or incomplete performance – in the event of muscular imbalance – could negatively affect the muscle coordination in the region of the shoulder and pelvic girdles. When asked for subjective evaluation, women emphasized improved stance stability.

ACKNOWLEDGMENT

This study was carried out within the research project granted by the Ministry of Education, Youth and Sports “Physical activity and inactivity of inhabitants of the Czech Republic in the context of behavioral changes, no: 6198959221”.

REFERENCES

- Hackl, M. (2001). *Omlazovací cvičení čínských císařů (Chuej čchun kung)*. Bratislava: Eugenika Pbl.
- Kolisko, P., & Salinger, J. (1995). Diagnostika tvaru páteře pomocí polohového snímače. In J. Riegerová (Ed.), *Diagnostika pohybového systému - metody vyšetření, primární prevence, prostředky pohybové terapie* (pp. 87–88). Olomouc: Univerzita Palackého.
- Kolisko, P., Krejčí, J., & Salinger, J. (2003). Diagnostický systém DTP1 a jeho využití při hodnocení tvaru a funkce páteře. *Česká antropologie*, (53), 35–38.
- Kolisko, P., Salinger, J., Krejčí, J., Novotný, J., & Szotkowská, J. (2005) *Hodnocení tvaru a funkce páteře s využitím diagnostického systému DTP1, 2*. Olomouc: Univerzita Palackého.
- Krejčí, J. (2007). *Systém pro diagnostiku tvaru páteře člověka*. Disertační práce, Univerzita Palackého, Přírodovědecká fakulta, Olomouc.
- Riegerová, J., Přidalová, M., & Szotkowská, J. (2005). Somatometrické charakteristiky a rozbor svalových funkcí u žen – seniorek před a po aplikaci cílených cvičení. *Slov. Antropol.*, 7(3), 142–146.
- Riegerová, J., Szotkowská, J., Přidalová, M., & Krejčí, J. (2006). Vliv čínského léčebného cvičení na posturu a pohybový aparát seniorek. *Med. Sport. Boh. Slov.*, 15(5), 212–216.
- Riegerová, J., Szotkowská, J., & Krejčí, J. (2007). Diagnostics of posture and spine using the DTP2: Position detector for U3A senior students before and after an intervention procedure by a targeted exercise program. *Auxologia a promocja zdrowia, Kielce*, 4, 253–264.
- Riegerová, J., Szotkowská, J., Přidalová, M., & Krejčí, J. (2007). The influence of medical exercise on the somatic parameters and movement system of senior women. *Przeglad Anthropologiczny*, 5, 111.
- Vařeková, R., Vařeka, I., Hnátek, J., Pišťková, N., & Burianová, K. (2007). Sledování pohybového systému u klientů středního a seniorského věku. *Česká antropologie*, (57), 80–82.

ANALÝZA POSTURY POLOHOVÝM SNÍMAČEM DTP2 U ŽEN VE VĚKU SENESCENCE PO APLIKACI CÍLENÉHO CVIČEBNÍHO PROGRAMU (Souhrn anglického textu)

U 3 souborů žen v mladším seniorském věku (průměrný věk 61, 63 a 66 let) jsme v roce 2005, 2006 a 2007 sledovali změny v držení těla a ve tvaru páteře pomocí diagnostického přístroje DTP2 po intervenčním zásahu cíleného cvičebního programu (čínské terapeutické cvičení Chuej čchun kung). Cvičení ovlivnilo především oblast pánve, trendy naznačující zlepšení držení těla a stability nedosáhly ve všech případech statistické významnosti. Vzhledem k tomu, že technika cvičení je cíleně náročná, nesprávně provedené pozice nevedly ke zlepšení, ale projevíly se nulovým efektem.

Vždy byly nalezeny pozitivní změny ve smyslu zlepšení stability stoje a signifikantního posunu hrudní kyfózy k vertikále, což svědčí o zlepšení držení těla. V postavení ramen se projevila určitá rozkolísanost ve smyslu změn asymetrie ramen. Také postavení pánve reagovalo na intervenční zásahy přesuny asymetrie spinálních úhlů po 1. a 2. etapě cvičení, po 3. etapě došlo ke statisticky významnému vyrovnání levostranné asymetrie. Nalezli jsme zmenšení rozsahu titubací axiálního skeletu, což je doprovodným projevem zvýšení stability stoje. Celkově se nejlepší výsledky projevíly po intervenci v roce 2007, kdy se snížil rozsah titubací ve směru osy x i y, byla zjištěna statisticky významná pozitivní změna v úpravě symetrie spina iliaca posterior superior a nalezen věcně významný trend snížení úhlových hodnot lordóz i hrudní kyfózy. Zdůvodnění těchto změn je možné najít ve

zvýšeném důrazu na správné provádění technik cvičení a tím i úprav svalových dysbalancí.

Subjektivní pocity senierek byly velmi příznivé, vysoce pozitivně hodnotily pocit zlepšení stability stoje.

Klíčová slova: držení těla, DTP2, ženy, senescence, cílený cvičební program.

Prof. RNDr. Jarmila Riegerová, CSc.



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

Education and previous work experience

University education, 1968–1990 lecturer, associate professor at the Faculty of Science, Palacký University, Olomouc, 1991 till the present associate professor, professor at the Faculty of Physical Culture, Palacký University, Olomouc.

Scientific orientation

Functional anthropology, environmentalism of human, kinesiology.

First-line publication

Until now has published 120 papers and research studies in Czech as well as in foreign literature, 1 monograph and 5 instructional texts.

THE HEIGHT OF THE LONGITUDINAL FOOT ARCH ASSESSED BY CHIPPAUX-ŠMIŘÁK INDEX IN THE COMPENSATED AND UNCOMPENSATED FOOT TYPES ACCORDING TO ROOT

Ivan Vařeka^{*, **}, Renata Vařeková*

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

***Luhačovice Spa, Co., Luhačovice, Czech Republic*

Submitted in January, 2008

It is known that functional types and subtypes of foot according to Root differ, among others, by the height of foot arch when load is applied. The study objective was to use the Chippaux-Šmiřák index (CSI) to evaluate the height of the longitudinal foot arch in functional (sub)types according to Root. The test group consisted of 141 women (17–85 year, $x = 58.8$, $SD = 12$) and 87 men (22–86 year, $x = 58.7$, $SD = 11.91$), mainly middle aged and older. One examiner assessed the foot types and subtypes in all test subjects – rearfoot varus compensated (RFvarC), partially compensated (RFvarP) and uncompensated (RFvarN), forefoot varus compensated (FFvarC), partially compensated (FFvarP) and uncompensated (FFvarN), forefoot valgus flexible (FFvalgF), semiflexible (FFvalgS) and rigid (FFvalgR) and neutral foot (N). The other examiner evaluated all footprints and he assessed CSI. The sequence was determined on the basis of average CSI; significance of the differences we found was tested by ANOVA and the post-hoc Fisher LSD test. The results showed that functional subtypes could be – with high significance – divided into 2 extreme groups. On one side of the spectrum are the compensated, resp. flexible subtypes with high CSI (thus lower longitudinal foot arch). On the other side of spectrum are uncompensated, respectively rigid subtypes with low CSI. In the central part of the spectrum there are intermediate subtypes. Neutral types can be placed in the central group, rather into its left side. Gender influence is negligible. The results also confirmed the assumption concerning the differences among functional (sub)types in the height of the longitudinal foot arch when load is applied. Nevertheless it cannot by itself replace a personal and physical examination by an examiner who is greatly acquainted with functional anatomy and kinesiology.

Keywords: Rearfoot varus, forefoot varus, forefoot valgus, Chippaux-Šmiřák index.

INTRODUCTION

Classical clinical typology distinguishes 3 basic foot types: flat foot, normal foot and high foot. Although the first description of flat foot is attributed to Galen (Xarchas & Tsolakidis, 2004), the term flat foot was introduced into contemporary practice by Durlacher in 1845 who also designed a suitable shoe padding. In 1888, Whitman completed the patomechanics in pes valgus and he considered muscle activity as a principle factor for foot stabilisation and muscle weakening as a cause for the overloading of other muscles and ligaments and the cause of pain as well. In the twenties, the classic typology was completed with a tripod model of foot arch that is related to the classic orthopaedic concept of collapsed arches as a cause of metatarsalgia. In spite of the fact that the tripod model has been recently repeatedly disputed (Henning & Milani, 1993; Roy, 1988; Cavanagh, Rodgers, & Ibiashi, 1987) it can be still granted a certain validity (Vařeka, 2003). Nevertheless it is obvious that from the aspect of function, a diagnosis

of flat foot is about as vague as a diagnosis of bad posture. When evaluating the findings, it is appropriate to take into account the difference between longitudinal and transversal flat foot because the heightened longitudinal arching is often accompanied by lowered transversal arching. Terminologically and practically it is also good to distinguish between the clinical findings of flat foot and pes planus diagnosis. A high arch (pes cavus) is the opposite of a flat foot. As far as the diagnostics and orthotics thereof, it is important that the accentuation of longitudinal arching is often accompanied by lowering of transversal arching under metatarsal heads. Various clinical examinations are used for their being placed into the mentioned categories, including simple footprints and anthropometric measurements. In an attempt to achieve greater objectivity and to obtain valid results, imaging technology (X-ray) and sophisticated systems measuring the distribution of pressure under the planta are used (e.g. footscan or EMED pedar). The interpretation of these results in accordance with classic typology is insufficient because classic typology does not

deal in great detail with dynamic changes of the loaded foot during the gait cycle.

In 1954–1966, Merton Root introduced the functional typology that lays stress on the foot as a dynamic complex and not merely as a static structure. He drew from the studies of Manter (movements in the subtalar and transversotarsal joint, 1941), of Hicks (orientation of joint axes, 1953), of Wright (rearfoot movements, 1956), of Elftman (locking of the transversotarsal joint during supination in the subtalar joint, 1960) and of Scheiber, Weinerman and Bar Levy (significance of the mutual position of forefoot and rearfoot, 1948 and 1950). It resulted in a new classification of normal and abnormal foot types. In basic (“normal”, ideal) position according to Root, the axis of the lower $\frac{1}{3}$ of the shank and of the heel passes vertically and at the same time the plantar planes of the heel and rearfoot coincide. The aberrations from this position are related to foot function disorders. The protocols for diagnostics and so called functional orthosis with the usage of chocks and backings were created on the above mentioned basis. Root, his colleagues and followers further improved this typology. The original classification of main types (rearfoot varus, forefoot varus and valgus forefoot) was completed with other subtypes and variations. Today it is a rather complex system that enables us to explain logically the findings on the foot also at the proximal levels. Various foot types can have similar but not identical clinical findings. That is why it is mostly important to distinguish between the findings in the case of the unloaded foot and the same foot when it is loaded during standing and walking – when the potential compensations can occur. That requires a certain level of knowledge of foot kinesiology and patho-kinesiology and practical experience as well.

It is known from medical practice that Root’s functional (sub)types differ – among others – by the height of the longitudinal arch when loaded. The objective of this study was to verify these differences.

METHODOLOGY

The test group consisted of 228 test subjects, 141 women (17–85 year, $x = 58.8$, $SD = 12$) and 87 men (22–86 year, $x = 58.7$, $SD = 11.91$). They were the clients of Luhačovice Spa Company, mainly middle aged or older. Kinesiological examination was carried out, including the static footprint by means of the membrane podoscope. Furthermore, we assessed the functional foot types according to Root. One examiner was performing continually this functional evaluation in the course of the whole research period. The other examiner assessed the footprints by means of the Chippaux-Šmirák index

(CSI) at the end of the whole research period. In CSI, the ratio of the smallest width of the middle part of the footprint to the biggest width of the forefoot is determined. The values of the smallest width of the forefoot are found on the line that is perpendicular to the lateral tangent of the footprint; the width of the front part of the footprint is measured at the joint point of the lateral and medial tangent point of the forefoot. Higher CSI can mean a relatively wider midfoot in comparison to the forefoot, which is considered to be an indicator of a lower arch. The reason why CSI was chosen for foot arch evaluation is because it correlates very well with the X-ray evaluation of an arch and because it is a very simple measurement (Maes, Andrienne, & Burny, 2004; Mathieson, Upton, & Prior, 2004). The methodology used draws upon Klementa’s descriptions (1987).

The functional examination was based on the former works of Magee (1992), McPoil and Brocato (1990), Sutherland (1996), Valmassy (1996) and Vařeka and Vařeková (2003, 2005). We firstly performed the visual evaluation of the lower limbs in a standing test subject by viewing him/her from behind. Then the subject lies pronated with $\frac{1}{3}$ of his/her lower limbs extending over the bed. He/she bent the non examined limb and put his/her foot’s heel on the level of the fossa poplitea of the examined limb. The neutral position of the subtalar joint was determined by the palpitation method. The dorsiflexion and the locking of the transversotarsal joint were achieved by applying pressure with the thumb of the other hand on the sole below the head of the 5th metatarsus. Then we visually evaluated the rearfoot position relative to the shank axis and the forefoot position relative to the rearfoot (McPoil & Brocato, 1990; Sutherland, 1996; Valmassy, 1996; Vařeka & Vařeková, 2003, 2005). For the purpose of this study, three functional foot types were determined – rearfoot varus (RFvar), forefoot varus (FFvar), forefoot valgus (FFvalg) and neutral foot. We compared the findings in each foot when unloaded and loaded by the subject’s standing on it and we determined the compensated (resp. flexible) and uncompensated (resp. rigid) subtypes. Inexplicit findings were placed as belonging to the intermediate subtype (TABLE 1).

To simplify the classification we did not establish the types upinated forefoot and that kind of finding was regarded as forefoot varus. Similarly, the finding of the plantarflexed first ray was regarded as forefoot valgus. Detailed description of individual foot types was published repeatedly (Scherer & Moris 1996; Valmassy, 1996; Vařeka & Vařeková, 2003, 2006).

The obtained data were sorted in the Excel program. ANOVA and the post-hoc Fisher LSD test in Statistica 6.0 were used to test the hypothesis. The differences were considered statistically significant at $p < 0.05$.

RESULTS

The basic descriptive statistics are shown in TABLE 2 where the subtypes are ranked according to CSI. Although the average values for the left and right foot differ a little, the ranking range is the same for both.

The significance of these differences (TABLE 3) convincingly confirmed the originally made assumption about the existence of differences in the height of the longitudinal foot arch among the individual functional subtypes that can be divided on the basis of CSI values into 3 subgroups - compensated (resp. flexible), intermediate and uncompensated (resp. rigid). On the

right side of the spectrum are compensated, resp. flexible subtypes - FFvarC, RFvarC and FFvalgF with high CSI (thus a lower longitudinal arch). Within this group, FFvarC has also significantly higher CSI (thus a lower arch) than FFvalgF and RFvarC. On the other side of the spectrum are uncompensated, resp. rigid subtypes - FFvalgR, RFvarN and FFvarN with low CSI - these subtypes have no significant differences in CSI. In the middle part of the spectrum are the intermediate types RFvarP, FFvarP and FFvalgS - none of these subtypes have significant differences in CSI. Normal functional types can be put on the basis of CSI into the middle group, rather to its left side.

TABLE 1

Functional types and subtypes

Type	Subtype	Abbreviation
Rearfoot varus RFvar	compensated	<i>RFvarC</i>
	partially compensated	<i>RFvarP</i>
	uncompensated	<i>RFvarN</i>
Forefoot varus FFvar	compensated	<i>FFvarC</i>
	partially compensated	<i>FFvarP</i>
	uncompensated	<i>FFvarN</i>
Forefoot valgus FFvalg	flexible	<i>FFvalgF</i>
	semiflexible	<i>FFvalgS</i>
	rigid	<i>FFvalgR</i>
Neutral		<i>N</i>

TABLE 2

Foot subtypes ranked according to the average value of the Chippaux-Šmirák index

Type	n	Left		Right	
		M	SD	M	SD
FFvarC	23	0.442	0.133	0.447	0.114
RFvarC	44	0.381	0.065	0.383	0.084
FFvalgF	32	0.357	0.048	0.356	0.038
RFvarP	26	0.340	0.089	0.329	0.089
FFvalgS	15	0.319	0.066	0.327	0.054
FFvarP	4	0.317	0.098	0.326	0.081
N	38	0.311	0.076	0.311	0.078
FFvarN	10	0.236	0.110	0.26	0.117
RFvarN	16	0.18	0.097	0.2	0.098
FFvalgR	20	0.163	0.091	0.18	0.091
Sum	228				

Legend:

n - number; M - simple average; SD - standard deviation
for the other abbreviations see TABLE 1

TABLE 3

Significance of differences in Chippaux-Šmirák index value among functional subtypes

									FFvarC 0.44; 0.45
								RFvarC 0.38; 0.38	*
							FFvalgF 0.36; 0.36	ns	**
						RFvarP 0.34; 0.33	ns	dx*	sin** dx***
					FFvalgS 0.32; 0.33	ns	ns	sin(*)	sin*** dx**
			FFvarP 0.32; 0.32	ns	ns	ns	ns	ns	*
		N 0.31; 0.31	ns	ns	ns	ns	ns	**	***
		FFvarN 0.24; 0.26	sin(*)	ns	ns	sin*	sin** dx*	sin*** dx**	***
	RFvarN 0.18; 0.2	ns	***	*	sin*** dx**	***	***	***	***
FFvalgR 0.16; 0.18	ns	ns	***	*	***	***	***	***	***

Legend:

functional subtypes ranked according to average value of CSI, average value is shown in order left; right ns - non-significant

(*) p < 0.06 (non-significant); * p < 0.05; ** p < 0.01; *** p < 0.001

for the other abbreviations see TABLE 1

TABLE 4

Influence of gender

	CSI_L		CSI_R	
	F	p	F	p
Gender	2.098	0.149	0.953	0.330
Gender* subtyp	1.370	0.229	1.579	0.156

Legend:

CSI_R(L) - Chippaux-Šmirák index left (right); F - ANOVA test criterion; p - significance level; Gender* subtyp - interaction between gender and subtype

TABLE 4 shows the gender influence on results showed in TABLE 3. It is obvious that the interaction between gender and foot subtype has no significant relation to CSI value, so the differences in CSI among foot subtypes is approximately similar in men as well as in women.

DISCUSSION

The results show agreement with the early published descriptions of loaded foot arch in the individual functional subtypes of foot during a gait cycle (McPoil & Brocato, 1990; Pratt & Sanner, 1996; Valmassy, 1996). The foot does not go through a whole gait cycle when taking the static footprint; nevertheless the static load is approximately comparable to midstance.

Compensated rearfoot varus with sufficient compensatory pronation in the subtalar joint (and adduction and plantarflexion of the talus) enables the contact of the medial edge of the foot with the ground. Rearfoot pronation is very quick and remains throughout the whole support phase. Thus the foot arch is decreased, which corresponds with the higher CSI values of our test subjects. On the contrary, in uncompensated rearfoot varus, the pronation in the subtalar joint does not occur so when one treads fully on one's foot, the permanent load stays in the lateral edge of the foot. As a substitutional compensatory mechanism, the 1st ray plantar flexes and it causes the accentuation of the medial curve of the foot arch (McPoil & Brocato, 1990; Valmassy, 1996), which again corresponds with our results.

It is typical for compensated forefoot varus that there is hyperpronation in the subtalar joint with heel valgus when one treads fully on one's foot. As a result, the transversotarsal joint is unlocked and the foot arch is flattened (Hunt, 1990; Pratt & Sanner, 1996). Concerning the fact that even greater compensatory pronation occurs in this case than in compensated rearfoot varus, the foot arch flattening should be more prominent as well. Our finding of the significant highest CSI from all subtypes is in accordance with this assumption. In uncompensated forefoot varus, unlocking and flattening does not occur, which is again in accordance with low CSI findings.

Flexible forefoot valgus is characterised by a sufficient opportunity for forefoot supination along the longitudinal axes of transversotarsal joint so that the forefoot can reach the ground when loaded. Thus it does not need compensatory supination in the subtalar joint (Hunt, 1990; Pratt & Sanner, 1996). But the supination in the transversotarsal joint unlocks the forefoot and in that it worsens the forefoot's resistance to applied load

in the midstance phase of the support and taking off phases. The foot medial curve collapses while loaded, which clinically manifests itself by showing a prominent difference in the height of the medial curve of the foot arch while loaded and unloaded. Rearfoot pronation remains throughout the whole support phase and through the initiation of the foot heel taking off. It corresponds with higher CSI in our test subjects. In rigid forefoot valgus, the compensatory supination along the longitudinal axis of transversotarsal joint does not occur. To achieve the situation that the whole area of the forefoot has contact with the ground, the compensatory inversion/supination of calcaneus (Hunt, 1990; Pratt & Sanner, 1996) with talus dorsiflexion and adduction (in transversal level) is needed. The lateral edge of the foot is overloaded when (among others, because of the lower ability of a rigid structure to absorb the load at the time). In gait cycle analysis, the rearfoot supination in heel contact is evident (sometimes even before the heel reaches the ground) and the medial curve of the foot arch is accented both when loaded and unloaded. In our test group, the subjects with this subtype had the lowest average values of CSI, ergo the lowest longitudinal arch.

CONCLUSION

The obtained results support our assumptions about foot arch height differences among individual functional foot types and subtypes. Compensated (resp. flexible) subtypes have lower longitudinal arches than uncompensated (resp. rigid) subtypes, which finding correlates with previously published kinesiological articles (Hunt, 1990; Magee, 1992; Pratt & Sanner, 1996; Valmassy, 1996; Vařeka & Vařeková, 2003, 2005). Gender influence is negligible. Footprint analysis can to a certain extent help to estimate the level of compensation or flexibility in individual functional foot types. Footprint evaluation cannot by itself replace a personal and physical examination by an examiner who is well acquainted with foot functional anatomy and kinesiology. For example a descriptive diagnosis of flat foot based on footprints cannot differentiate between compensated subtypes of rearfoot/forefoot varus and the flexible forefoot valgus. The situation is similar in the field of uncompensated (resp. rigid) subtypes. Also, the middle values of CSI can indicate not only a normal foot but also partially compensated (resp. semiflexible) subtypes. The ways of compensatory orthoses are then different (Pratt & Sanner, 1996; Valmassy, 1996; Vařeka & Vařeková, 2005) and their unsuitable application could lead to problem accentuation.

REFERENCES

- Cavanagh, P. R., Rodgers, M. M., & Ibiashi, A. (1987). Pressure distribution under symptom - free feet during barefoot standing. *Foot Ankle*, 7(5), 262-276.
- Henning, E. M., & Milani, T. L. (1993). The tripod support of the foot: An analysis of pressure distribution under static and dynamic loading. *Z. Orthop. Ihre Grenzgeb.*, 131(3), 279-284.
- Hunt, G. C. (1990). Examination of lower extremity dysfunction. In J. A. Gould (Ed.), *Orthopaedic and sports physical therapy* (2nd ed.). St. Louis: Mosby.
- Klementa, J. (1987). *Somatometrie nohy. Frekvence některých ortopedických vad z hlediska praktického využití v lékařství, školství a ergonomii*. Praha: SPN.
- Maes, R., Andrianne, Y., & Burny, B. (2004). Retrospective study of the correlation between foot print parameters and the Djian-Annonier angle for studying the plantar vault: Results in 158 feet. *J. Bone Joint Surg.*, 86, 35.
- Magee, D. J. (1992). *Orthopaedic physical assessment* (2nd ed.). Philadelphia: W. B. Saunders.
- Mathieson, I., Upton, D., & Prior, T. (2004). Examining the validity of selected measures of foot type: A preliminary study. *J. Am. Podiatr. Med. Assoc.*, 94(3), 275-281.
- McPoil, T. G., Jr., & Brocato, R. S. (1990). The foot and ankle: Biomechanical evaluation and treatment. In J. A. Gould (Ed.), *Orthopaedic and sports physical therapy* (2nd ed.) (pp. 293-321). St. Louis: Mosby.
- Pratt, D. J., & Sanner, W. H. (1996). Paediatric foot orthoses. *The Foot*, 6(3), 99-111.
- Roy, K. J. (1988). Force, pressure and motion measurements in the foot current concepts. *Clin. Podiatr. Med. Surg.*, 5(3), 491-508.
- Scherer, P. R., & Morris, J. L. (1996). The classification of human foot types, abnormal foot function and pathology. In R. L. Valmassy (Ed.), *Clinical biomechanics of the lower extremities* (pp. 59-84). St. Louis: Mosby.
- Sutherland, Ch. C., Jr. (1996). Gait evaluation in clinical biomechanics. In R. L. Valmassy (Ed.), *Clinical biomechanics of the lower extremities* (pp. 59-84). St. Louis: Mosby.
- Valmassy, R. L. (1996). Pathomechanics of lower extremity function. In R. L. Valmassy (Ed.), *Clinical biomechanics of the lower extremities* (pp. 59-84). St. Louis: Mosby.
- Vařeka, I. (2003). Dynamický model „tříbodové“ opory nohy. *Pohybový systém*, 10(3, 4), 193-198.
- Vařeka, I., & Vařeková, R. (2003). Klinická typologie nohy. *Rehabil. fyz. lék.*, 10(3), 94-102.
- Vařeka, I., & Vařeková, R. (2005). Patokineziologie nohy a funkční ortézování. *Rehabil. fyz. lék.*, 12(4), 155-166.
- Xarchas, K. C., & Tsolakidis, G. F. (2004). Galen: Author of the first flatfoot description. *J. Am. Podiatr. Med. Assoc.* 94(5), 508-509.

**VÝŠKA PODÉLNÉ NOŽNÍ KLENBY
STANOVENÁ METODOU CHIPPAUX-ŠMÍŘÁK
U KOMPENZOVANÝCH
A NEKOMPENZOVANÝCH TYPŮ NOHY
DLE ROOTA
(Souhrn anglického textu)**

Je známo, že funkční typy a subtypy nohy dle Roota se liší mimo jiné i výškou nožní klenby při zatížení. Cílem této práce bylo porovnat výšku podélné nožní klenby u funkčních (sub)typů nohy dle Roota pomocí Chippaux-Šmířáková indexu (CSI). Soubor tvořilo 141 žen (17-85 let, $x = 58,8$, $SD = 12$) a 87 mužů (22-86 let, $x = 58,7$, $SD = 11,91$) převážně středního a vyššího věku. Jeden vyšetřující stanovil u všech probandů funkční typ a subtyp nohy - varozní zánoží kompenzované (RFvarC), částečně kompenzovaná (RFvarP) a nekompensovaná (RFvarN), varozní předonoží kompenzované (FFvarC), částečně kompenzované (FFvarP) a nekompensované (FFvarN), valgozní předonoží flexibilní (FFvalgF), semiflexibilní (FFvalgS) a rigidní (FFvalgR) a neutrální typ (N). Druhý vyšetřující zhodnotil všechny plantogramy a stanovil CSI. Na základě průměrné hodnoty CSI bylo stanoveno pořadí a statistická významnost zjištěných rozdílů byla testována pomocí ANOVA a post-hoc Fisherova LSD testu. Výsledky ukázaly, že funkční subtypy lze s vysokou mírou statistické pravděpodobnosti rozdělit do 2 krajních skupin. Na jedné straně spektra leží subtypy s vysokou hodnotou CSI (tedy nižší podélnou klenbou), kompenzované, resp. flexibilní subtypy. Na opačné pravé straně spektra leží nekompensované, resp. rigidní subtypy s nízkou hodnotou CSI. Ve střední části spektra leží přechodné subtypy. Neutrální funkční typ lze zařadit do střední skupiny, spíše k levé straně. Vliv pohlaví je zanedbatelný. Výsledky tak potvrdily předpoklad o rozdílech mezi funkčními (sub)typy ve výšce podélné nožní klenby při zatížení. Stanovení výšky podélné klenby nohy pomocí plantogramu může pomoci při odhadu stupně kompenzace či flexibility jednotlivých funkčních typů. Samo o sobě však nemůže nahradit vlastní aspekci a fyzikální vyšetření nohy vyšetřujícím, který je dobře seznámen s funkční anatomii a kineziologií.

Klíčová slova: varozní zánoží, varozní předonoží, valgozní předonoží, index Chippaux-Šmířák.

MUDr. Ivan Vařeka, Ph.D.

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

Education and previous work experience

1987 – graduated on Faculty of Medicine, Palacký University, Olomouc, Czech Republic.

1990 – postgraduate diploma in internal medicine.

1994 – diploma in myoskeletal medicine.

1995 – postgraduate diploma in physiotherapy, balneology and rehabilitation medicine.

2002 – certificate in rehabilitation medicine – postgraduate training course – Tel Aviv University, Israel.

2005 – Ph.D. thesis (Postural function of the lower extremity – influence of the knee flexion on the subtalar joint position in closed kinematic chain).

Work experience

1987–1990 – Medical department, District hospital, Krnov, Czech Republic – PRHO.

1990–1992 – The 1st clinic of internal medicine, Faculty hospital, Olomouc, Czech Republic – PRHO-SHO registrar.

1992–cont. – Department of physiotherapy, Faculty of Physical Culture, Palacký University, Olomouc, Czech Republic – lecturer (ass. prof.) – kinesiology, physical therapy, internal medicine.

1992–2002 – RRR centrum (centrum for treatment of pain and movement disorders), Olomouc, Czech Republic – medical assistant.

1996–1998 – RL corpus (centre for treatment of children movements disorders with Vojta's method), Olomouc, Czech Republic – SpR consultant.

2001 (3 months) – Department of orthopaedic rehabilitation, Chaim Sheba Medical Centre, Tel Hashomer (Tel Aviv), Israel – trainee.

2001–cont. – Luhačovice Spa, Luhačovice, Czech Republic – consultant.

First-line publications

Vařeka, I., & Dvořák, R. (1999). Ontogenesis of human motor as the ability to control the position of centre of mass. *Rehabilitace a fyzikální lékařství*, 6(3), 84–85.

Vařeka, I., & Dvořák, R. (2001). The postural model of chain reaction in functional disorders at the locomotor system. *Rehabilitace a fyzikální lékařství*, 8(1), 33–37.

Vařeka, I., & Vařeková, R. (2003). The clinical typology of the foot. *Rehabilitace a fyzikální lékařství*, 10(3), 94–102.

Vařeka, I. (2003). The dynamic model of “tripod” foot support. *Pohybové ústrojí*, 10(3, 4), 193–198, 233–239.

Vařeka, I. (2004). Subtalar joint pronation/eversion induced by knee flexion in closed kinematic chain. *Rehabilitace a fyzikální lékařství*, 11(4), 163–168.

Vařeka, I., & Šiška, E. (2005). Laterality – the interdisciplinary problem. *Československá psychologie*, 49(3), 237–249.

Vařeka, I., & Vařeková, R. (2005). The pathokinesiology of the foot and functional orthoses. *Rehabilitace a fyzikální lékařství*, 12(4), 109–111.

Vařeka, I. (2006). Interpretation of the course of motor development revisited – the newborn period and holokinetic stage. *Rehabilitace a fyzikální lékařství*, 13(2), 74–81.

Vařeka, I. (2006). Interpretation of the course of motor development revisited – from monokinetic stage up to toddler period. *Rehabilitace a fyzikální lékařství*, 13(2), 82–91.

THE SIGNIFICANCE OF SENSORIMOTOR RESPONSE COMPONENTS AND EMG SIGNALS DEPENDING ON STIMULI TYPE IN FENCING

Zbigniew Borysiuk

Faculty of Physical Education and Physiotherapy, Opole University of Technology, Opole, Poland

Submitted in January, 2008

The purpose of the present study was to examine reaction time, movement time (MT) and electromyography signals under conditions of tactile, acoustic and visual stimulation. Two groups of subjects took part in the study – one consisting of advanced fencers ($n = 12$, average age 22.3) having practiced fencing for an average of 8.3 years; and the other consisting of novice fencers ($n = 15$, average age 14.8) having practiced fencing for an average of 2.8 years. The research tool applied in the study was an innovative system of surface electromyography with peripheral equipment that enabled participants' reactions to tactile, audio and visual stimulation to be recorded. The system made it possible to record RT and MT separately. The subjects were exposed to forty five stimuli in a randomized manner for each type of stimulation. The tested fencers responded fastest to tactile stimuli, then to acoustic stimuli, and in a much slower way to visual stimuli ($p < 0.01$). The advanced fencers exhibited significantly lower values of RT, MT, and EMG in comparison with the novice fencers. Both groups exhibited a decrease in the EMG signal value during the tactile, acoustic and visual stimulation trials, supporting the hypothesis. A slight coincidence of EMG signal curves was also observed in the visual stimuli test. It can be concluded that visual perception lowers muscle tension in novice fencers ($p < 0.050$).

Keywords: Surface electromyography, fencing, reaction time, tactile stimuli.

INTRODUCTION

Apart from assessment of movement precision, another fundamental type of evaluation of motor behavior is measurement of sensor-motor responses, depending on the type of stimuli. It is assumed that an individual who processes information faster in the course of time is more efficient in many types of motor tasks. Reaction time (RT) and movement time (MT) are the basic measures (ms) of the speed of information processes (Schmidt, 1991).

In terms of the training process one needs to take account of the significance of the dominant stimuli characteristic of a particular sport, such as reactions to visual, tactile and acoustic stimuli (Czajkowski, 2001). Quick perception and prompt identification of acoustic stimuli play a significant role in athletic running events, swimming and skating (Starkes & Ericsson, 2003). Combat sports (such as fencing, boxing, and karate) feature a number of requirements as far as tactile and visual perception is concerned. In fencing in particular, apart from the obvious significance of reactions to visual stimuli, responses to the opponent's blade strikes (so called iron sensing) are also vital. What is more, acoustic effects are also important to some extent in fencing, as the fencer's step rhythm enables assessment of the distance between the contestants and determines the choice of footwork techniques (Lukovich, 1986).

RT can be defined as an interval between the appearance of a stimulus (e.g. visual stimulus) and the first bioelectrical muscle activity (Kelso, 1995). MT is an interval between the registered muscle activity and the completed movement. Thus it became necessary to design a device that could examine RT and MT separately along with the EMG signal. As we know, most movement reactions in real sport are made in a repetitive sequence manner, and thus a system able to register such movements was developed. For this purpose, the threshold of electromyography signal detection was established. This was necessary as empirical studies indicated that subjects often tensed their muscles excessively before testing, which caused a failure in the registration system (Borysiuk, 2000).

Studies of responses to stimulation in sport have been carried out by Williams and Grant (1999) and Abernethy (1996), who suggest that the RT to (receptive tactile) stimulation falls between 90 and 130 ms, to acoustic stimuli from 20 to 50 ms, and to light signals from 180 to 200 ms. Earlier studies examining different kinds of fencers' RT reached similar conclusions (Tyszler & Tyszler, 1995), and also there was also a finding that advanced athletes displayed a considerably shorter RT in their responses to visual stimuli. The Borysiuk's and Zmarzly's (2005) study of physically active students using the surface electromyography (sEMG) system showed that RT to tactile stimuli (RTT) was about

20 ms shorter than RT to acoustic stimuli (RTA), and about 80 ms shorter in RT to visual stimuli (RTV). An innovative system of information registration was used in this research, in conjunction with sEMG (De Luca, 1997). This new approach was motivated by the need to separate data about information processes taking place in the central nervous system (RT), from the movement itself (MT).

The following research questions were formulated:

1. Does the type of stimulation influence RT, MT and EMG signal values in advanced and novice fencers?
2. How significantly do the parameters of information processes differ in advanced and novice fencers?

The adopted hypothesis predicted that the RT, MT and EMG parameters differed considerably depending on the type of stimulation, and that they were significantly reduced in the advanced fencers.

Thanks to application of the beginner expert paradigm, certain proposals can be suggested to fencers. The differences in RT, MT and EMG can serve as a database for development of motor habits, understood as sensor-motor responses to tactile, acoustic and visual stimuli.

METHODS

Participants

The participants were divided into two groups. The group of advanced fencers ($n = 12$, mean age 22.3) consisted of athletes who had been actively practicing fencing for a mean of 8.3 years. The group of novice fencers ($n = 15$, mean age 14.8) consisted of athletes who had been practicing fencing for a mean of 2.8 years.

The study was preceded by numerous piloting studies, which made it possible to choose the most optimal methods of measurement. The range and methodology of the experiment gained the approval of the lead

author's institute's Bioethics commission of scientific research (13. 4. 2006).

Instrumentation

From the standpoint of physical culture sciences, i. e. muscle physiology and psychomotor reactions, the system of surface electromyography (sEMG) seems to be the most useful. Following De Luca (1997) three types of sEMG application can be distinguished:

- establishment of the muscle activation time, i. e. the start and finish of muscle stimulation,
- assessment of muscle strength,
- establishment of the muscle fatigue index through analysis of the spectrum of signal frequency.

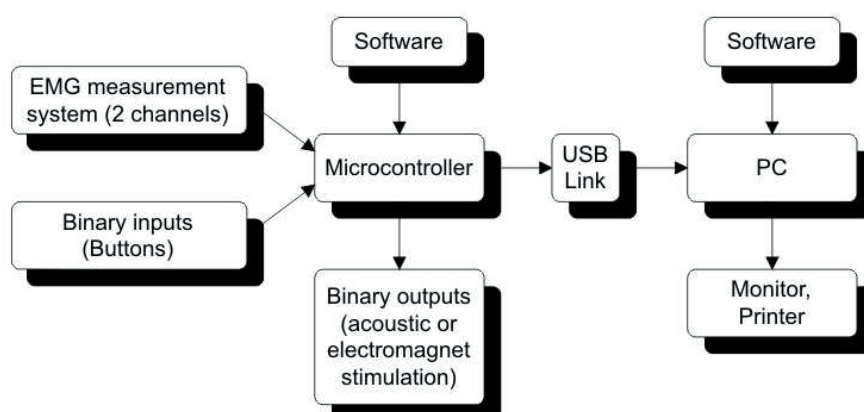
The first use of sEMG, i. e. setting the muscle activation time, can be also employed in diagnostics of information processes. This innovative application would necessitate a separate analysis of parameters of information processes in the central nervous system, interpreted as reaction time (RT) and movement time (MT). RT is the interval between the occurrence of the stimulus (e.g. visual) and the first bioelectrical activity of the muscle. MT is the interval between the registered muscle activity and the completion of movement. It would be necessary to design a device capable of calculating these parameters as well as the value of muscle activation (μV).

Measurement system

The measurement system consists of the analogue and digital parts (Borysiuk & Zmarzly, 2006). Fig. 1 presents the respective flow chart. The analogue part allows pre-amplification and filtering of the EMG signal. The signal is then digitalized and transmitted to the microprocessor. The microprocessor input is equipped with the switching circuit (buttons). The applied software allows synchronizing measurement samples, digital prefiltering and generation of data transfer protocol. The data is transferred with the aid of USB 2.0 (Universal

Fig. 1

Flow chart of the measurement system



Serial Bus). The digital signal representing the EMG voltage is sent to the PC. The software allows detection of the latency time, motor reaction time and synchronization with the visual impulses. Moreover, the PC collects data and studied parameters and the subject's characteristics and places them into a database.

PC software

The software consists of modules responsible for data acquisition, signal processing, setting the signal parameters and visualization and storage of measurement results. The data transfer module ensures the transfer of synchronic data representing the measured EMG signal. The data is processed, digitally filtered and buffered. A respective module determines the measurement sequence consisting of cyclic light impulses in a specific color. The number of impulses and intervals between them can be regulated in a wide spectrum. There is a possibility of random timing. Furthermore, the sequence may include interfering impulses in different colors and quantity. On the basis of the time difference between the occurrence of the light impulse in a specific color and the signal of muscle activation, the motor reaction time and latency time are detected. The time course of the EMG signal, respective time intervals and the voltage range during reaction are visualized during measurement. At the same time respective characteristics are being generated. After the measurement the results can be stored in a database or saved as graphic files (JPG).

Testing station with peripheral devices

The testing station consists of a PC and an electromyograph connected to two pairs of electrodes and the reference electrode through binary outlets. The electromyograph is operated from the control panel. Since the computer screen can emit only visual stimuli the testing station was also equipped with a loudspeaker emitting acoustic signals and an electromagnet generating tactile stimuli (Fig. 2).

Fig. 2

The subject is waiting for a tactile signal (an electromagnet bolt hits against the palm)



Procedures

The participants responded to singular tactile, acoustic and visual stimuli. Their responses were recorded as simple reactions classified into different types. During the study three test trials were carried out in which the sEMG system emitted 45 tactile, acoustic and visual stimuli. The three trials were separated by two ten minute breaks, where were used to avoid sensor-motor facilitation and thus to obtain more objective results. RT, MT and EMG were registered in all trials:

1. In the tactile stimuli test a computer assisted electromagnet was used. The electromagnet bolt was placed in the plate on which the subject's palm of his/her dominant hand rested. After the bolt hit against the palm, the subject pressed the button with his/her fingers, covering a distance of 35 mm.
2. The acoustic signal was emitted by a speaker connected to the EMG apparatus. The subject pressed the panel button following each stimulus in the same way as in the tactile stimuli test.
3. The visual stimulus was displayed on the computer screen as a red circle taking up about a quarter of the screen. Immediately after noticing the signal the participants had to press the button in the same way as in the previous tests.

In all the trials, time intervals in stimuli emission were set at random between 1 and 5 seconds (Fig. 3).

Statistical analysis

The conformity of results with the normal distribution was examined. Friedman's ANOVA was chosen as a nonparametric test as this criterion was not satisfied. A t-test for dependent variables was chosen for the analysis of the subjects' internal structure. The inter group analysis results were represented graphically by way of unweighted means.

RESULTS

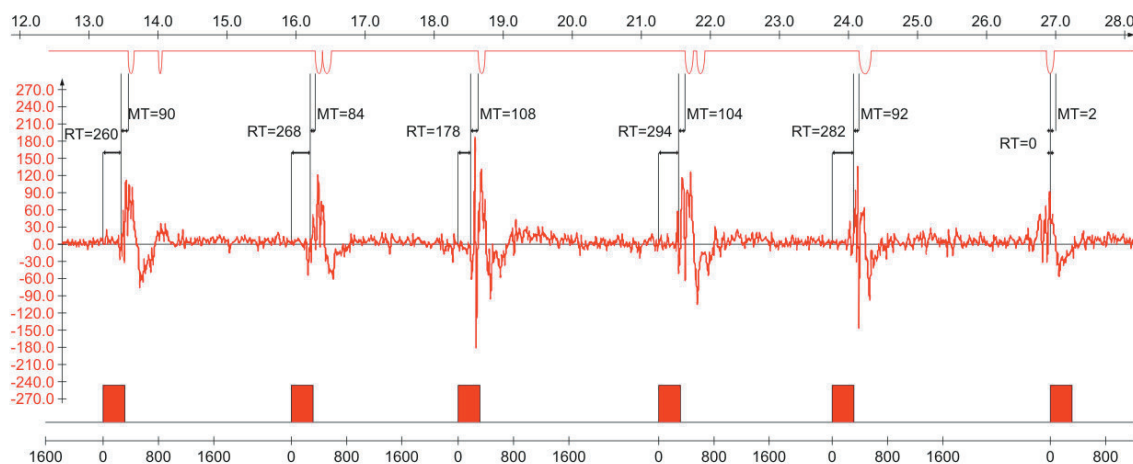
The system registered RT, MT and EMG to tactile stimuli (RTT, MTT, EMGT); acoustic stimuli (RTA, MTA, EMGA) and visual stimuli (RTV, MTV, EMGV).

Advanced fencers

The collected data confirmed the assumption that the fencers achieved the best results in reaction to tactile stimuli by reducing RT for about 21 ms in their responses to acoustic stimuli and 75 ms in their responses to visual stimuli (TABLE 1).

The t-test for dependent variables confirmed significant differences between the three indices of reaction time: RTV v. RTT ($p < 0.001$), RTV v. RTA ($p < 0.001$) and RTT v. RTA ($p < 0.021$). There were no significant

Fig. 3
EMG signal curve with RT and MT marked values



differences in the MT parameters between 214 and 221 ms. The level of statistical significance for MT of the three kinds of stimulation amounted to MTV v. MTT ($p < 0.819$), MTT v. MTA ($p < 0.698$), MTA v. MTV ($p < 0.601$), respectively. The obtained results were similar as the subjects had to cover the same distance (35 mm) using their fingers. The significant time differences in RT in the three trials had no influence on MT fluctuation.

The collected data point to a significant variability of EMG parameters (TABLE 2). The highest values concerned the differences between EMGA and EMGV ($p < 0.002$) and between EMGT and EMGV ($p < 0.003$). As far as the differences in EMG signals to tactile stimuli and acoustic stimuli are concerned, the level of significance was $p < 0.048$. The results showed that the tactile and acoustic stimulation caused a lower EMG signal. They indicate that the participants' response to visual signals causes a decrease of muscle tension without effective RT reduction.

TABLE 1
Variability indicators of RT, MT depending on the type of stimuli with advanced fencers

Variable	Average rank	Sum of ranks	Average	Standard deviation
RTT	1.250	15.000	125.250	24.110
MTT	4.833	58.000	219.833	33.108
RTA	2.1667	26.000	146.166	29.941
MTA	4.250	51.000	213.666	52.908
RTV	3.416	41.000	200.166	28.856
MTV	5.083	61.000	220.833	20.818

TABLE 2
Variability of EMG signal on tactile, acoustic and visual stimulation with advanced fencers

Variable	Average rank	Sum of ranks	Average	Standard deviation
EMGT	2.750	33.000	716.833	196.081
EMGA	2.000	24.000	585.167	52.958
EMGV	1.250	15.000	512.333	61.705

Novice fencers

The collected data confirmed the assumption that in reactions to different stimuli novice fencers achieved the best (the lowest) RT values, ie: RTT, RTA and RTV. The following differences were noted: RTV v. RTT ($p < 0.001$) and RTV v. RTA ($p < 0.001$). There were no significant differences between RTA and RTT ($p < 0.378$). An analysis of mutual dependencies for MT did not show any significant differences in particular trials (TABLE 3).

TABLE 3
Variability indicators of RT, MT depending on the type of stimuli with novice fencers

Variable	Average rank	Sum of ranks	Average	Standard deviation
RTT	1.733	26.000	149.067	28.255
MTT	4.400	66.000	225.733	31.263
RTA	1.600	24.000	164.267	45.731
MTA	3.533	53.000	217.333	55.068
RTV	5.467	82.000	243.733	42.568
MTV	4.267	64.000	232.067	51.149

Significant differences were noted in the value of the EMG signal for the three kinds of stimulation. A similar decrease in the EMG signal value was noticed in the novice fencers as well as in the advanced fencers (TABLE 4). Bioelectrical muscle tension expressed by a decreasing EMG value displayed a linear tendency: EMGT v. EMGA ($p < 0.001$), EMGT v. EMGV ($p < 0.001$) and EMGA v. EMGV ($p < 0.004$).

TABLE 4

Variability of EMG signal on tactile, acoustic and visual stimulation with novice fencers

Variable	Average rank	Sum of ranks	Average	Standard deviation
EMGT	2.933	44.000	904.600	153.677
EMGA	1.867	28.000	763.667	99.139
EMGV	1.200	18.000	603.600	142.931

EMG - electromyography

EMGA - electromyography acoustic

EMGT - electromyography tactile

EMGV - electromyography visual

MT - movement time

MTA - movement time acoustic

MTT - movement time tactile

MTV - movement time visual

RT - reaction time

RTA - reaction time acoustic

RTT - reaction time tactile

RTV - reaction time visual

Comparative analysis of parameters of different kinds of stimulation for advanced and novice fencers using a t-test with a separate variance assessment

In the cases of each of these three kinds of stimulation one can observe significant RT differences as far as tactile ($p < 0.029$) and visual ($p < 0.057$) indices between the tested groups were concerned. It is vital that the greatest differences concerned most RT to tactile stimuli; slight differences were recorded in responses to acoustic stimuli ($p < 0.249$). A characteristic tendency is the lack of significant differences concerning MT in the three trials. This suggests that novice athletes may compensate for delays in processing sensual information (expressed by RT) with their speed of movement (expressed by MT) (Fig. 4).

Both groups featured an expected drop in the EMG signal value in the tactile stimuli trial, acoustic stimuli trial and visual stimulation trial. A slight coincidence of EMG signal curves could also be observed in the visual stimuli test. This may suggest that visual perception lowers the novice fencers' muscle tension ($p < 0.050$) (Fig. 5).

DISCUSSION

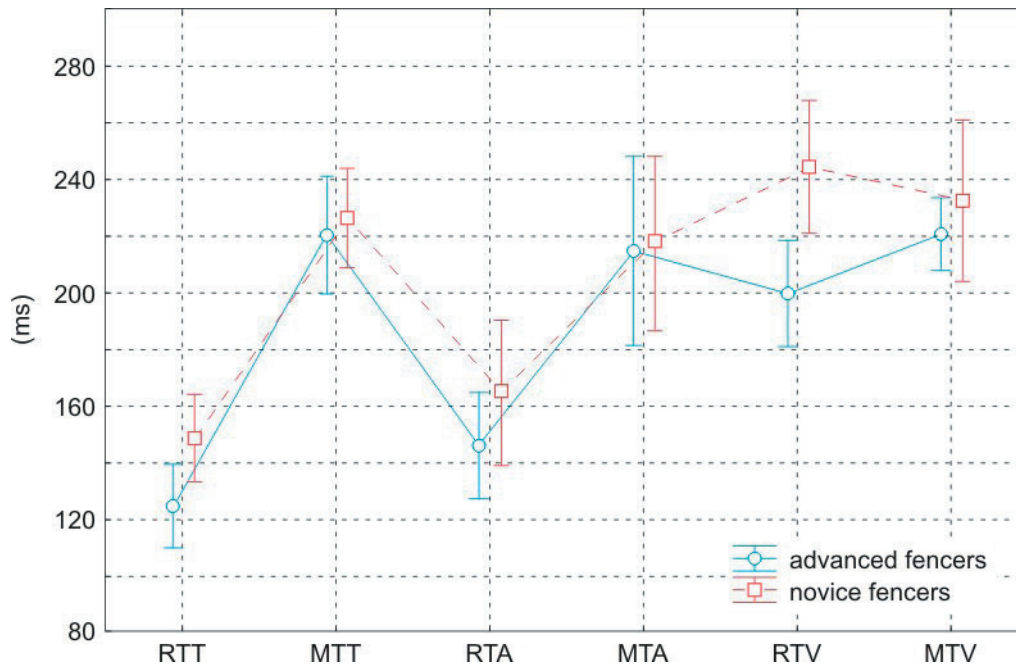
The research was aimed at estimation of reaction time (RT) and movement time (MT) in fencing. According to fencing experts, some elite fencers feature instant RT and MT. There are, however, some elite fencers whose pace of information processing is very fast, but the performance of their movements is relatively slow albeit accurate (Lukovich, 2003). The study used three types of stimulation (tactile, acoustic, visual) considering the fact that success in fencing, unlike in many other combat sports, depends on the time of response to these three types of stimulation. An innovative EMG system not only allowed registration of muscle tone during the tests but also registration of information from any number of repeated movements.

The authors used experiments - considering the specificity of fencing responses - measuring simple reaction time. It was assumed that a number of motor habits in sport would appear in the form of single sensor-motor responses (Poulton, 1957), (Czajkowski, 2005). For instance, a simple reaction can be a response with a trained movement to a known stimulus. In fencing, simple reaction takes place when a fencer responds with a thrust or a parry to a familiar stimulus (coach's signal) (Borysiuk, 2006). What is unknown is when exactly the coach would make the movement. This model of simple reaction is the basis of one of the most widely applied training methods in combat sports, i. e. exercising a given action in response to the coach's signal (Salczenko, 1980). That is why the stimuli in the present study were emitted at random in the range between 1 and 5 seconds.

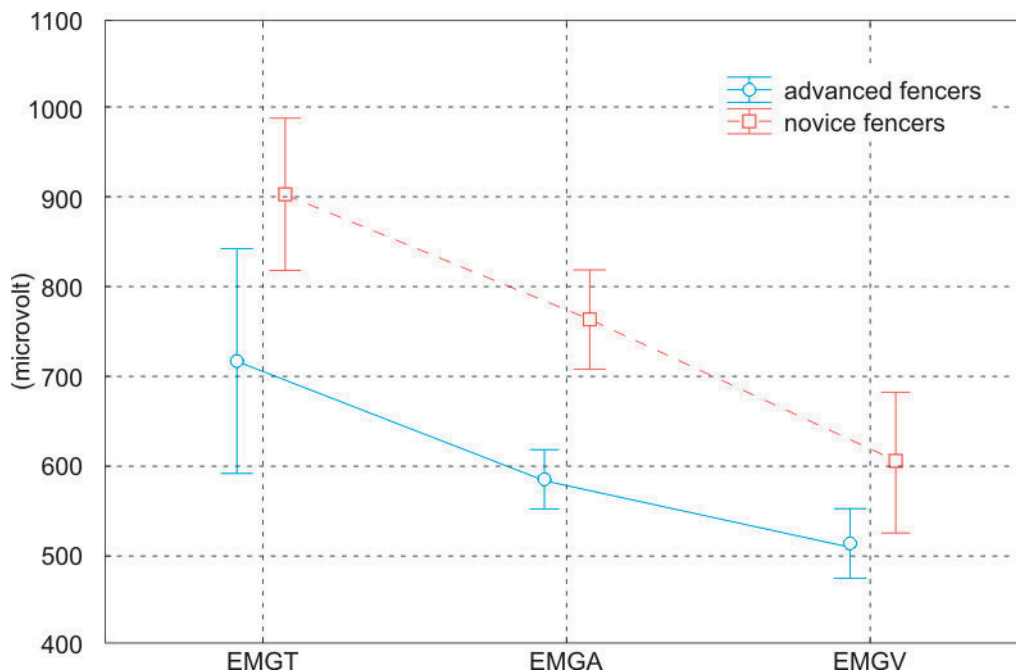
The analysis of the study results confirmed the initial hypothesis about different reaction times, depending on the type of stimulation (Kandel et al., 2000). The responses to tactile and acoustic stimuli were significantly faster than responses to visual stimuli. These differences were associated with neuronal transduction. It is commonly asserted that reaction to visual stimuli is associated with a considerable number of synaptic links with the retina. It can be assumed that significantly faster reactions to tactile stimuli are due to the large concentration of receptors in the finger pad (about 2000) as well as due to the system of conduction of impulses and the speed of stimulation of cortical areas of somatic sensation (Enoka, 2002). Finally, the efficiency of the auditory system depends on the receptors in the spiral organ of the middle ear cochlea. The impulses are conducted by sensory neurons in the auditory canal to the temporal lobes of cerebral cortex. According to Welford (1980) acoustic stimuli cover this distance in 10-15 ms.

Fig. 4

RT and MT profiles as dependent variables for advanced and novice fencers

**Fig. 5**

EMG signal profiles as dependent variables for advanced and novice fencers



The obtained results are in accordance with the results of Abernethy, Woods and Parks (1999) of their study of athletes. However, they are slightly different from the data of Welford (1986) and Luce (1986), who studied young people featuring an average level of physical activity. According to their findings, RT to acoustic

stimuli amounted from 140 to 160 ms, and it was shorter from 20 to 40 ms in comparison with responses to tactile stimuli. The aforementioned differences indicate that fencing training affects the speed of information processing in each kind of stimulation. At the same time, the use of a fencing weapon had a decisive influ-

ence on the improvement of reactions to tactile stimuli, which is of crucial significance in fencing.

The reaction time profiles of novice and expert fencers revealed significant differences in RT to acoustic, tactile and visual stimuli. Characteristically, the reactions to acoustic stimuli revealed no significant differences. One may, therefore, conclude that reactions to tactile and visual stimuli can be effectively exercised. A similar tendency was observed in movement times of sensor-motor reactions to the three types of stimuli. It shows that one's predispositions to perform fast movements appear at the early stages of training and can be further developed only to a limited extent. It can be claimed that the type of stimulation, as opposed to reaction time (RT), does not significantly affect the variability of movement time (MT) parameters. The greatest differences between RT and MT, between experts and beginners, were, however, noted in reactions to visual stimuli. This shows that fencing training greatly reduces the information processing time in reaction to visual stimulation. A long term fencing training program, held under conditions of permanent time shortage, greatly affects the speed of the constitutive information processes (identification of stimuli, choice of response and reaction programming) as attributes of the decision making speed. The effectiveness of the information processing speed is related to the development of cognitive processes such as analysis of initial signals, concentration and divisibility of attention. The advanced fencers' ability to produce a fast reaction conditions the feeling of pace, which is an important part of fencing shock tactics.

Significant differences were observed between EMG values, which were much higher in the novice fencers in their reactions to tactile, acoustic and visual stimuli. Thus, the higher capacity of expert fencers reduces the tension of muscles involved in performance of the test. This relationship has been confirmed by many combat sports experts, e.g. Czajkowski (2005), Sadowski (1999).

The tactile system delivers information gathered in tactile receptors (Meisner's and Rusffini corpuscles). Once the stimulation strength exceeds the threshold of activation of sensory nerves, the signals are activated and transmitted directly to the brain. In combat sports tactile perception plays a very important role next to visual perception. Eastern martial arts, boxing and fencing are contact sports in which the feedback about the strength and type of tactile stimuli determines the fighter's choice of sensor-motor responses. What is characteristic of the historical development of fencing technique is the fact that even the most basic fencing movements, including thrusts, in all kinds of fencing weapons, commence with the contact between the master's and student's blades. The master's release is a signal for action. Also acoustic stimulation is crucial for cognitive processes

in fencing as anticipatory perception of other stimuli. Acoustic information consists of such components as perception of the rhythm of movements, their frequency, timing and sound pitch and amplitude. The importance of hearing in sports involving artistic expression has been widely discussed in literature. In fencing (Szabo, 1977), (Czajkowski, 2001) footwork training is based on the feeling of rhythm relative to the concept of fencing pace. Losing the proper rhythm during offensive actions in the use of conventional weapons (saber, foil) usually ends in relinquishing the right of way and exposes fencers to defeat in particular bouts.

Visual perception serves as a framework for sound signals. In other words, visual memory is like a map demonstrating auditory expression relative to motor proprioception. It can be concluded that visual information is complementary information in the process of making and adjusting decisions (Evangelista, 2000; Lukovich, 2003).

CONCLUSION

1. Assuming that a study of sport mastery development for several years from the novice to the master level is not practically feasible in longitudinal research, an informative beginner expert paradigm was adopted (Schack, 2003).
2. The obtained results confirm other reports concerning fast processing of tactile and acoustic information as opposed to visual information in athletes and sedentary and moderately physically active students (Starkes & Ericsson, 2003).
3. The research shows that novice and expert fencers differ significantly in their times of sensor-motor responses to tactile and visual stimulation. The expert fencers' sensor-motor responses were significantly reduced in reaction time (RT), whereas non significant differences were observed in movement time (MT). The acoustic stimuli did not display any variability. These results prove that fencing training consisting of the application of blade work (parries and binds) in individual sessions with a coach, affects the development of perception skills and processing of tactile stimuli. The greatest differences were observed in the processing of visual information, which was decisively faster in the expert fencers.
4. Important conclusions can be drawn concerning the EMG signal, which reveals lower bioelectrical tension in expert fencers' muscles in the cases of these three types of stimulation. The expert fencers responded faster, however more economically and sensibly, without generating unnecessary bioelectric tension. The similarity between the tests and real fencing actions made the expert fencers reproduce the motor patterns in the tests almost automatically.

5. The present research reveals differences in the quality, structure and organization of motor patterns in performing motor tasks among expert and novice fencers. These differences are associated with the formation of neuronal as well as central representations. At a high sports level their organization is multi-hierarchical allowing for the effectiveness and repeatability of responses which are determined by the spatial and temporal aspects of movement organization.

The research conclusions can be useful guidelines for coaches in their development of motor patterns during a long term perceptual training program, based on the concept of KR (knowledge of results) feedback which considers time as a variable affecting the organization of motor programs.

ACKNOWLEDGMENT

Thanks to Prof. Dariusz Zmarzly from the Laboratory of electrical engineering, automatic control and computer science of Opole University of Technology for their great support and technical assistance.

REFERENCES

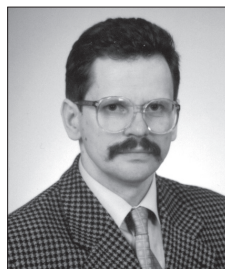
- Abernethy, B. (1996). Training the visual-perceptual skills of athletes: Insights from the study of motor expertise. *American Journal of Sports Medicine*, 24, 589–592.
- Abernethy, B., Wood, J. M., & Parks, S. (1999). Can the anticipatory skills of experts be learned by novices? *Research Quarterly for Exercise and Sport*, 70, 313–318.
- Borysiuk, Z. (2000). Factors determining sport performance level for fencers at the preliminary and championship stages of their training. *ECSS conference*, Jyvaskyla.
- Borysiuk, Z., & Zmarzly, D. (2005). Surface electromyography (sEMG) as a research tool of psychomotor reactions. *Annales Universitatis Mariae Curie-Skłodowska*, Lublin-Polonia.
- Czajkowski, Z. (2001). *Theory, practice and methodology in fencing. Advanced course for fencing coaches*. Katowice: AWF.
- Czajkowski, Z. (2005). *Understanding fencing: Unity and practice*. SKA Swordplay Books. NY: Staten Island.
- De Luca, C. J. (1997). The use of surface electromyography in biomechanics. *Journal of Applied Biomechanics*, 13, 135–163.
- De Luca, C. J. (2002). *Surface electromyography: Detection and recording*. DelSys In.
- Enoka, R. (2002). *Neuromechanics of human movement* (3rd ed.). Champaign, IL: Human Kinetics.
- Evangelista, N. (2000). *The inner game of fencing: Excellence in form, technique, strategy and spirit*. Illinois: Master's Press, Lincolnwood.
- Kandel, E. R., Schwarz, J. H., & Jessell, T. M. (2000). *Principles of neural science*. New York: McGraw-Hill.
- Kelso, J. (1995). *Dynamic patterns: The self organization of brain behavior*. Cambridge, MA: MIT Press.
- Luce, R. D. (1986). *Response times: Their role in inferring elementary mental organization*. New York: Oxford University Press.
- Lukovich, I. (1986). *Fencing*. Debrecen: Alfoldi Printing House.
- Lukovich, I. (2003). *Electric foil fencing: Advanced competitive training*. Staten Island, NY: SKA Swordplay Books.
- Poulton, E. C. (1957). On prediction in skilled movements. *Psychological Bulletin*, 54, 467–478.
- Roberts, G. C. (1992). *Motivation in sport and exercise*. Champaign, IL: Human Kinetics.
- Sadowski, J. (1999). Studies of selected elements of movement coordination in taekwondo athletes. *Rocz. Nauk. IWFis*, 5, 37–40.
- Salczenko, I. N. (1980). *Dwigazjelnyje wzajemodijestwi-ja sportsmienow*. Kijew: Zdorowje.
- Sanders, A. F. (1998). *Elements of human performance: Reaction processes and attention in human skill*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Schack, T. (2003). High speed scanning in movement based memory: Experimental studies in free climbing. *Journal of Sport & Exercise Psychology*, 25, 116–117.
- Schmidt, R. (1991). *Motor learning and performance*. Champaign, IL: Human Kinetics.
- Schmidt, R., & Wrisberg, C. (2004). *Motor learning and performance* (3rd ed.). Champaign, IL: Human Kinetics.
- Starkes, J. L., & Ericsson, K. A. (2003). *Expert performance in sports*. Champaign, IL: Human Kinetics.
- Szabo, L. (1977). *Fencing and the master*. Budapest: Corvina Kiado.
- Tyshler, D., & Tyshler, G. (1995). *Fencing*. Moscow: Physical Education and Science Press.
- Welford, A. (1980). Motor skill and aging. In C. Nadeau, W. Halliwell, K. Newell, & G. Roberts (Eds.), *Psychology of motor behavior in sport* (pp. 253–268).
- Welford, A. T. (1986). Choice reaction time: Basic concepts. In A. T. Welford (Ed.), *Reaction times* (pp. 73–128). New York: Academic Press.
- Williams, A. M., & Grant, A. (1999). Training perceptual skill in sport. *International Journal of Sport Psychology*, 30, 194–220.

**VÝZNAM KOMPONENTŮ
SENZORIMOTORICKÉ RESPONZE
A EMG SIGNÁLŮ
V ZÁVISLOSTI NA TYPU STIMULŮ PŘI ŠERMU
(Souhrn anglického textu)**

Cílem této studie bylo zkoumat reakční čas (RČ), pohybový čas (PČ) a elektromyografické signály za podmínek taktilní, akustické a vizuální stimulace. Studie se zúčastnily dvě skupiny osob – jedna zahrnovala pokročilé šermíře (n = 12, průměrný věk 22,3), kteří se šermu věnují průměrně 8,3 roku, druhá pak zahrnovala začínající šermíře (n = 15, průměrný věk 14,8), kteří se šermu věnují průměrně 2,8 roku. Výzkumným nástrojem užitým při této studii byl inovativní systém povrchové elektromyografie s periferním vybavením umožňujícím zaznamenat reakce účastníků na taktilní, akustickou a vizuální stimulaci. Systém umožňoval zaznamenávat zvláště RČ a PČ. Účastníci byli vystaveni čtyřiceti pěti náhodně voleným stimulům pro každý typ stimulace. Testování šermíři reagovali nejrychleji na taktilní stimuly, dále na akustické stimuly a teprve mnohem pomaleji na stimuly vizuální ($p < 0,01$). Zkušenější šermíři vykazovali ve srovnání se začínajícími šermíři významně nižší hodnoty RČ, PČ a EMG. Obě skupiny vykazovaly při taktilních, akustických a vizuálních testech sníženou hodnotu signálu EMG, což podporuje hypotézu. Při vizuálním stimulačním testu byla také pozorována mírná shoda signálních křivek EMG. Lze formulovat závěr, že vizuální percepce snižuje u začínajících šermířů muskulární napětí ($p < 0,050$).

Klíčová slova: povrchová elektromyografie, šerm, reakční čas, taktilní stimuly.

Dr. Zbigniew Borysiuk



Opole University of Technology
Faculty of Physical Education
and Physiotherapy
ul. Prószkowska 76
45 758 Opole
Poland

Education and previous work experience

Doctor of physical education science, graduated the Academy of Physical Education in Warsaw; doctor's dissertation at Academy of Physical Education in Katowice. Successfully links theory with practice as a coach of the National Polish fencing team. In 1993 he trained British fencers and gave lectures to instructors and coaches as a result of the agreement with the Scottish national fencing federation. His students have won the titles of the World Champion and European Champion of juniors. He conducted research in the human kinetics area and the influence of psychomotor factors on the effectiveness in combat sports. Member of European college of sport science and International association of sport kinetics. Close cooperation with Faculty of Human Kinetics at Technical University of Lisbon. The author of tens papers in motor control field, coaching and methodology of fencing published in Polish and foreign magazines and books.

First-line publications

- Borysiuk, Z. (2005). Analysis of changes in saber fencing after the introduction of electrical scoring apparatus. *Human Movement*, 6(2), 129–136.
- Borysiuk, Z. (2006). Complex evaluation of fencers predisposition in three stages of sport development. *Biology of Sport*, 23(1), 41–55.
- Borysiuk, Z. (2007). Time and spatial aspects of movement anticipation. *Biology of Sport*, 24(3), 285–295.
- Borysiuk, Z. (2008). Psychomotor reactions and expert opinions as factors of talent identification in fencing. In *Book of abstracts: 1st International congress on science and technology in fencing* (pp. 65–69). Barcelona.

LOAD INTENSITY IN VOLLEYBALL GAME LIKE DRILLS

Michal Lehnert, Pavel Stejskal, Pavel Háp, Miroslav Vavák*

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

**Faculty of Physical Education, Komenský University, Bratislava, Slovak Republic*

Submitted in December, 2007

The key problem of training in sports games is rightfully considered the relation between match performance and training load (Argaj, 2005; Bloomfield, Fricker, & Fitch, 1992; Dobrý & Semiginovský, 1988; Laurenčík, 2006; Reilly & Bangsbo, 1998; Tomajko, 2000). The training process in volleyball must result from the typical demands of match load, the specificities of players' specializations and their roles in the game system of a team, athletes' individual specificities and, at the same time, respect the trends of modern volleyball and the training process. Changing an intensive movement activity focused on performing specific tasks for particular game specializations during a relay lasting only a few seconds with relatively long time outs is regarded as a significant volleyball match load parameter (Aartrijk, 2000; Alberda, 1995; Baacke, 1994; Papageorgiou, 1999; Papegeorgiou & Timmer, 1990; Polglaze & Davson, 1992; Přidal & Zapletalová, 2003; Ureña, 2000; Zhang, 2000; Zimmermann, 1999).

Keywords: Heart rate, sports games, training control, training process.

In the current training process, complex game like drills and preparatory games requiring participation and the close cooperation of more players or the whole team respectively are preferred. Drills drawn in this way represent adaptation stimuli of complex character, which lead to an increase in effectiveness and game like situations' solution stability and which can also contribute to fitness development and maintenance. Effective load manipulation requires a perfect understanding of the used training means, which primarily holds for "key" drills of particular training periods. As one of the most approachable and reliable physiological indicators of inner load, the heart rate is considered (Bouchard, Shephard, & Stephens, 1994; De Van, Lacy, Cortez-Cooper, & Tanaka, 2005; Jeukendrup & Van Diemen, 1998; Neumann, Pfüchner, & Hottenrott, 2005; Pate, 1991; Süß, 2006).

We proceeded based on the above mentioned facts found as a result of our research, whose aim was to find out the level of load represented by verified preparatory games' versions and if the load in two repetitions of the same type of a preparatory game is similar.

METHODS

During the 2 one week competition microcycles, we observed 6 players of the SKUP Olomouc men's volleyball team (age 21.2 ± 1.6 years). Their resting heart rate ($\bar{x} = 49.0 \pm 3.0$ bpm) was measured by means of heart rate monitors before they entered their training

session. Using the Leger test (Multiple progressive shuttle run test) (Kovář, 1990; Novosad, Lehnert, & Frömel, 1994) we determined the players' maximum heart rate ($\bar{x} = 192.0 \pm 6.5$ bpm) one week before the preparatory games were included. During the observed training cycles the players took part in four training sessions with the content of the preparatory competitive game being 6 v. 6 - in the first week with rule modifications and in the second week it was done without the modifications. The games were recorded with a camera.

A preparatory competitive game, the relay, was started with a serve by one of two specified players, who regularly took turns in serving and did not participate in the game further. After the relay was finished, the coach threw another ball to the passing side. After four relays were played, the front line players exchanged their positions with the back row players. The passing team thus attacked in the same position four times after the serve pass and four times after passing the tossed ball. The passing team is given the advantage of the first attack, therefore the opponent is awarded by 2 points for each relay won. The game was played according to the rules of volleyball - the set was won by the team which first scores 25 points, the intervals between sets lasted for 2 minutes. During the training sessions, 9 sets were played (the actual time, i. e. without intervals of rest between sets, was 50:20 min. in the first measurement and 51:45 min. in the second measurement). The B preparatory game was played without rule modifications. The fifth one of 5 sets was played up to 15 points (the actual times were 66:45 min. and 62:30 min.). The tactics of

the attack combinations were the same and prearranged in both types of preparatory games.

The intensity of the inner load during the preparatory games was assessed by measuring the heart rate using "Polar Vantage" heart rate monitors (Terbizan, Dolezal, & Albano, 2002). To assess the load intensity, the actual playing time (the sum of the length of single sets and rest intervals between them) was measured. To formulate the intensity, we determined, by means of "Polar" software and video record the necessary. Information, which we entered into a set form onto which we recorded the number of attacks performed by particular players during a set. Before the training session the players recorded every movement activity longer than 15 minutes (any high intensity movement activity was forbidden during the period under consideration). They expressed themselves as to their currently felt fatigue and about sleeping as well (Pivnička, 2002).

RESULTS AND DISCUSSION

The inner load during the first and second repetition of the A preparatory game (TABLE 1) was evaluated through the use of average heart rate in the game (AHR) and maximal heart rate (HRmax) during the game. The average circulation load expressed in the percentage of a maximal heart rate determined by the Leger test (% HRmax) was calculated as well. The values of AHR found in this way represented 83.1% or 81.1% of a maximal heart rate as determined by the Leger test. From the results it is clear that the differences in values of controlled parameters were neither logically nor statistically significant. We can presume that typical volleyball game patterns express the considerable stability of the team game load. Comparison of particular average and maximal heart rate values during exercises in particular players enabled us to get data about differences in load caused by the realized exercises (TABLE 1). In

this respect we can state that there were considerable differences. Significant differences of AHR in the case of the first training session were found in players number 5 and 6, i.e. outside hitters (18 bpm and 13 bpm). The difference was above all caused by a higher number of hits during the first measurement, which results from these players' offensive activity record and game record analysis.

Also in the B preparatory game AHR and HRmax values in the first and second measurements differed minimally and were neither statistically nor logically significant (TABLE 2). The measured AHR values represented 76.9% and 74.8% of HRmax. However, the interindividual variability between the first and second measurements was considerable (1.2–16.4 bpm) with the biggest difference in the no.1 (diagonal) player. From whence it follows, among others, that it is very questionable to evaluate exercise's demandingness according to the HR average values of a whole team because individual circulation response and any particular player's game involvement can differ markedly. The video record shows that the differences in repetitions of training exercises in tested players were especially influenced by different game dynamics, the amount of activity participation, and other influences, which are typical for sports games and which can significantly modify the training load parameters.

In A and B preparatory games we counted the average values of AHR and CL from the first and second exercises and subsequently we compared the preparatory games (TABLE 3). With regard to the mentioned HR data we can state that the differences between the A and B preparatory games in AHR (12 bpm) and in ZC (7%) represent, in terms of load manipulation, a significant difference, whose statistical significance was confirmed in both cases (we also counted the values of the median which did not significantly differ from the arithmetic mean and therefore we consider these values to be characteristic enough).

TABLE 1

Preparatory game A – average and maximal heart rate values of tested players and verification of difference in significance in two repetitions (n = 6)

Indicator		Player						\bar{x}	SD	CL	Z
		1	2	3	4	5	6				
AHR	M1	181	150	144	155	167	160	159.5	12.04	83.1	.00
	M2	178	155	149	155	149	147	155.5	10.52	81.1	
HRmax	M1	192	166	168	169	186	178	176.5	9.76	92.0	.00
	M2	192	170	172	172	171	167	174.0	8.23	90.7	

Legend:

M1 – first measurement; M2 – second measurement; AHR – average heart rate; HRmax – maximal heart rate; \bar{x} – average value of a parameter in tested group; SD – standard deviation; CL – circulation load in % of maximal heart rate determined by Leger test; Z – Wilcoxon test criterion value

Statistically significant values ($p < 0.05$) are in bold characters.

TABLE 2

Preparatory game B – average and maximal heart rate values of tested players and verification of these differences' significance in two repetitions (n = 6)

Indicator		Player						\bar{x}	SD	CL	Z
		1	2	3	4	5	6				
AHR	M1	165	140	147	145	152	136	147.5	9.32	76.9	.41
	M2	149	141	142	151	149	129	143.5	7.48	74.8	
HRmax	M1	182	155	169	162	178	156	167.0	10.33	87.1	.00
	M2	169	157	169	170	177	157	166.5	7.25	86.8	

Legend:

M1 – first measurement; M2 – second measurement; AHR – average heart rate; HRmax – maximal heart rate; \bar{x} – average value of a parameter in tested group; SD – standard deviation; CL – circulation load in % of maximal heart rate determined by Leger test; Z – Wilcoxon test criterion value

Statistically significant values ($p < 0.05$) are in bold characters.

TABLE 3

Basic statistical characteristics of the parameters in view and verification of preparatory games A and B values in terms of the differences' significance (n = 6)

Parameter	Med	\bar{x}	SD	R	Z
AHR I	154.5	157.7	11.46	33.1	2.04
AHR II	146.1	145.4	8.66	25.1	
CL I	80.9	82.5	3.82	9.7	2.04
CL II	76.4	75.8	4.50	12.6	

Legend:

AHR I – average heart rate in A preparatory game; AHR II – average heart rate in B preparatory game; CL I – circulation load in % of maximal heart rate in preparatory game A; CL II – circulation load in % of maximal heart rate in preparatory game B; Med – median; \bar{x} – arithmetic mean; SD – standard deviation; R – range; Z – values of sign test criterion

Statistically significant values ($p < 0.05$) are in bold characters.

The cause of significant differences in load intensity was a different game content including a number of offensive and defensive actions realized by both teams. In some players we can assume that, based on quite high HR values, the A preparatory game stimulated anaerobic glycolysis and mobilized carbohydrate energy sources. Therefore it is obvious that break shortening and extension of load intervals during the preparatory game result in an increase of training efficiency, under the condition that there is also optimal recovery.

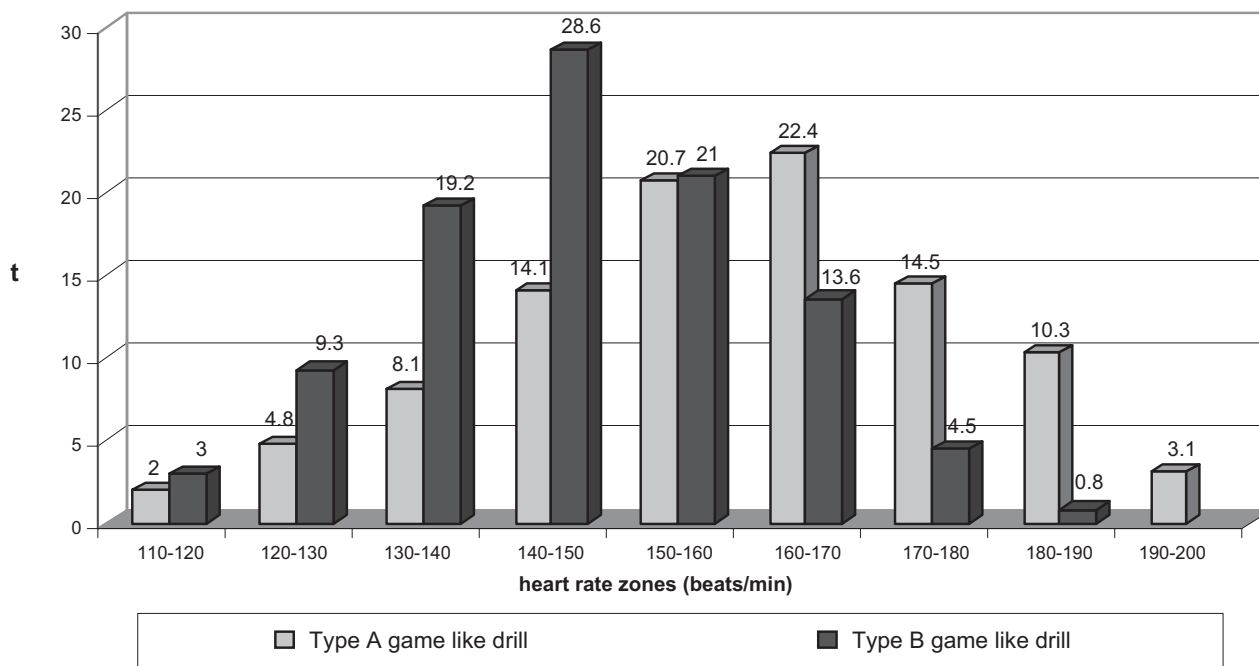
To complete the image of a circulation response to both types of preparatory games we can use the HR values' distribution in particular zones (Fig. 1). While in the B preparatory game, the lower HR zones' load dominated, the A preparatory game is represented distinctively more in HR zones higher than 160 bpm. Also from this picture it is possible to assume that in light of the intensity of the inner load, the A and B preparatory games represented two completely different stimuli and that a relay extension due to an additional ball toss in the A preparatory game resulted in a significant increase of the circulation load.

To specify the data about differences in particular players we counted average HR values of the players from both repetitions of preparatory games A and B.

From TABLE 4 it is obvious that in all tested persons we found higher values of AHR and CL in the A preparatory game but the difference was considerably diverse. From the tested group the biggest difference was found in players 1 and 6 (diagonal player and outside hitter). The video record shows that the difference was, in the first case, due to a higher participation of the diagonal player in offensive actions connected with locomotion to the attacking zone in back row positions. For a diagonal player it is the typical participation in offensive game combinations, which was emphasized in the preparatory game. Also in the case of an outside hitter, there was an expressive increase in the number of passes and net attacks. It is probable that due to a higher involvement of anaerobic glycolysis, this kind of load exhausts the player's muscle glycogen more than in the preparatory game without a change of rules. Thanks to the increased requirements of the A preparatory game we can assume its higher training effect if conditions allow optimal recovery.

Fig. 1

Average HR values distribution of the tested group in particular zones of preparatory games A and B



Legend:

t - drill time with average HR within particular HR zones (%)

TABLE 4

Comparison of preparatory games A and B - average HR values and circulation load in individuals

Player	pmm PG	AHR (CL)	SD	/d/
1	A	179.5 (89.5)	4.44	22.6
	B	157.2 (79.2)	8.51	
2	A	152.7 (81.7)	8.25	12.2
	B	140.5 (75.1)	3.26	
3	A	146.7 (79.9)	8.82	2.4
	B	144.3 (77.6)	3.55	
4	A	155.2 (84.3)	3.90	7.9
	B	147.8 (80.3)	4.12	
5	A	158.3 (80.0)	10.8	7.6
	B	150.7 (75.1)	4.80	
6	A	153.7 (79.8)	10.49	21.6
	B	132.1 (67.7)	4.70	

Legend:

PG - preparatory game; AHR - average heart rate; CL - corresponding value of circulation load in %; SD - standard deviation; d - difference of values in preparatory games A and B

CONCLUSIONS

1. A comparison of average HR values and the load circulation of players in the first and second performances of the verified types of volleyball preparatory games showed logically and statistically insignificant

difference in the inner load. However, the difference in particular players was distinctively diverse.

2. We found out that in the tested group the A preparatory game represented a stronger training stimulus in terms of inner load. The differences in the observed parameters were diverse in particular players.

3. The amount of load in both types of preparatory games, as well as the differences, is necessary to view in connection with the performance level of players, quality of their training habits, keeping to tactical instructions, the motivation of players and other influences.
4. It was confirmed that the average HR values of the whole group do not give a proper view of the load of particular players and they can be a source of error in training control.

PRACTICAL RECOMMENDATIONS

In training process control we recommend to take into consideration possible differences between HR values in a tested group and individuals.

Requirements of the drills for particular players can be significantly modified by a coach. In drills of this kind we recommend to intentionally regulate the players' participation, especially by setting tactical tasks and by the placing of or setting the difficultness of the additional balls. In this way we can prepare a background for creating game like situations of a particular type and perfection of solving the situations in compliance with the actual needs of the players and the team.

The complex character of the A preparatory game and the possibility of changing the game conditions enable its use not only for perfection of the technical-tactical aspects of game performance but also for the development of specific volleyball endurance. We recommend including the A preparatory game during the preparatory period, especially in its second half. It is advisable to use it in stabilization and competition microcycles (here it is necessary to decrease the volume and to take into account the location within a training microcycle according to an oncoming match).

ACKNOWLEDGMENT

This study was carried out within the research project granted by the Ministry of Education, Youth and Sports "Physical activity and inactivity of inhabitants of the Czech Republic in the context of behavioral changes, no: 6198959221".

REFERENCES

Argaj, G. (2005). Analýza tréninkového a herného zaťaženia pri vybraných športových hrách. In *Zborník vedeckých prác Katedry hier FTVŠ UK* (pp. 65-68). Bratislava: Fakulta telesnej výchovy a športu, Občanské združenie Športové hry.

- Aatrijk, S. (2000). The rally point system - entertainment and excitement. *The Coach, 1*, 12-13.
- Alberda, J. (1995). Load in volleyball. In F. Dannemann (Ed.), *Load in volleyball* (pp. 11-33). Frankfurt/M.: DVV.
- Baacke, H. (1994). The particular features of volleyball and consequences for training. *International Volleyball Technique, 2*, 9-20.
- Bloomfield, J., Fricker, P. A., & Fitch, D. (1992). *Textbook of science and medicine in sport*. Champaign, IL: Human Kinetics.
- Bouchard, C., Shephard, R. J., & Stephens, T. (1994). The consensus statement. In C. Bouchard, R. J. Shephard, & T. Stephens (Eds.), *Physical activity, fitness, and health: International proceedings and consensus statement* (pp. 9-76). Champaign, IL: Human Kinetics.
- De Van, A. E., Lacy, K., Cortez-Cooper, Y., & Tanaka, H. (2005). Post exercise palpation of pulse rates: Its applicability to habitual exercisers. *Scandinavian Journal of Medicine and Science in Sports, 15*, 177-181.
- Dobry, L., & Semiginovský, B. (1988). *Sportovní hry: výkon a trénink*. Praha: Olympia.
- Kovář, R. (1990). Vicesťupňový člunkový běh na vzdálenost 20 metrů. *Teorie a praxe tělesné výchovy, 38(6)*, 350-358.
- Laurenčík, T. (2006). Vnútorne zaťaženie hráčov volejbalu v zápase a vo vybraných metodicko-organizačných formách. In *Zborník vedeckých prác Katedry hier FTVŠ UK* (pp. 71-82). Bratislava: Fakulta telesnej výchovy a športu, Občanské združenie Športové hry.
- Neumann, G., Pfüchner, A., & Hottenrott, K. (2005). *Trénink pod kontrolou: Metody, kontrola a vyhodnocení vytrvalostního tréninku*. Praha: Grada.
- Novosad, J., Lehnert, M., & Frömel, K. (1994). Modifizierung des Ausdauerpendellaufes und deren Ausnutzung bei der Diagnostik der kardiorespiratorischen Tüchtigkeit. *Acta Universitatis Palackianae Olomucensis. Gymnica, 24*, 35-40.
- Papageorgiou, A. (1999). Training with the new rules. *The Coach, 1*, 13.
- Papageorgiou, A., & Timmer, T. (1990). Laufhandlungen im Volleyball. *Deutsche Volleyballzeitschrift, 5*, 38-41.
- Pate, R. R., Blair, S. N., Durstine, J. L., Eddy, D. O., Hanson, P., Painter, P., & Smith, L. N. (1991). *Guidelines for exercise testing and prescription*. London: Lea and Febiger.
- Polglaze, T., & Dawson, B. (1992). The physiological requirements of the positions in state league volleyball. *Sports Coach, 15*, 32-37.
- Přidal, V., & Zapletalová, L. (2003). *Volejbal. Herný výkon - trénink - riadenie*. Bratislava: Peter Mačura - PEEM.

- Reilly, T., & Bangsbo, J. (1998). Anaerobic and aerobic training. In B. Elliot (Ed.), *Training in sport (Applying sport science)* (pp. 351-409). Chichester: John Wiley and Sons.
- Süss, V. (2006). *Význam indikátorů herního výkonu pro řízení tréninkového procesu*. Praha: Karolinum.
- Terbizan, D. J., Dolezal, B. A., & Albano, C. (2002). Validity of seven commercially available heart rate monitors. *Measurement in Physical Education and Exercise Science*, 6(4), 243-247.
- Tomajko, D. (1997). *Pohybové hry*. Habilitační práce, Univerzita Palackého, Fakulta tělesné kultury, Olomouc.
- Ureña, A. (2000). Effect of the new scoring system on male volleyball. *The Coach*, 4, 12-18.
- Zhang, R. (2000). How to profit by the new rules. *The Coach*, 1, 9-11.
- Zimmermann, B. (1999). Changes and potential possibilities with the introduction of liberos in men's world class volleyball. *The Coach*, 1, 4-12.

INTENZITA ZATÍŽENÍ PŘI HERNÍCH CVIČENÍCH VE VOLEJBALU

(Souhrn anglického textu)

V současném tréninkovém procesu vyspělých družstev ve sportovních hrách jsou preferována tréninková cvičení komplexního charakteru vyžadující zapojení a úzkou spolupráci více hráčů. Předpokladem efektivní manipulace se zatížením je dokonalé poznání používaných cvičení. Cílem provedené studie sledování, jehož se zúčastnilo 6 hráčů seniorského volejbalového družstva (průměrný věk 21.2 ± 1.6 let) bylo zjistit, jaké zatížení představují dvě ověřované varianty průpravných her a zda bude zatížení při dvou opakováních stejného typu průpravné hry podobné. Porovnání průměrných hodnot srdeční frekvence sledovaného souboru volejbalistů při prvním a druhém provedení ukázalo na věcně i statisticky nevýznamný rozdíl ve velikosti vnitřního zatížení. Rozdíly hodnot sledovaných charakteristik srdeční frekvence u jednotlivců však potvrdily vysokou intraindividuální variabilitu velikosti vnitřního zatížení. Z porovnání průměrných hodnot srdeční frekvence a zatížení cirkulace u dvou typů průpravných her vyplynulo, že z hlediska vnitřního zatížení představovaly odlišné tréninkové stimuly. Z výsledků studie vyplývá, že při manipulaci se zatížením ve volejbalu u herních cvičení a průpravných her je vhodné považovat údaje o průměrných hodnotách srdeční frekvence pouze za orientační.

Klíčová slova: řízení sportovního tréninku, sportovní hry, srdeční frekvence, tréninkový proces.

Doc. PaedDr. Michal Lehnert, Dr.



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

Education and previous work experience

1980-1985 - Pedagogical Faculty, Palacký University: Physical Education - Biology.

1985-1986 - Pedagogical Faculty, Palacký University: PaedDr.

1987-1991 - teacher at elementary school

1991-2007 - Faculty of Physical Culture, Palacký University: assistant Professor.

1993-1997 - Faculty of Physical Culture, Palacký University: Ph.D.

Since 2008 - Faculty of Physical Culture, Palacký University: Associate Professor.

First-line publications

Lehnert, M., Novosad, J., & Neuls, F. (2001). *Základy sportovního tréninku I*. Olomouc: Hanex.

Lehnert, M., Janura, M., & Stromšík, P. (2003). The jump serve of the best servers on the Czech national men's volleyball team. *International Journal of Volleyball Research*, 6(1), 10-13.

Lehnert, M., Janura, M., Jakubec, A., Stejskal, P., & Stelzer, J. (2007). Reaction of the volleyball players to the training microcycle with an increased strength training volume. *International Journal of Volleyball Research*, 9(1), 11-18.

AN EXAMPLE OF AN E-LEARNING COMMUNITY FOR LIFELONG LEARNING BY PHYSICAL EDUCATION TEACHERS

Matej Majerič, Milan Žvan, Marko Kolenc*

Faculty of Sport, University of Ljubljana, Ljubljana, Slovenia

**Zavod IZZIV, Ljubljana, Slovenia*

Submitted in January, 2008

The contemporary trends in the world and in the EU indicate an increase in the number of e-learning communities. This paper presents an example of the first learning community in Slovenia in the field of practical pedagogical training for students, the "Sportfolio.si".

The Faculty, sport students, professors, and the mentors at schools cooperate within the e-learning community and in this way interconnect "theory and practice". Within the e-community and by using blogs (web logs), users can share "examples of the best practice" and therefore gain, develop, and share professional competencies in the field of physical education – they are proving the idea that "you can develop your own knowledge if you share it with others".

These are also the trends in the EU which require teachers to continuously adopt new roles (competencies), and to change or abandon some of their earlier ones. Teachers must therefore permanently arrange for their own personal and professional development. With so called lifelong learning, teachers are becoming an important integral part of the "learning society" or the society of knowledge, which represents one of the fundamental goals of the European policies in the field of education and training to be achieved by the year 2010.

In the future, e-learning communities could provide an efficient source of support for the lifelong learning of physical education teachers and promote the development of sport of all types and dimensions.

Keywords: Lifelong learning, knowledge management, acquisition and development of professional competencies, informational communication technology, learning communities.

INTRODUCTION

Changes in the society force teachers to adopt some new roles (by acquiring new competencies) and to change or abandon some of the earlier ones (Key competencies, 2002; Lifelong learning programme, 2006).

A teacher should primarily instigate changes or encourage learning also by looking after his/her own personal and professional development. Therefore, in the context of lifelong learning, each teacher is becoming an important part of a "learning society" or so called society of knowledge, which has also been one of the fundamental goals of European policies on education and training (Bologna declaration, 1999; Lisbon strategy, 2000; Lifelong learning programme, 2006).

According to Razdevšek-Pučko (2004), the vision of lifelong learning and continuous professional development requires critical thinking of the teacher. Schon (1999) says that a teacher should principally be "competent in practice" and able to generate new findings through the inspection of his/her own activity. Some of the key parts in the process of a lifelong learning process are the use of modern informational technology, cooperation with, experts, parents and other teachers as well as being qualified to inspect, scrutinise and evalu-

ate one's own work. These are also some of the roles, demanding of the teacher to be "open" to changes and motivated for lifelong learning and continuous professional development.

One of the key findings of the key competencies analysis from the year 2002 similarly suggests specific ways to fulfil the goals in the field of educational and training systems by 2010 within the framework of Lisbon strategy, as set by the EU member nations. The authors of an analysis have emphasised that new social conditions (on the global, national, local and other levels) put teachers into new roles, which they can acquire only by constant training and development of their knowledge and new competencies. Authors have emphasised as key competencies: qualification for implementing new types of work in the classroom (use of suitable approaches according to the social, cultural and ethnical diversity of pupils; the organisation of an optimal and motivating learning environment with the aim of simplifying or encouraging the learning process; teamwork with other teachers and experts, who participate in the educational process with the same pupils), qualification for accepting new roles outside of the classroom and with social partners (organisation and evaluation of educational work; cooperation with parents and other social part-

ners), qualification for developing new competencies and new knowledge in pupils (developing lifelong learning habits of pupils in the society of knowledge – teaching them about learning), development of their own professionalism (research approach and direction in problem solving; the responsible management of one's own professional development in a lifelong learning process) and the use of informational communication technology (ICT) in formal learning situations (in the classroom) and other professional work (when needed for professional development).

SUBJECT

Modern trends in the EU and the world show an increase in the number of e-learning communities (i. e. e-communities), which use open coded internet tools, such as blogs (e.g. Wordpress, Blogger etc.). Blogs (web logs) are more than just simple web pages; they are personal internet diaries that allow the users to communicate with the World Wide Web by publishing their articles, comments, video materials, pictures, presentations and other links.

RIS analysis from 2006 states that nearly 100 million people around the world use blogs. Data from the same analysis also show that in 2006 approximately 75.000 internet users in Slovenia between the ages of 10 and 75 visited or used blog sites. Further development of blog sites in Slovenia should follow developed countries; meaning that in the next few years half of these populations will follow blogs and a tenth will also contribute to them. Forecasts show that the number of blog sites in Slovenia will exceed the number 100.000 in the next few years, whilst the changes of school system (e-education) can push this number even higher (RIS, 2006).

The majority of blog sites in the world are still designed to report about events, impressions and opinions from the bloggers' personal lives. Gradually the use of blogs and e-communities, particularly at the universities, is spreading into the field of education (for example Princeton University, University of Minnesota, Cornell University, University of Massachusetts Lowell, The University of British Columbia). Examples have confirmed that functions of blog sites could be transferred to education. Their networking could set up e-communities that will allow the users to acquire, develop and exchange professional competencies (Majerič & Kolenc, 2005).

According to the strategic direction of most of the EU policies (Bologna reform, 1999; Lisbon strategy, 2000; Lifelong learning programme, 2006 etc.) it can be expected that the learning communities in the field of training and education will, in the context of setting-up a "society of knowledge", in the future, acquire a leading

role in the area of lifelong learning. This is particularly true, as one of the main goals of training and education in the EU is for an individual to gain functional knowledge or specific professional competencies in the shortest time possible and to quickly enter the job market, where she/he can add to these competencies and add to his/her own "know how". In a society of knowledge the "know how" represents the "trademark" of an individual, who can promote it on blog sites and thus achieve better mobility and flexibility in the employment process. Additional functions (e.g. RSS) enable the establishment of individual blog networks, depending on the individual's interests. It can be expected that blog sites will in the future also simplify the Europass, which is designed to increase the mobility of employment within the EU.

All these processes are also connected with the modernisation of educational systems. Various institutions (universities, faculties etc.), which educate and train human resources, will need to use their experts (teachers, researchers...) to introduce novelties and establish a "living" knowledge that will suit the needs and demands of the users in the job market. E-communities with their good practice of "living knowledge" could be a good support system in addition to conventional types of education, as they will strengthen active partnership between "theory and practice".

From the e-education point of view the e-communities can be understood as a support system for lifelong learning and the development of professional competencies, which has been devised based on the open method of regulation and has been assigned by the European council in Lisbon (2000) as a "way to spread good practice and fulfil strategic goals in the area of education and training within the EU until 2010" (Izobraževanje in usposabljanje v Evropi, 2002).

Fig. 1
Example of e-community work

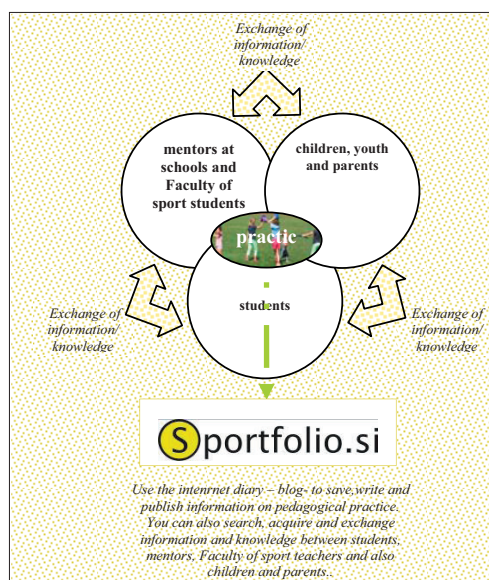


Fig. 2
Homepage <http://sportfolio.si>



On the basis of listed starting points and considering the modern trends and technological solutions for setting up of learning communities, which were enabled by open coded internet tools, the first learning community "sportfolio.si" in the area of practical pedagogical training of students in Slovenia has been created within the project "Model of practical pedagogical training of students at Faculty of Sport", which is partly financed by the European social fund and the Ministry of education and sport.

As a starting point, changes that occur in teacher's everyday work were used; these changes have been accelerated in the EU along with the process of the implementation of strategic policies (Bologna reform, 1999; Lisbon strategy, 2000; Lifelong learning programme, 2006 etc.) with a goal of establishing a "society of knowledge". The main aim was to improve the quality and efficiency of systems of education and training of teachers and educators; furthermore, to promote lifelong learning and the development of competencies for a society of knowledge with the use of ICT. At the same time, goals and strategies of the University of Ljubljana for the period 2006–2009 (UL, 2006) have been considered.

The main goal of the pilot project "Sportfolio.si" was to establish a learning community of teachers at the Faculty of Sport, teachers – mentors and students in practical pedagogical training; a community that will strive for cooperation and a connection between "theory and practice". Users can exchange "examples of good practice" (different experience, opinions of performed lessons, teaching plans, other materials etc.) inside the community with the help of blogs (internet diaries) and in this way acquire, develop and exchange professional competencies in the field of physical education. In this way the idea that knowledge can be developed by shar-

ing it with others can be realised. A creative commons licence, which is a global movement for the protection of author's rights, was being used to protect author's rights whilst respecting the national legislation.

METHODOLOGY

The project started in June 2006 with a pilot analysis (Majerič, Kovač, Strel, & Kolenc, 2006) that studied the conditions for the setting up of an e-community for the purpose of the practical pedagogical training of teachers – mentors and students. From June to September a model of an e-community has been designed; this model has been being developed since 2004 (Majerič & Kolenc, 2005). In December 2006, three months into the running of the project, a quantitative analysis of data usage in the e-community was carried out. In March 2007 the number of visits and data transfer in the e-community www.sportfolio.si was analysed (Kolenc, 2007).

Sample of measured teachers – mentors

A questionnaire was returned by 53 out of 62 teachers – mentors, representing 85.5% of all teachers – mentors, included in the project. 49.1% of the measured subjects were men ($N = 26$) and 50.9% were women ($N = 27$), 45.3% worked in the primary schools ($N = 24$) and 54.7% ($N = 29$) worked in high schools. Of the measured subjects, 92.3% had university degrees and 35.8% had been working in education for more than 20 years, while the proportion of subjects working in education between 6 and 10 years was 20.8%, between 11 and 15 years was 17% and between 16 and 20 years was 18.9%, which findings are very similar. Of the teachers, 52.8% had the title of "adviser", 32.1% had the title of "mentor", 5.7% of them had the title of "higher adviser" and 9.4% of them did not hold any title. Teachers – mentors had been participating in carrying out the practical pedagogical training of students for an average of 10.1 years and their weekly workload amounted to 21.4 hours per week.

Sample of measured students

In the academic year 2005/2006, 86 of 184 students in their final year at the Faculty of Sport, the University of Ljubljana, were randomly interviewed. They were included in practical pedagogical training; the sample represents 48.28% of all students training to become physical education teachers in the above mentioned year; 51.72% of subject in the sample were men and 48.28% were women. The majority of students wished to find employment in primary or high school after finishing the Faculty of Sport ($AV = 1.78$ out of 3).

Sample of measured variables

Sample of questions in the questionnaire for students and teachers – mentors included:

1. Opinion of teachers – mentors about the importance of different statements on the acquiring and exchange of knowledge, experience and competencies for professional development.
2. Opinion of teachers – mentors about the way they are prepared to share their knowledge, experience and competencies with others.
3. Opinion of teachers – mentors and students about the e-communities, which enable the development of professional competencies in the sense of lifelong learning.
4. Opinion of teachers – mentors and students about the benefits of acquiring and exchanging of professional experiences, knowledge and competencies.
5. Opinions of teachers – mentors and students about their willingness to cooperate in the e-communities, which will enable the acquiring and mutual exchange of competencies between the teachers and students.
6. Opinions of teachers – mentors about their willingness to share learning materials with others and willingness of students to use e-communities in the academic year 2005/2006.

Data collection and analysis

Data were collected within the pilot analysis by Majerič et al. (2006) in June 2006. The statistical SPSS for Windows package was used to analyse the data and calculate basic indicators of descriptive statistics. Data about the working of the learning society (number of visits, quantity of transferred data, number of users, number of active bloggs) were collected with the use of the AWStats programme and the quantitative analysis of users on the website www.sportfolio.si.

RESULTS AND AN ANALYSIS

Pilot analysis

It has been found that teachers – mentors in the acquiring and exchanging of knowledge, experience and competencies for professional development consider it particularly important to be able to acquire and exchange various professional information (av = 3.72 out of 4), new ideas for professional work (av = 3.51 out of 4) and answers to various professional problems (av = 3.38 out of 4) (TABLE 1).

It has been found that the majority of teachers – mentors are prepared to share their knowledge, experience and competencies by answering the questions

TABLE 1

Opinion of teachers – mentors about the importance of different statements on the acquiring and exchange of knowledge, experience and competencies for professional development

Answer	av	sd
By acquiring and exchanging of knowledge, experience and competencies:		
I can acquire and exchange various professional information	3.72	0.45
I can acquire and exchange new ideas for professional work	3.51	0.54
I can acquire and exchange answers to various professional problems	3.38	0.69
I can acquire and exchange new business contacts	2.53	0.87
I can acquire and exchange social contacts	2.13	0.94
I can acquire and exchange business opportunities	1.96	0.96

Note:

4 level measuring ladder was used, with 1 representing the least important and 4 the most important

TABLE 2

Opinion of teachers – mentors about the way they are prepared to share their knowledge, experience and competencies with others

Answer	Over telephone		By answering the questions via email		By answering questions on internet forums		At workshops or seminars for students		In e-communities	
	f	%	F	%	f	%	f	%	f	%
Yes	18	33.96	47	88.68	33	62.26	37	69.81	43	81.13
No	31	58.49	4	7.55	18	33.96	14	26.42	8	15.09
N/A	4	7.55	2	3.77	2	3.77	2	3.77	2	3.77
Total	53	100.00	53	100.00	53	100.00	53	100.00	53	100.00

via email (88.68%) and e-communities (81.13%) and less in workshops or seminars for students (69.81%) and by answering questions on internet forums (62.26%). The smallest proportion of teachers is prepared to share their experience over the telephone (33.96%) (TABLE 2).

Of these teachers, 60.38% use the internet every day (electronic mail, web searches...) and 28.30% a few times per week. This proportion is even higher in students – 63.22% of students use internet every day and 32.18% of the interviewed subjects a few times per week (TABLE 3).

Of teachers – mentors (60.38%) and 83.91% of students are of the opinion that professional e-communities, working in the internet environment and with the

help of web pages or various internet applications, enable the solving of current professional questions, the access and exchange of different professional sources and also enable the development of professional competencies in a sense of lifelong learning, which are useful and necessary for successful work (TABLE 4).

Of teachers – mentors (96.23%) as well as 98.85% of students are of the opinion that acquiring and exchanging knowledge, experience and competencies is beneficial as they can acquire and exchange various professional information, new ideas for professional work, answers to various professional problems, business contacts, social contacts and new business opportunities (TABLE 5).

TABLE 3

Opinions of teachers – mentors and students about the frequency of internet use (electronic mail, web searches etc.)

Answer	Teachers – mentors		Students	
	f	%	f	%
Every day	32	60.38	55	63.22
Few times per week	15	28.30	28	32.18
Few times per month	6	11.32	4	4.60
Total	53	100.00	87	100.00

TABLE 4

Opinion of teachers – mentors and students about e-communities, which enable the development of professional competencies in the sense of lifelong learning

Answer	Teachers – mentors		Students	
	f	%	f	%
They are useful and necessary for successful work	32	60.38	73	83.91
They are not useful and do not contribute to successful working	2	3.77	4	4.60
Other: I do not know them, I do not use them, they do not exist, they are not required to progress, they are probably useful, they are useful	16	30.19	10	11.49
Missing answers	2	3.77	0	0.00
Total	53	100.00	87	100.00

TABLE 5

Opinion of teachers – mentors and students about the benefits of the acquiring and exchanging of professional experiences, knowledge and competencies

Answer	Teachers – mentors		Students	
	f	%	f	%
In my opinion it is beneficial to acquire and exchange various professional information, new ideas for professional work, answers to various professional problems, business contacts, social contacts and new business opportunities	51	96.23	86	98.85
In my opinion it is not beneficial, as the increasing competition forces me to keep my experience, knowledge and competencies for myself	0	0.00	1	1.15
Other	2	3.77	0	0.00
Total	53	100.00	87	100.00

Of teachers - mentors (73.58%) as well as 88.51% of students are prepared to cooperate in e-communities of teachers and students, as they are interested in modern approaches to acquiring and exchanging of professional competencies (TABLE 6).

Of teachers - mentors (86.79%) are prepared to share their teaching plans and didactic materials (learning papers, cards, posters, criteria and descriptions for evaluation, video materials...) with other teacher - mentors and students within e-communities, which would operate based on the rules of respecting intellectual ownership and authors' rights.

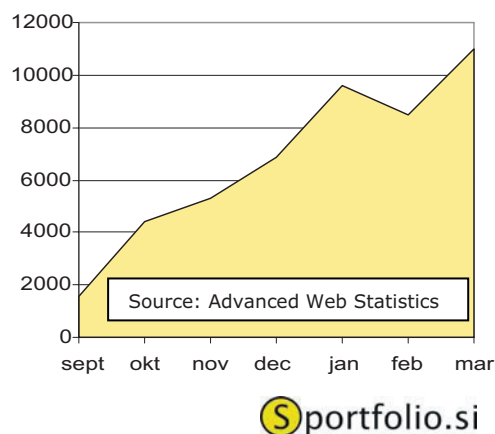
Of students, 88.51% answered that they would have used the e-communities in the previous academic year (2005/2006), if they had been available, as they are interested in modern approaches to acquiring and exchanging of professional competencies (TABLE 7).

The knowledge of internet blogs was also analysed in order to set up e-communities. It has been found that the proportion of teachers - mentors with a knowledge of internet blogs is 37.74% and is similar to the proportion of teachers without the knowledge of internet blogs (39.62%). The proportion of students with knowledge of internet blogs is slightly higher (49.43%), compared to those without knowledge about internet blogs (39.08%).

Analysis of the running of the elearning community "Sportfolio.si" and an analysis of the number of visits and data transfer within the community

Fig. 1

Review of visits on the web page of the learning society (September 2006 - March 2007)



Until December 2006, 219 blogs were set up in the first learning community "Sportfolio.si" at the University of Ljubljana. Out of all the registered blogs, 50 belonged to teachers (out of 63 participating), 165 belonged to

TABLE 6

Opinions of teachers - mentors and students about their willingness to cooperate in e-communities, which will enable the acquiring and mutual exchange of competencies between teachers and students

Answer	Teachers - mentors		Students	
	f	%	f	%
Yes, I am prepared to cooperate (I am interested in modern approaches to acquiring and exchanging of professional competencies)	39	73.58	77	88.51
No, I am not prepared to cooperate (I prefer traditional methods of acquiring and exchanging of professional competencies)	2	3.77	6	6.90
Other: shortage of time, overloading, partial cooperation until necessary, if it is necessary, clear rules, "open cards"	10	18.87	4	4.60
Missing answers	2	3.77	0	0.00
Total	53	100.00	87	100.00

TABLE 7

Opinions of teachers - mentors about their willingness to share learning materials with others and willingness of students to use e-communities in the academic year 2005/2006, if they were available

Answer	Teachers - mentors		Students	
	f	%	f	%
Yes	46	86.79	77	88.51
No	5	9.43	6	6.90
Missing answers	2	3.77	4	4.60
Total	53	100.00	87	100.00

students (out of 184 participating), 3 belonged to teachers or assistant professors at the Faculty of sport (out of 7 participating) and one was a user support blog. In March 2007, 169 out of all the registered blogs were still active (36 belonged to teachers – mentors, 130 belonged to students and 3 belonged to teachers at the Faculty of Sport). It has been found that 61 students used their blogs mainly to publish assignments and ICT materials; 69 students also wrote diaries of practical pedagogical training and published teaching plans and various suggestions for practice. 28 teachers – mentors used their blogs to publish timetables and other information related to practical pedagogical training of students; 8 teachers regularly published various information. From September 2006 until March 2007 more than 1000 various contributions were already published (teaching plans, video materials, good practice examples, other materials...). More than 9 GB of information and electronic contents were exchanged between the blogs and nearly 50.000 visits on the web page www.sportfolio.si were recorded.

FINDINGS

Data show that teachers – mentors in the process of acquiring and exchanging the knowledge, experience and competencies for professional development consider as particularly important the possibility to acquire and exchange various professional informations, new ideas for professional work and answers to various professional problems.

Analysis shows that the majority of teachers – mentors and students are prepared to cooperate in the e-community and share their knowledge, experience and competencies with others. They consider the e-communities, which enable lifelong learning, useful and necessary for a successful work, as they can acquire and exchange various professional informations, new ideas for professional work and answers to various professional problems. The majority of them were prepared to cooperate in the e-community and exchange within the community didactic materials (teaching papers, cards, posters, criteria and descriptions for evaluation, video materials...) and teaching plans and share them with other teachers – mentors and students. The majority of students stated that they would use the e-community in the academic year 2005/2006, if it was available, and that they have already used other internet tools for exchanging information.

The findings have confirmed the assumptions that key factors exist for the establishing of a learning community; therefore on the basis of the starting points of Majerič and Kolenc (2005), a model of learning communities for practical pedagogical training was set up,

similar to those at some foreign universities (Princeton University, University of Minnesota, Cornell University, University of Massachusetts Lowell, and The University of British Columbia). A fundamental starting point was that it has to be simple for users and that it supports the use of modern information communication technology. Therefore, internet blogs, which allow the users to keep a personal internet diary and to exchange various information and knowledge (presentations, photos, video material, etc.), were used.

The application of a learning community in practice and its use among the teachers and students shows very encouraging results. This means that in a very short time a support to the lifelong learning in the field of professional competencies was set up, which is based on the open method of regulation and has been assigned by the European Council in Lisbon (2000) as a “way to spread good practice and fulfil strategic goals in the area of education and training within the EU until 2010” (Izobraževanje in usposabljanje v Evropi, 2002). This also brought the setting up of a new culture of knowledge management, which is based on the idea that “one’s own knowledge (competencies) can be developed by sharing it with others”.

E-learning societies are one of the modern methods for professional and quality discussions between theory and practice. They work on the principle of self regulation. This means that the users have an opportunity to prevent the publishing of unsuitable contents with their own comments. In this way they can exclude users that publish “dubious” contents and do not respect the rules of the learning community (author’s rights, etc.). Establishing an expertly critical self regulation of the users should be a challenge for the educational institutions, which they should use to form and shape professional culture and knowledge management. This results in a direct connection of “theory and practice” and brings new opportunities for a quality promotion of the profession. Therefore, educational institutions should be the main instigators and (expert) coordinators of e-learning communities.

The Faculty of Sport has, as the first at the University of Ljubljana, set up an e-learning community, which allows students, assistant teachers and teachers in “practice” to exchange the knowledge, competencies and experience in the area of practical pedagogical training. This enables them to quickly exchange the information and knowledge between the Faculty of Sport as a main “institution of knowledge” in the field of sport in Slovenia and the teachers in its partner schools. This approach enables them to fulfil strategic goals of the UL (2006–2009), as it encourages and develops a partnership between theory and practice, strengthens the community of teachers at the faculty, students and teachers in “practice” and provides support for lifelong learning.

It is planned, as a result of the acquired experience and encouraging results in the setting up and functioning of the e-learning community "Sportfolio.si", that several updates will be prepared for the academic year 2007/2008. This will facilitate additional possibilities for the users in the acquiring and exchanging of knowledge and competencies. It is also planned that new learning communities in the field of sport will be used, which will influence development of all aspects of sport.

The project "sportfolio.si" serves the University of Ljubljana as a good example of cooperation between theory and practice. A model of the Faculty of Sport can be quickly transferred to any faculty or university. A kind of inter sector cooperation and exchange of information and knowledge between the faculties at any university or between the universities and cooperation between various sectors of the economy could be established. This also facilitates the fulfilling of strategic EU policies (Bologna declaration, 1999; Lisbon strategy, 2000; Lifelong learning programme, 2006, etc.) in the area of education and training and the establishing of a "knowledgeable society".

REFERENCES

- Bolonjska deklaracija (1999). *Ministrstvo za visoko šolstvo, znanost in tehnologijo*. Retrieved 27. 3. 2007 from the World Wide Web: http://www.mvzt.gov.si/fileadmin/mvzt.gov.si/pageuploads/doc/dokumenti_visokosolstvo/Bolonjski_proces/bolonjska_deklaracija.pdf
- Izobraževanje in usposabljanje v Evropi: Različni sistemi, skupni cilji za 2010 (2002). *Delovni program o ciljih za prihodnost sistemov izobraževanja in usposabljanja*. Bruselj: Generalni direktorat za izobraževanje in kulturo, Evropska komisija.
- Key competencies* (2002). Brussels: Eurydice, European Unit.
- Kolenc, M. (2007). *Obisk na spletnem mestu Sportfolio.si, po 5ih mesecih strmo navzgor*. Retrieved 27. 3. 2007 from the World Wide Web: <http://klub.sportfolio.si/>
- Lizbonska strategija* (2000). Retrieved 27. 3. 2007 from the World Wide Web: http://ue.eu.int/ueDocs/cms_Data/docs/pressData/en/ec/00100-r1.en0.htm
- Majerič, M. (2006). *Poročilo o izvajanju projekta v letu 2006*. Ljubljana: Fakulteta za šport.
- Majerič, M., & Kolenc, M. (2005). E-samoučeča skupnost na področju vzgoje in izobraževanja. In Z. Labernik & M. Varšek (Eds.), *10. mednarodna konferenca - MIRK 05: Zbornik povzetkov* (pp. 40). Ljubljana: Ministrstvo za šolstvo in šport in drugi.
- Majerič, M., Kovač, M., Strel, J., Kolenc, M., & Markelj, M. (2006). Pilotska analiza projekta. Projekt "Model praktičnega pedagoškega usposabljanja študentov Fakultete za šport" [*Pilot analysis of the project Model of practical pedagogical training of Faculty of Sport students - unpublished*]. Neobjavljeno. Ljubljana: Fakulteta za šport.
- Pehan, V., & Vehovar, V. (2006). *E-izobraževanje 2005/2006 - visokošolski in višješolski zavodi*. Retrieved 27. 3. 2007 from the World Wide Web: <http://www.ris.org/index.php?fl=2&lact=1&bid=1293&parent=13>
- Program vseživljenjskega učenja (2006). *Uradni list Evropske unije*. Retrieved 27. 3. 2007 from the World Wide Web: http://eur-lex.europa.eu/LexUriServ/site/sl/oj/2006/l_327/l_32720061124sl00450068.pdf
- Razdevšek-Pučko, C. (2004). What kind of teacher is needed (expected) in today's (and tomorrow's) school? *Sodob. pedagog.*, 55, 52-74.
- RIS (2007). *Blogi v letu 2006*. Retrieved 27. 3. 2007 from the World Wide Web: <http://www.ris.org/index.php?fl=1&nt=9&p1=276&p2=285&p3=&id=1074&sid=457>
- Univerza v Ljubljani (2006). *Strategija 2006-2009*. Retrieved 27. 3. 2007 from the World Wide Web: http://www.uni-lj.si/Univerza/StrategijaUL2006_2009.pdf

PŘÍKLAD E-LEARNINGOVÉ KOMUNITY¹ V CELOŽIVOTNÍM VZDĚLÁVÁNÍ UČITELŮ TĚLESNÉ VÝCHOVY (Souhrn anglického textu)

Současné trendy ve světě i v EU vykazují zvyšující se počet skupin, vzdělávajících se prostřednictvím e-learningu, tzv. e-learningových komunit. Tento příspěvek představuje první takovouto e-learningovou komunitu ve Slovinsku, a to v oblasti pedagogické praxe studentů - „Sportfolio.si“.

Pedagogové, studenti sportu, profesori a mentoři na školách v rámci e-learningové komunity spolupracují a propojují tak „teorii a praxi“. V rámci e-komunity a pomocí blogů (weblogů) mohou uživatelé sdílet příklady nejlepších postupů a získávat, rozvíjet a sdílet tak

¹ Autoři zvolili pro překlad výrazu e-learning community výraz e-learningová komunita, ačkoliv v tomto případě nejde o komunitu v sociologickém pojetí, ale ve významu přeneseném, a to do prostředí internetu. E-learningovou komunitou je zde rozuměna sociální skupina (v sociologickém významu skupina osob, jejíž členy spojuje vzájemná komunikace, normy, vzájemná očekávání a společně vykonávaná činnost), která se prostřednictvím elektronické komunikace v rámci tzv. weblogu vzdělává, přičemž toto vzdělávání zahrnuje vzájemné sdílení nabytých poznatků a zkušeností.

profesní kompetence v oblasti tělesné výchovy. Potvrzují tak myšlenku, že „vlastní vědomosti lze rozvíjet tím, že je sdílíme s ostatními“.

Takové jsou rovněž trendy v EU, která od pedagogů požaduje neustále přejímat nové role (kompetence) a měnit či opouštět některé role dřívější. Pedagogové se tudíž musí neustále starat o vlastní osobnostní a profesní rozvoj. Pomocí tzv. celoživotního vzdělávání se pedagogové stávají nedílnou součástí „učící se společnosti“ neboli společnosti vědomostní, která představuje jeden ze zásadních cílů evropské politiky v oblasti výchovy a vzdělávání, kterého má být dosaženo do roku 2010.

V budoucnosti by e-learningové komunity mohly představovat účinnou oporu při celoživotním vzdělávání učitelů tělesné výchovy a podpořit rozvoj sportů všech typů a měřítek.

Klíčová slova: celoživotní vzdělávání, management znalostí, osvojování a rozvoj profesních kompetencí, informační a komunikační technologie, e-learningové komunikace.

Assist. prof. Matej Majerič, Ph.D.



University of Ljubljana
Faculty of Sport
Gortanova 22
1000 Ljubljana
Slovenia

Education and previous work experience

Since 1999 employed at the Department of Didactics of Physical Education in schools at the University of Ljubljana, Faculty of Sport. Completed his Ph.D. in 2004 at the Faculty of Sport with a dissertation the “Analysis of assessment models of sports knowledge in physical education”. Working on the modern approaches to life-

long learning experience and permanent expert training of teachers and professionals in sport, he is a head of the Department for permanent expert education at the Faculty of Sport and a coordinator of practical pedagogical training of the students at the Faculty of Sport. In 2006 and 2007 he successfully completed a project “A model of practical pedagogical training of students at the Faculty of Sport”, which has been in part financed by the EU European Social Fund and the Ministry of Education and Sport of Republic of Slovenia. Within the project, the first e-learning community “Sportfolio.si”, intended for the lifelong learning of teachers and students in Slovenia, has been set up. “Sportfolio.si” is based on an open method of adjustment, which the European Council in Lisbon (2001) defined as a “way for expanding examples of good practice, which enables the fulfilment of strategic goals in the area of education and training in the EU until 2010”. He is a member of the Programme board for further education and training of professional workers in education in Republic of Slovenia.

Scientific orientation

Recently, he has been researching knowledge management and modern approaches to lifelong learning in the field of sport, as well as the exchange and development of knowledge in the “society of knowledge”.

First-line publications

Majerič, M., & Kolenc, M. (2005). *E-self learning community in the field of education and training*. Ljubljana: Ministry of education and sport.

Majerič, M., & Kolenc, M. (2007). Sportfolio.si: Setting up an e-community for the development of professional competencies and lifelong learning of physical education teachers. *Šport*, 55(2), 5–12.

Majerič, M., Žvan, M., & Kolenc, M. (2007). Sportfolio.si: E-learning community for lifelong learning of physical education teachers. In *4th FIEP European congress Physical education and sports: Teacher's preparation and their employability in Europe: Book of abstracts* (pp. 80). Bratislava: Comenius University, Faculty of Physical Education and Sport, Slovak Scientific Society for Physical Education and Sport.

INSTRUCTIONS FOR MANUSCRIPT

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

General instructions

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

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

All contributions are reviewed anonymously.

Interface of the contribution

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

Text of the contribution

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

Epilogue of the contribution

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

Tables, pictures, graphs, appendices

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

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

We look forward to our further cooperation!

Doc. PhDr. Vlasta Karásková, CSc.
Executive Editor

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

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

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

POKYNY PRO PŘÍPRAVU RUKOPISU

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

Obecné pokyny

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

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

Odevzdává se text v editoru Word a 1 výtisk textu.

Všechny příspěvky jsou anonymně recenzovány.

Úvod příspěvku

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

Text příspěvku

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

Závěr příspěvku

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

Tabulky, obrázky, grafy, přílohy

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

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

Děkujeme Vám za spolupráci.

Doc. PhDr. Vlasta Karásková, CSc.
výkonný redaktor

Doc. MUDr. Pavel Stejskal, CSc.
vědecký redaktor

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

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

**ACTA
UNIVERSITATIS PALACKIANAE OLOMUCENSIS
GYMNICA**

Vol. 38 No. 1

Published by Palacký University, Olomouc 2008

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

Published quarterly
MK ČR E12792

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

ISSN 1212-1185