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INHALT

OBSAH

THE EFFECT OF AGE ON SHORT–TERM HEART RATE VARIABILITY

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The aim of the study is to establish age dependence of the indices of short-term spectral analysis of HRV in the supine and standing position. We tested 132 healthy subjects (76 man and 56 woman) divided into two age groups: 12–24 years (n=62) and 43–70 years (n=70). Total spectral power was divided into three components: high frequency (HF) (150–500 mHz), low frequency (LF) (50–150 mHz) and very low frequency (VLF) (20–50 mHz). There were significantly lower values for total spectral power, indices calculated from the LF and HF components and mean frequencies of the VLF and HF components in the older group than in the younger group in the supine position. On the other hand, the values for indices %VLF, VLF/LF, VLF/HF and LF/HF were significantly higher in the older group. The differences between supine and standing values were either significantly less in the older group than in the younger group or did not exhibit a remarkable variation; the sole exception being the change in total spectral power which was significantly greater in the older group.

Keywords: autonomic nervous system, power spectral analysis, aging, HRV, active orthostatic load.

INTRODUCTION

It is known, that advancing age in healthy humans and animals is accompanied by a deterioration in communication between the nervous system and the heart and vasculature (Xiao & Lakatta, 1991) and that a "dysautonomia of aging" occurs (Jarish et al., 1987).

Variations in the heart rate over time have a close relationship with changes in nervous system activities influencing the heart. A large number of scientific studies within the last 20 years have confirmed that spectral analysis of heart rate variability (SA HRV) is a valid noninvasive methodology aiding in the examination of the autonomic nervous system (ANS). By using an SA HRV, that transforms the time sequence of the R–R intervals into a frequency domain, it is possible to quite accurately specify the position of individual components on the frequency axis of the spectrum.

An increase in HRV occurs during early human life (Finley et al., 1987; Massin & Von Bernuth, 1997; Piha, 1991); in some studies it has been documented that from the age of six years HRV begins to decrease (Finley et al., 1987; Piha, 1991), in others, the authors have found the maximum for the total spectral power, or of its partial components, at between 15 to 30 years of age (Korkusho et al., 1991). It is, however, generally accepted that HRV gradually decreases and that such a dependence on age specifically affects total spectral power and its individual components (Byrne et al., 1996; Ingall et al., 1990; Korkusho et al., 1991; Lipsitz et al., 1990; Pagani et al., 1986; Piccirillo et al., 1995; Schwartz et al., 1991).

Postural change from a supine to an upright position is accompanied by a shift of the sympatho-vagal balance towards sympathetic activity (Malliani et al., Pomeranz et al., 1985; Saul, 1993). Although the results of examining the effects of increasing age on the HRV spectrum using postural changes are ambiguous, they seem less pronounced with older subjects both in the parasympathetic and sympathetic branches (Ingall et al., 1990; Lipsitz et al., 1990; Piccirillo et al., 1995, Ziegler et al., 1992).

In spite of relatively large number of studies, there are still some doubts about the results of monitoring the effects of aging on individual components of SA HRV. The results are very often controversial and their interpretation is, therefore, very difficult. Such contradictions and inconsistencies occur due to insufficiently standardized nomenclature and methods

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of measurement and to inaccurately defined physiological and pathophysiological correlates (Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996).

The aim of our study is to establish the age dependence of commonly and less commonly used parameters of SA HRV with healthy humans both in the supine and upright positions. It is obvious, that apart from indices strongly affected by age there are some that are less affected and some that are not affected by age at all. In cardiac patients, neurological diseases (namely with patients suffering from diabetic autonomic neuropathy) and some renal diseases, the spectral power of HRV is altered as well (Van Ravenswaaij et al., 1993); e. g., with patients that have had a myocardial infarction, the reduction of the spectral power, especially that of its high-frequency components, is connected to an increased risk of sudden cardiac death. Because chronic cardiac disease development and sudden cardiac death are, along with aging, related to a decline in vagal activity, it is necessary to define the overlapping area of the reduced HRV between healthy older subjects and patients and thus set limit points for separating these groups. In order to accomplish this, it is necessary to determine the distinction between physiological changes accompanying aging and pathological changes of HRV (Kupari et al., 1993; Odemuyiwa, 1995; Piha, 1991; Suleiman et al., 1992; Van Hogenhuyze et al., 1986). Overall assessment of selected spectral indices with the highest validity in a supine position and their integral reactions to postural changes could aid in determining such a distinction.

METHODS

Subjects

132 healthy subjects (76 men and 56 women) took part in the study. They were divided into two groups of variying age: the first group (group A) consisted of subjects aged 12 to 24 (18.16 ± 3.60 yrs), the second group (group B) consisted of subjects aged 43 to 70 (50.20 ± 7.12 yrs). There were 62 subjects in group A (35 men and 27 women) and 70 subjects in group B (41 men and 29 women), (TABLE 1); the average age of the men and women within each group did not bayrdiffer significantly.

None of the subjects had taken any medications for at least 3 months prior to the examination. Criteria for exclusion from the study included pathological baseline ECG or during stress, diastolic blood pressure higher than 90 mmHg, systolic blood pressure higher than 155 mmHg, smoking of more than 5 cigarettes per day, cholesterolemia higher than 5.2 mmol/l, history or demonstrable evidence of diabetes mellitus and cardiovascular, respiratory, renal, hepatic, gastrointestinal, or systemic diseases. Informed consent was obtained from all volunteers.

Measurement

The subjects were studied in the caffeine-free, nonabsorptive state. Prior to the HRV examination every subject underwent a basic physical, anthropometrical and ECG examinations. After completing the HRV measurement, the subjects' venous blood was taken for biochemical analysis, after which they underwent a stress test with the use of a CHR-test (Stejskal et al., 1993).

The HRV examination complied with the following protocol: The examination began between 8 and 9 a. m. After blood pressure measurement, the subjects lay in a quiet room with the temperature of 21 °C to 24 °C; for the purpose of isolating their sensual perception they lay with their eyes closed and with headphones playing music with a calming effect. An ECG record of 300 consecutive heartbeats was performed after five minutes of lying in the rest position. The subject then stood up and, after 1 minute of standing, an ECG record of 300 consecutive heartbeats was performed again. Immediately after that, the subject's blood pressure was measured. The subject then lay down again and, after reaching his/her steady state, an ECG record of 300 consecutive heartbeats was duly performed. Moving from a supine to a upright position took approximately 10 seconds. Two subjects, who showed a considerable decrease in systolic blood pressure, (>25 mmHg) in the upright position, were excluded from the test. Data were acquired during spontaneous respiration.

The first position, supine at rest, served only for the purpose of standardizing the examination and its results were not taken into consideration.

Spectral analysis of heart rate variability

To calculate the SA HRV parameters in the study, we used a microcomputer system VariaPulse TF 3 (Sigma Media Olomouc Ltd., Czech Republic) (Salinger et al., 1995), which controls the process of the examination and monitors the ECG signal from which it collects R–R intervals with an accuracy of 1 ms. R–R intervals are telemetrically transmitted to the receiver which is connected to an IBM PC microcomputer through the COM port. The algorithm of the system software is a short-term spectral analysis of the HRV.

The parameters of the SA HRV are computed by means of a fast Fourier transformation with a partially adapted Coarse-Graining Spectral Analysis (CGSA) (Yamamoto & Hughoson, 1991) algorithm, which ensures optimal reduction of non – harmonic and noise elements of the analyzed HRV signal, especially in the range of low frequencies. Automatic and manual artifact filtration are a part of the software procedures.

A basic SA HRV parameter, which serves for derivation of a number of others, is Power Spectral Density (PSD) (ms^2/Hz). It is defined for individual frequency ranges: high-frequency (HF) (150–500 mHz), low-frequency (LF) (50–150 mHz) and very low-frequency (VLF) (20–50 mHz).

The following indices were calculated for all of the above mentioned components: integral level of the power spectrum (p) (ms^2), maximum density, i. e. PSD amplitude, the relative part of individual components in total power (%), the variation coefficient of individual components and of total spectral power (CCV) (Hayano et al., 1995) and the position of the average value of the maximum amplitude on the frequency axis (frequency = f) (mHz). VLF/HF, LF/HF, VLF/LF ratios were calculated from the values of the individual components.

The overall value of HRV was evaluated by the total spectral power (Tp) (ms^2) (sum of the VLF, LF and HF spectral powers) and by only one time domain index (MSSD – Mean Squared Successive Differences) (ms^2).

From the graphical point of view, we provide a "3D" chart of PSD (Fig. 1), which allows us to keep track of the frequency spectrum dynamics with respect to the change in standard or non-standard activity situations during the examination.

All indices were calculated both for the upright position and for the second supine following the upright position. This study states the values recorded in the supine position, and values of the differences between both positions (supine minus upright position).

Statistical analysis

Basic statistical quantities were calculated for each variable of the above mentioned SA HRV indices and the normal distribution was verified by the Kolmogorov – Smirnov test. In the case of a normal, or lognormal pattern, Student's non-paired t-test was used for comparison of age groups. Mann-Whitney's non-parametric test was used when the data did not show the normal pattern. A p-value $< 0{,}05$ was considered to indicate a statistical significance. The calculated values and sampling distribution are clearly shown in the tables.

RESULTS

In the supine position, the values of the total HRV indices (MSSD, Tp) in group A were significantly higher than in group B (TABLE 2). In the following terms the same differences were found in power, maximum density, and in the variation coefficient of the LF and HF components, while corresponding indices for VLF components did not significantly differ between the groups.

The relative representation of individual components on total spectral power gives us a different picture: significant differences between younger and older subjects were evidenced for %HF (group A showed higher values) and for %VLF (group A showed lower values). Significant differences between the groups were not evidenced for %LF (TABLE 2).

The ratios between components was significantly lower in the A group then in the B group (TABLE 2).

A statistical significance of the differences between the groups was evidenced for fVLF and fHF – which were higher with the younger subjects; fLF did not differ between the groups.

Both groups evidenced a considerable increase of the R–R interval, MSSD, all indices calculated from the HF component (pHF, PSDHF, CCVHF, %HF) and fLF after transition from upright to supine. On the contrary, the values derived from the VLF component (pVLF, PSDVLF, CCVVLF, %VLF), CCVLF, VLF/HF, LF/HF and CCVTp decreased significantly (TABLE 2).

While in the A group a considerable decrease in %LF and VLF/LF and a considerable increase in fHF was observed after transition from upright to supine, corresponding indices in the B group were not as statistically dynamic (TABLE 3). On the other hand, the older group showed a considerable decrease in total spectral power after position change; there was no significant change in the younger group.

The effect of postural changes on pLF, PSDLF, and fVLF indices were not significant in either group (TABLE 3).

A significant difference was found in the reaction to postural changes between the groups for R–R, MSSD indices and for all indices derived from the HF component: postural dynamics of the given indices were much lower with the older group than with the younger group (TABLE 3). Similarly, the differences between %VLF, %LF, CCVLF indices were significantly smaller within the older group in comparison to the younger group.

Contrarily, no significant differences between the groups were found for the values of pVLF, PSDVLF, CCVVLF, pLF and PSDLF indices influenced by postural change; similarly, the postural changes values of LF/HF and VLF/LF did not differ between the groups (TABLE 3).

An increase of fHF after position change was significantly greater in the younger group compared to the older group. Contrarily, an increase of fLF was equally significant in both groups and did not significantly differ between the groups (TABLE 3). The fVLF remained unchanged in both groups.

After the change from the upright position to supine, the total spectral power decreased with the older group; whereas, it did not significantly change with the younger group (TABLE 3) (this was the only index in the older group that showed accentuated dynamics over the younger group).

During the general evaluation of the effect of age, it is obvious that 22 indices — from 44 indices used — were significantly higher in the A group (50% of the indices used) and 6 indices (14%) were significantly higher in the B group. Generally, a significant difference between the groups was not proven for 16 indices (36% of the total number).

The greatest differences between groups in the supine position were calculated for MSSD, Tp and CCVTp, for all indices derived from the HF component, for %VLF and for VLF/HF ratio (TABLE 2). The highest level of significance for the differences in postural change between the groups was evidenced in the HF component indices, MSSD and R-R interval (TABLE 3).

DISCUSSION

Since spontaneous respiratory rate inhibition already occurs at middle age (Anderson et al., 1995), we chose, with respect to the pronounced age difference between the groups, an examination with spontaneous breathing to avoid the uneven effect on HF component power (Hirsch & Bishop, 1981). We chose an active change of position, because it is more suitable for the study of orthostatic regulation of circulation than a passive change of position (head-up-tilt) (Piha, 1991).

The results of our comparison of the two groups, whose difference in age was over 30 years on average, proved that more than 70% of the SA HRV indices we used were age-dependent in the supine position. This concerns, first of all, MSSD, total spectral power and high-frequency component indices, which show the greatest differences between the younger and older groups. There were considerably lower values of the above in the older group than in the younger one. Since it is generally accepted that all the indices mentioned are effected by vagal tone, such a finding is usually interpreted as reduced parasympathetic activity that occurs in older subjects (Lipsitz et al., 1990). Determination of the age-related HF component reduction is consistent with the age-related reduction of the vagal control of respiratory sinus arrhythmia and of bradycardiacal response to Valsalv's maneuver. The cause is usually attributed to a decrease in acetylcholine synthesis, a decrease in the number cholinergic receptors and in their affinity towards the agonists, a decrease in cholinergic plexus density and an involutional ANS plexus degeneration (Baker et al., 1985; Korkushko et al., 1991; Shvalev et al., 1989). Therefore, it is necessary that the indices are always related to the age of the patient.

Both groups differed on the same level of significance in relative VLF component power (%VLF) and VLF/HF ratio. Contrary to the indices of vagal activity, these above values increase with advancing age. These findings could prove that they can be considered as predominant sympathetic activity indices. This prevalence in older people is the result of an enormous reduction of the vagal component that has a significant effect on total spectral power.

A slightly less significant difference between both groups occurs with the indices derived from the LF component whose values decrease with advancing age (%LF does not show a significant difference at all); in spite of the ambivalence of the saturation of the component (Akselrod et al., 1981; Akselrod et al., 1985), the effect of the sympathetic activity on LF power, which reflects baroreceptor activity, is presumably greater. Because the levels of the indices were significantly reduced in older subjects in supine, the findings suggest that sympathetic activity decreases with aging. Many scientists interpret the findings in accordance with the above mentioned facts and explain it by decreases in the efficacy of beta-adrenergic modulation of cardiovascular functions (Lakatta, 1980; Shimada et al., 1986); the age-associated deficit in the effectiveness of beta-adrenergic control is largely postsynaptic in nature (Lakatta, 1993). Reduced sympathetic activity in older subjects can be explained by involutional degeneration of adrenergic elements of ANS and the decreased number of baroreceptors (Ferrari et al., 1986; Korkushko et al., 1991). Adenosine levels, that are enhanced in the aged myocardium may be responsible, in part, for the diminished contractile responsiveness of the older adult heart to beta-adrenergic stimulation (Dobson et al., 1990). Such a reduction in response to beta-adrenergic stimulation persists even after intensive exercise training (Stratton et al., 1992).

In this context we should accept the fact that by using the HRV methodology an isolated sympathetic activity cannot be identified (Ahmed et al., 1994; Kolai et al., 1994) and that the LF component does not specifically reflect cardiac sympathetic modulation in human (Hopf et al., 1995). In addition to this, the level of vagal activity affects the observed changes in heart rate variability that are associated with sympathetic stimulation (Kim et al., 1997). Therefore, it seems more correct to evaluate the dynamics of the changes in the balance between both ANS branches and to evaluate the effect of age more in the sense of a relative increase of sympathetic activity (as a result of a greater decrease in vagal tone).

The results of the comparison of both groups showed that the age related reduction in the supine position decreased from left to right. In other words, HF power decreased most with age, LF power decreased somewhat less and VLF power did not differ significantly between the groups. Therefore, the %LF age-associated reduction was non–significant and, to the contrary, that is why we observed a significant difference between the values of younger and older subjects not only for the VLF/HF ratio but for the LF/HF and VLF/LF ratios as well. The ratio between the power of individual components indicate best a sympatho-vagal balance. Since these values were higher with older people, we can draw the conclusion that sympathetic activity is prevalent in this age-group.

Similar conclusions were arrived at by Lipsitz et al. (1990), who calculated regression lines relating the log amplitude to the log frequency in the supine and upright positions. Regression lines for older subjects were lower and steeper; this implies that it was significantly more declivitous. Bigger et al. (1995) and

Yeragani et al. (1997), who performed long-term HRV examinations, found different age-associated reductions in different spectrum ranges for a group of healthy humans between 40–69 years of age; while the VLF, LF, and HF components decreased with age, the ultra-low frequency component did not change and the LF/HF increased. From the results of other authors (Korkushko et al., 1991; Ziegler et al., 1992), we-high-frequency band over changes in the low-frequency band of the HRV spectrum.

Generalizing this hypothesis, as an index of relative sympathetic activity, we can consider the ratio between the powers of two components, where the lower frequency component is in the numerator and the higher frequency is in the denominator. It seems logical that the greater the distance between the components is the better their ratio expresses the participation of the sympathetic activity on the total ANS activity.

Not all of the authors have reached the same conclusions. For example, Pagani et al (1986) found that the LF/HF ratio did not change with age and that aging was associated with a new ANS balance. Piccirillo et al. (1995) found that the older group had significantly lower LF and greater HF spectral power (analyzed in absolute and normalized units). It is difficult to explain such differing results; it could be because their younger group was formed by subjects at the age of our older group (44–64 years) and that a number of people from their older group (64–85 years) were outside of our target age range. It cannot be excluded that another considerable decrease in sympathetic activity takes place in the 6th decade of human life (Piccirillo et al., 1995); contrarily, it seems that the decrease in vagal activity is slower for ages over 70 or that it does not continue at all (Reardon & Malik, 1996).

From the results mentioned above it is obvious that, when comparing different studies evaluating individual components of the HRV spectral power, absolute values of age and the age range of compared subjects must always be taken into consideration. It seems that an age–associated decrease of component power at a lower band of frequencies (i. e. VLF and LF) is not only smaller, but takes place later (Korkushko et al., 1991).

At present, it is generally accepted that though sympathetic activity decreases with increasing age in adults, its decrease is smaller than the decrease in vagal activity (Korkushko et al., 1991; Lipsitz et al., 1990; Singer & Ori, 1995; Ziegler et al., 1992) and that adulthood is characterized by a shift of the vegetative balance towards sympathetic dominance.

Similarly, the values of VLF and HF maximum density frequency, in the supine position, show a considerable difference between the groups: the average values for younger subjects were significantly higher. In other words, the frequency of both border components shifts to the left (i. e., towards lower values) with increasing age. Such an oscillatory deceleration is probably due to a decrease of vagal activity which shifts the ANS balance towards the sympathetic activity, i. e., to the left.

By changing the position from supine to upright, a considerable decrease in all vagal activity indices occurs while the majority of relative sympathetic activity indices increases significantly (Malliani et al., 1991; Barger et al., 1985; Saul, 1993). No postural dynamic was, however, evidenced for pLF and PSDLF which, regardless of age, did not change considerably after postural changes. LF power is a result of the activity of both ANS branches and therefore sympathetic activity can be masked by antagonistic vagal activity (Akselrod, 1995). Spectral power, in the 50–150 mHz band, corresponds both to slow sympathetic and to faster vagal baroreceptor responses to arterial blood pressure changes (Sleight & Casadei, 1995).

If, by calculating the difference of CCVLF between supine and upright, we can, in part, eliminate the fact that with an increase in the carrier frequency its variability decreases, then the LF postural dynamic becomes significant – it increases when standing in both groups. Significant pLF postural dynamics can be observed as well, if they are related to pHF dynamics (LF/HF).

The upright position resulted in a considerable decrease of fLF in both groups while fVLF did not show any significant difference. Such a finding suggests that the effect of sympathetic activity is less in the higher frequency part of the LF spectral band than in its lower frequency part and that the rhythm activity, associated with vasomotion, is slowed while standing. Significantly greater VLF dynamics, in comparison to LF dynamics (Tab. 3), evidently affect the maximum density frequency of the adjacent LF component. Since the increase in pVLF in both groups is equal when standing, the fLF shift to the left is equally significant.

Standing caused a significantly smaller decrease of pHF in the older group than in the group of younger subjects; such a finding corresponds to results of other studies (Ingall et al., 1990; Piccirillo et al., 1995; Ziegler et al., 1992). Reduced pHF postural dynamics in older subjects resulted in an insignificant change of fHF; on the other hand, in younger subjects while standing fHF significantly decreases – as a result of the greater reduction of the HF component. By comparing the changes of power and the frequency of individual components after postural change we can better infer the dynamics and mutual relationship between both ANS branches.

It seems that the reason for age-related differences in postural maneuvering is the fact that a significant reduction of pHF in older subjects in supine does not allow further significant decrease of pHF in the upright position. Similarly, reduced LF postural dynamics were evidenced in older subjects (Ingall et al., 1990; Lipsitz et al., 1990; Piccirillo et al., 1995). Different results of postural changes of individual vagal or sympathetic indices for some authors can be explained by different examination conditions. For example, Lipsitz et al.

(1990) worked with different bandwidths and the postural change consisted of a passive 60° tilt. Furthermore, passive change of position resulted in a vasovagal syncope in 6 out of the 12 tested young subjects; these subjects were then characterized by a significant increase in total spectral power and LF power, while the rest of the tested subjects did not show any significant difference after postural change. Contrarily, Kochiadakis et al. (1997) found a decrease in the LF and HF bands in older subjects with vasovagal syncope and positive tilt testing when standing, and the LF/HF ratio did not significantly change. In healthy subjects or subjects with negative tilt test results, the LF band did not change or increased, the HF band decreased, and the LF/HF ratio increased. It seems that for patients with a tendency towards vasovagal syncope it will be necessary to consider the age factor when evaluating the ANS functional state.

At first sight, a significant increase of total spectral power due to the postural maneuver in older subjects is surprising, while in a younger group, the same index did not significantly change. The explanation can be simple: a physiological increase of sympathetic tone in older subjects results mainly in an increase of VLF power (Tp increases significantly), while in younger subjects, the same effect is achieved by a significant decrease of the HF component (Tp tends to decrease) (TABLE 3).

The result of these age-associated ANS changes is a considerably reduced dynamic of heart rate in older subjects after postural change. This same conclusion was arrived at by Byrne et al. (1996) as well. They did not find a significant relationship between the mean R-R interval and age in the supine, but they demonstrated a significant lengthening of the R–R interval with age in the seated and standing positions. The above mentioned considerations imply that such an age-associated reduction of heart rate postural dynamics is probably caused primarily by decreased baroreflex and myocardial sensitivity to beta-adrenergic stimulation.

CONCLUSION

The results of a comparison of HRV spectral power and of its individual components in two significantly different age groups, confirmed an age-dependent HRV reduction, mainly in the high-frequency component; therefore, a relative prevalence of sympathetic activity occurs in older people. The analysis indicated the usability of indices derived from the power spectrum of the selected components.

With respect to the fact that orthostatic stimulation of the ANS expands the possibilities of its evaluation, consideration of the physiological changes associated with aging is absolutely necessary. Ascertainment of a disorder in age-associated dynamics extends the range of easily attainable information for a number of diseases.

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TABLE 1

Mean values ($\overline{X}$) and standard deviations (SD) of the individual charakteristics for the groups of younger (A) and older (B) subjects.

	Group A		Group B		
	$\overline{X}$	SD	$\overline{X}$	SD	D2
Men					
Weight (kg)	66,91	10,18	78,85	14,56	$p < 0,001$
BMI (kg. M^{-2})	21,37	2,4	25,18	3,57	$p < 0,001$
Body fat (%)	8,52	4,79	16,06	6,27	$p < 0,001$
Age	18,65	3,84	49,09	6,8	
Women					
Weight (kg)	63,89	16,8	69,99	12,95	$p > 0,05$
BMI (kg. M^{-2})	22,9	7,31	25,96	4,73	$p > 0,05$
Body fat (%)	16,55	8,64	22,31	7,31	$p < 0,05$
Age	17,52	3,28	52,12	7,41	
Men and women					
Weight (kg)	65,47	13,26	75,31	14,51	$p < 0,001$
BMI (kg. M^{-2})	21,96	5,1	25,5	4,06	$p < 0,001$
Body fat (%)	11,76	7,7	18,69	7,36	$p < 0,001$
Age	18,16	3,6	50,2	7,12	

TABLE 2

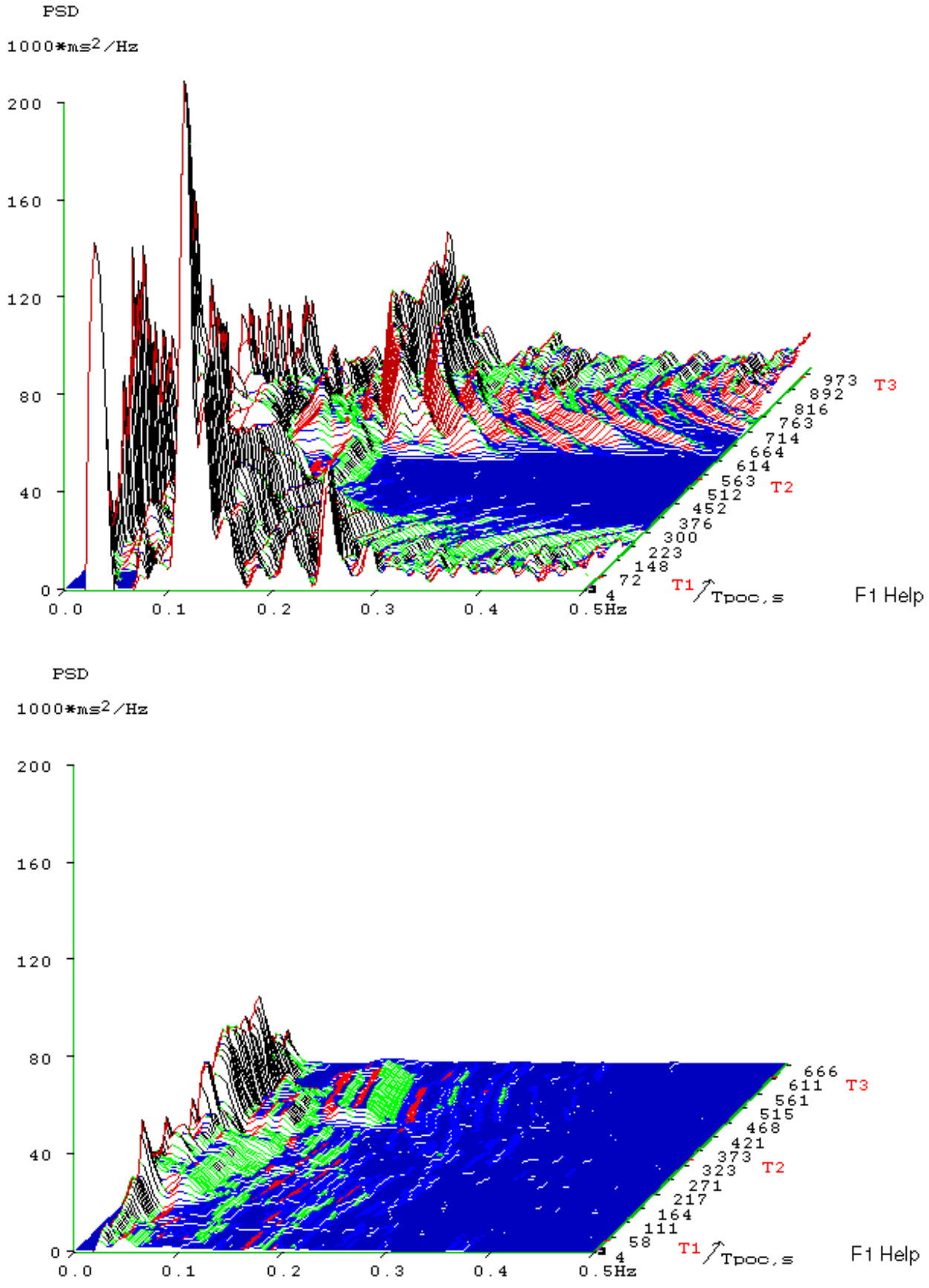
Mean values ($\overline{X}$) and standard deviations (SD) of the individual indices in supine for the groups of younger (A) and older (B) subjects.
p = absolute power, Tp = total power, % = relative part of individual component in total power, PSD = power spectral density, f = average value of frequencies of maximal density powers, MSSD = mean squared successive differences, CCV = coefficient of component variations.
Ind. – compared indices. Dtr. – sampling distribution: 1 – normal distribution, 2 – log normal distribution, 3 – non normal distribution. D1 – statistical differences between the groups.
p > 0, 05 – no significant difference (NS)
p < 0, 05 – *
p < 0, 01 – **
p < 0, 001 – ***

		group A		group B		
Ind.	Dtr.	$\overline{X}$	SD	$\overline{X}$	SD	D1
PVLF	2	6.33	0.84	6.51	0.83	NS
PLF	2	6.55	1.09	5.77	1.10	***
PHF	2	7.65	0.85	5.66	0.92	***
Tp	2	8.31	0.60	7.30	0.72	***
% VLF	1	18.20	13.51	50.08	20.96	***
% LF	1	24.33	18.50	26.76	14.80	NS
% HF	1	57.48	22.85	23.16	12.47	***
PSDVLF	2	10.75	0.90	10.82	1.01	NS
PSDLF	2	9.99	1.05	9.00	1.00	***
PSDHF	2	10.30	0.96	8.36	1.01	***
FVLF	3	23.09	8.88	20.26	8.21	***
FLF	1	98.76	29.08	90.97	26.44	NS
FHF	1	257.07	82.00	227.00	61.02	*
VLF/HF	2	–1.32	1.20	0.85	1.08	***
LF/HF	2	–1.10	1.38	0.11	0.89	***
VLF/LF	2	–0.21	1.09	0.76	1.18	***
R–R	1	1.02	0.17	0.99	0.12	NS
MSSD	2	8.76	0.76	6.82	0.84	***
CCVVLF	2	0.86	0.44	0.97	0.42	NS
CCVLF	2	0.97	0.55	0.60	0.55	***
CCVHF	2	1.52	0.41	0.55	0.43	***
CCVTp	1	66.48	20.06	41.82	14.43	***

TABLE 3
Mean values ($\overline{x}$) and standard deviations (SD) of the differences of the individual indices (supine minus upright position) for groups of younger (A) and older (B) subjects.
D2 – statistical differences between (supine minus upright position) values.

		group A			group B			
Ind.	Dtr.	$\overline{x}$	SD	D2	$\overline{x}$	SD	D2	D1
PVLF	3	–1493	3976	**	–1303	3618	**	NS
PLF	3	–199.96	1167	NS	–48.69	764.10	NS	NS
PHF	3	2510	2490	***	258.84	483.38	***	***
Tp	3	818.39	4382	NS	–1093	3767	*	***
% VLF	1	–24.29	28.83	***	–9.97	24.98	**	**
% LF	1	–17.80	24.14	***	–3.96	20.56	NS	***
% HF	1	42.09	26.51	***	13.93	12.48	***	***
PSDVLF	3	–205222	579553	**	–239686	617835	**	NS
PSDLF	3	1209	44917	NS	–3815	28215	NS	NS
PSDHF	3	39356	51164	***	4133	7024	***	***
FVLF	3	2.11	13.93	NS	4.33	9.93	NS	NS
FLF	1	13.82	31.54	**	10.63	29.59	**	NS
FHF	1	70.08	76.60	***	18.80	79.40	NS	***
VLF/HF	3	–21.65	61.24	**	–39.97	104.07	**	*
LF/HF	3	–4.41	4.84	***	–5.55	6.94	***	NS
VLF/LF	3	–5.37	19.18	*	–2.07	16.43	NS	NS
R–R	1	0.28	0.11	***	0.17	0.07	***	***
MSSD	3	7200	7054	***	693.70	1280	***	***
CCVVLF	3	–2.94	4.82	***	–1.96	3.78	***	NS
CCVLF	1	–1.46	1.91	***	–0.55	1.30	***	**
CCVHF	1	2.48	2.10	***	0.63	0.80	***	***
CCVTp	3	–15.99	40.19	**	–17.94	36.39	***	NS

Fig. 1
"3D" plot. Spectral analysis of heart rate variability in one young (top) and one older (bottom) healthy subject in supine (T1, T3) and upright (T2) positions. The younger subject shows a greater total power, primarily in the HF component in supine



DER EINFLUSS DES ALTERS AUF DIE VARIABILITÄT DER HERZFREQUENZ BEI DER KURZEN AUFNAHME

(Zusammenfassung des englischen Textes)

Das Ziel der Arbeit ist, die Abhangigkeit der Parametern der kurzen Aufnahme der Spectral Analyze die variabilität der Herzfrequenz von dem Alter beim Stand und Liegen festzustellen. 132 gesunde Personen wurden getestet (76 Männer und 56 Frauen). Sie waren in zwei Gruppen nach dem Alter geteilt: 12–24 Jahre (n=62) und 43–70 Jahre (n=70). Die Gesamtspektralleistung war in drei Komponenten geteilt: die hohe Frequenz (150–500mHz), die mittlere Frequenz (50–150mHz) und die niedrige Frequenz (20–50mHz). Die Werte der Gesamtspektralleistung, der Parametern gerechneten von den Komponenten LF und HF und der durchschnitlichen Frequenz von den LF und HF Komponenten im Liegen wurden signifikant niedriger bei der Gruppe der älteren Probanden als bei der jüngeren Gruppe. Im egenstand, die Werte der Parametern % VLF, VLF/HF, VLF/LF und LF/HF wurden signifikant höher bei der älteren Gruppe. Die Unterchiede zwischen den Werten, die im Liegen und und im Stand festgestelt wurden, waren entweder signifikant niedriger bei der alteren Gruppe oder sie haben sich nicht signifikant unterschieden; nur die Änderung der gesamt Spektralleistung war signifikant höher bei der älteren Gruppe.

Schlüsselwörter: der autonome Nervensystem, der Alter, HRV, das aktive Orthostatischemanöver.

VLIV VĚKU NA KRÁTKODOBÝ ZÁZNAM VARIABILITY SRDEČNÍ FREKVENCE

(Souhrn anglického textu)

Cílem práce bylo stanovit závislost parametrů, získaných z krátkodobého záznamu spektrální analýzy variability srdeční frekvence v lehu a ve stoji, na věku. Vyšetřili jsme 132 zdravých jedinců (76 mužů a 56 žen) ve věku: 12 až 24 let (1. Skupina, n = 62) a 43 až 70 let (2. Skupina, n = 70). Celkový spektrální výkon byl rozdělen do tří komponent: s vysokou frekvencí (HF) (150–500 mHz), s nízkou frekvencí (LF) (50–150 mHz) a s velmi nízkou frekvencí (VLF) (20–50 mHz). Ve skupině starších osob jsme zjistili signifikantně nižší hodnoty celkového spektrálního výkonu, parametrů vypočítaných z komponenty LF a HF a průměrné frekvence komponent VLF a HF ve srovnání se skupinou mladších osob v poloze v lehu. Naopak, hodnoty parametrů %VLF, VLF/LF, VLF/HF a LF/HF byly ve skupině starších osob signifikantně vyšší. Rozdíl mezi hodnotami v leže a ve stoje byl ve skupině starších osob ve srovnání se skupinou mladších nižší, nebo se významně nelišil; pouze změna v celkovém spektrálním výkonu byla signifikantně větší ve skupině starších osob.

Klíčová slova: autonomní nervový systém, spektrální analýza, stárnutí, variabilita srdeční frekvence, aktivní ortostáza.

SOMATICAL DIAGNOSIS OF WOMEN IN THE AGE OF MATURUS AND PRESENILIS – FEMALE STUDENTS OF THE UNIVERSITY OF THE 3RD AGE AT THE FACULTY OF PHYSICAL CULTURE AT PALACKÝ UNIVERSITY IN OLOMOUC

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In the framework of completing the aim of the project supporting health, which is entitled "Intervention programme for optimal mobility and its influence on health" in June 1998 we carried out a physical diagnosis of University students of the 3rd age at the Faculty of Physical Culture. The test group finished the 2nd year with a specialisation "Journey to health, organism regeneration by movement", which dealt with a group of comparative psychological and physical activity. One of the basic research intentions, which is solved in the field of anthropology, is diagnosing physical status, postural function and mobility stereotype in a population group with specific and non-specific physical activities, from the widest age spectrum. In the framework of preventative care they are diagnosed and then recommended and practice compensatory physical exercise.

Keywords: physical diagnosis, muscular function, kinetic stereotypes, population age of maturus and presenilis.

INTRODUCTION

The aim of the research was an assessment of physical status, postural function and kinetic stereotypes. A two year specialised University specialisation of the 3rd age introduces an array of theoretical and practical programmes, a scientific approach to understanding the regenerative function of mobility, following with the application of suitable exercise, stimulating flexibility and strength in the subjects. The main idea is improvement and stabilisation of physical integrity in individuals, including the creation of conditions for changes in life style.

METHODOLOGY

We investigated 31 women, their average age was 60.83 years (with an age range of 45.69 – 69.37 years). For the somatometrical analysis standard anthropometry and instruments were used, for the examination of the muscles, the modified method of Janda 1996 was used. Muscle dysbalance is a dynamic phenomenon, with relative numerous changes in relation to quantity and variability of physical activity, sex, age and psychological factors.

RESULTS AND DISCUSSION

TABLE 1 shows the above mentioned basic statistical characteristics of the examined and calculating somatometrical characteristics.

TABLE 1
Somatometrical parameters of the women of the University of the 3rd age, n = 31

Features	M	SD
Age	60.83	5.26
weight	66.20	8.57
weight dex.	33.30	5.15
weight sin.	32.90	6.07
dif. dex. / sin.	5.20	4.84
height	160.00	5.26
upper extr. length	71.60	2.62
lower entr. length	86.50	3.29
elbow breadth (biepi hum)	6.60	0.35
knee breadth (biepi fem)	9.60	0.78
ankle breadth (sph-sph)	6. 80	0.38
wrist breadth (sty-sty)	5.50	0.28
arm circumference relaxed	27.60	2.41
arm circumference tensed	29.80	2.78
mid-thigh circumference	50.90	5.01
calf circumference max.	35.80	3.36
fat % by Pařízková	23.60	4.03
Composition of the body by		
Matiegka skeleton kg	9.80	1.17
skeleton %	14.78	1.75
muscles kg	22.86	3.60
muscles %	34.31	3.97
fat kg	17.70	4.84
fat %	26.10	5.24
reziduum kg	16.54	4.72
reziduum %	24.81	6.24
endomorph. comp.	5.40	1.23
mesomorph. comp.	5.70	1.42
ectomorph. comp.	0.60	1.18

Fig. 1
Values of normalization indexes of the measured features

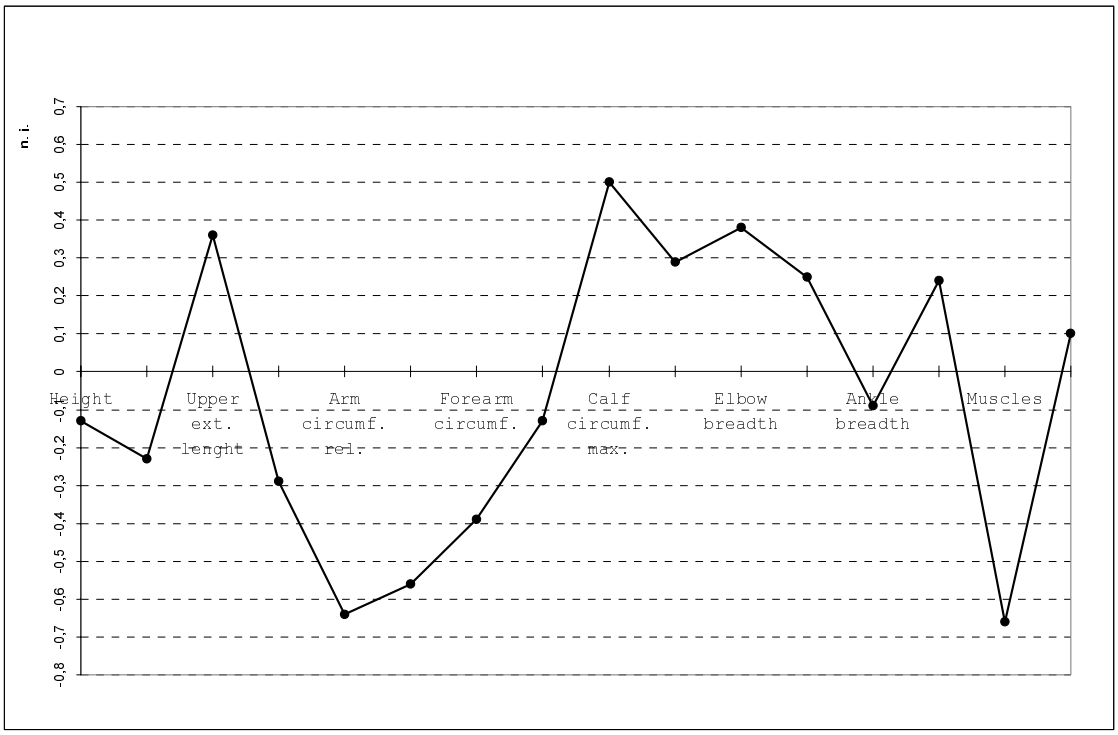
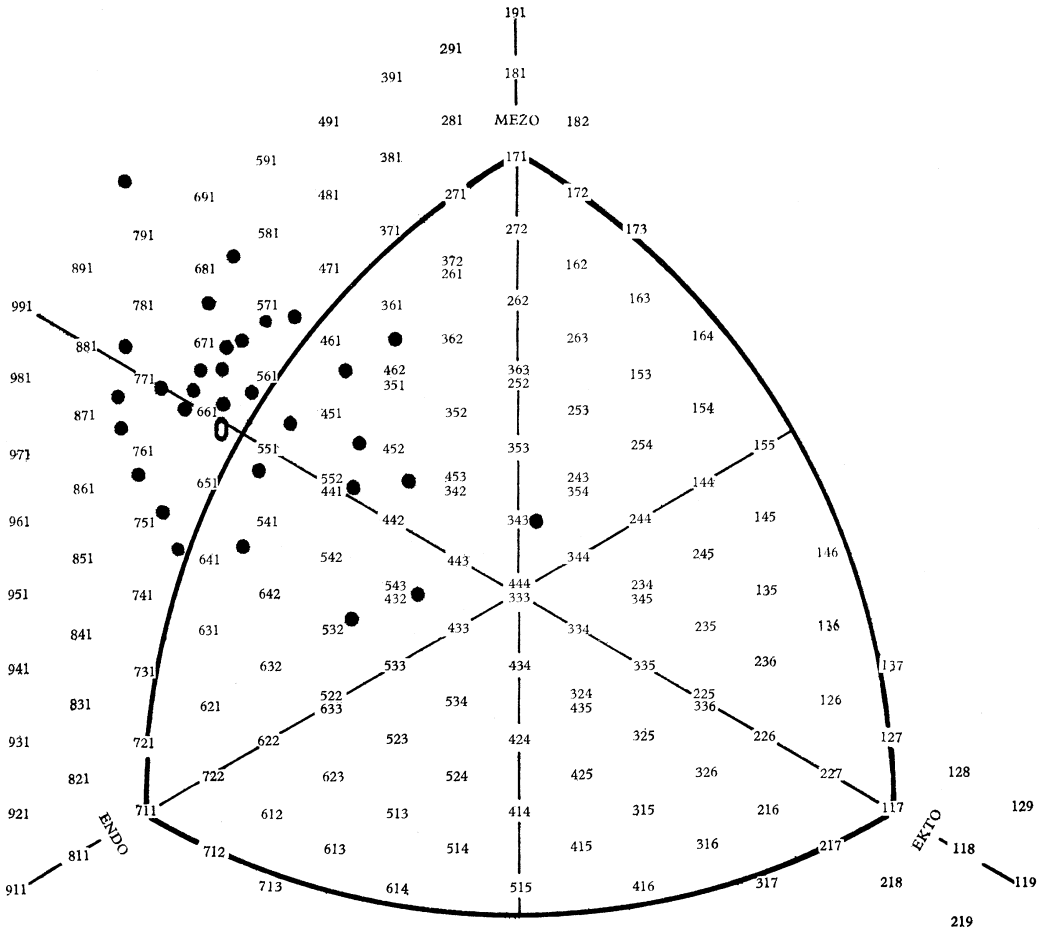


Fig. 2
Individual somatotypes of the studied women U3rdA, n = 31



A comparison of the physical parameters with the population norm with the help of the standard deviation, shown in Fig. 1. All of the measured indicators fluctuate between ±0.75 s, it means in between the average.

A very low rank on the standard deviation for fat fraction indicates the physical state of the senior Czech female population, because in our selected group 64.51% of women were classified as having obesity of a lower and middle degree (51.61%, 12.90%). 32.26% of the tested people were classified as having normal mass. Only in 1 case was it near the lower limit of normal mass measured by the BMI, it means that only 1 woman was thin (3.22%). Also the average rank of the BMI in the higher 25.83 unit confirms obesity of a lower level.

The average quantity of fat according to Pařízková was 23.6%. The Matiegka method however showed 26.10% fat, the average endomorfine level gave 5.4 points. The highest quantity of fat was cumulated on the thighs, triceps and stomach, the smallest thickness of body hair was found on the face and on the forearm.

Individual somatotypes are concentrated in the mesomorphic-endomorphic and endomorphic-mesomorphic type, especially on the border of the somatograph. The average somatotype gained a rank of 5.4–5.7–0.6 and was also found to be on the border of the somatograph. If one talks about linear proportionality, the relative length of the upper limbs is average in all of the studied groups macrobrachial (with long upper limbs). The relative length of the lower limbs characterises women's metroskeletal (with middle length lower limbs).

We also followed the symmetry by breaking down the weight by weighing on two scales. We know, that on standing limbs there is always a bigger stress than on the support limbs, with standing straight the sides difference should not exceed 10% of total mass.

The average rank of mass difference between the sides is plotted in total in (TABLE 1). In 29.03% (9) there was found a higher weight bearing limb, in 61.29% (19) also a higher right weight bearing limb. In 9.68% (3) it was found to be balanced. Differences higher than 10% when comparing limbs on both sides of the body was found in 22.58% (7), with a maximum of 16kg on the right side.

The discovered evidence about the state of the postural function and movement stereotype indicates an interesting relationship.

TABLE 2
Frequency of shortening postural muscles, women U3rdA, n = 31 1 = 3.23%

Muscle/muscle group	n	%
m. trapezius sin.	29	93.55
m. trapezius dex.	29	93.55
m. pectoralis maj. sin	6	19.35
m. pectoralis maj. dex	6	19.35
m. erector spinae – lumbar section	31	100.00
m. iliopsoas	10	32.26
m. rectus femoris	9	29.03
m. tensor fascie latae	10	32.26
femoral adductors	24	77.42
knee joint flexors	12	38.71
m. triceps surae	3	9.68

TABLE 3
Frequency of weakened muscles and muscle groups, imperfect movement stereotypes, women U3rdA, n = 31

Muscle/muscle group	n	%
m. rectus abdominis	30	96.77
m. gluteus max.	25	80.64
m. glut. med. and min.	22	70.96
deep neck flexors	3	9.68
lower scapula fixators	13	41.94
upper extr. length abduction	14	45.16

Further division status of the m. rectus abdominis:

weakened	middle weakened	satisfactory	good
22 (70.97%)	8 (25.81%)	1 (3.22%)	–

TABLE 4
Trapped pain in a section of the spine and joints, women U3rdA, n = 31

	n	%
neck section	16	51.61
chest	4	12.90
hips	21	67.74
shoulder joint	2	6.75
hip joint	12	38.71
knee joint	7	22.58
talar joint	1	3.22

In almost 100% where both sides had a shortened m. trapezius were accompanied by a fault in the axial balance in the area crossing the cervical and thoracical spinal column. The area C6, C7 to Th1 with serious phenomenon as inactive, with part worn out tissue fat in the area aponeurosis m. trapezius.

During the evaluation of the stereotype abduction of the upper limb in 46.7% the substitute stereotype was found, when as the first activated short m. trapezius, with a following overload on the cervical spinal column.

Paravertebral muscles in the lumbar section of the spine were shortened in all of the groups, that is in 100%. We believe this is part of the compensatory response to weakening of the m. rectus abdominis and mm. glutaei (TABLE 4).

Fig. 3
A comparison of the occurrence of shortened muscles in the group of women in the age of maturus (M, n = 48, average age 32.94) and presenilis (P, n=31, average age 60.83)

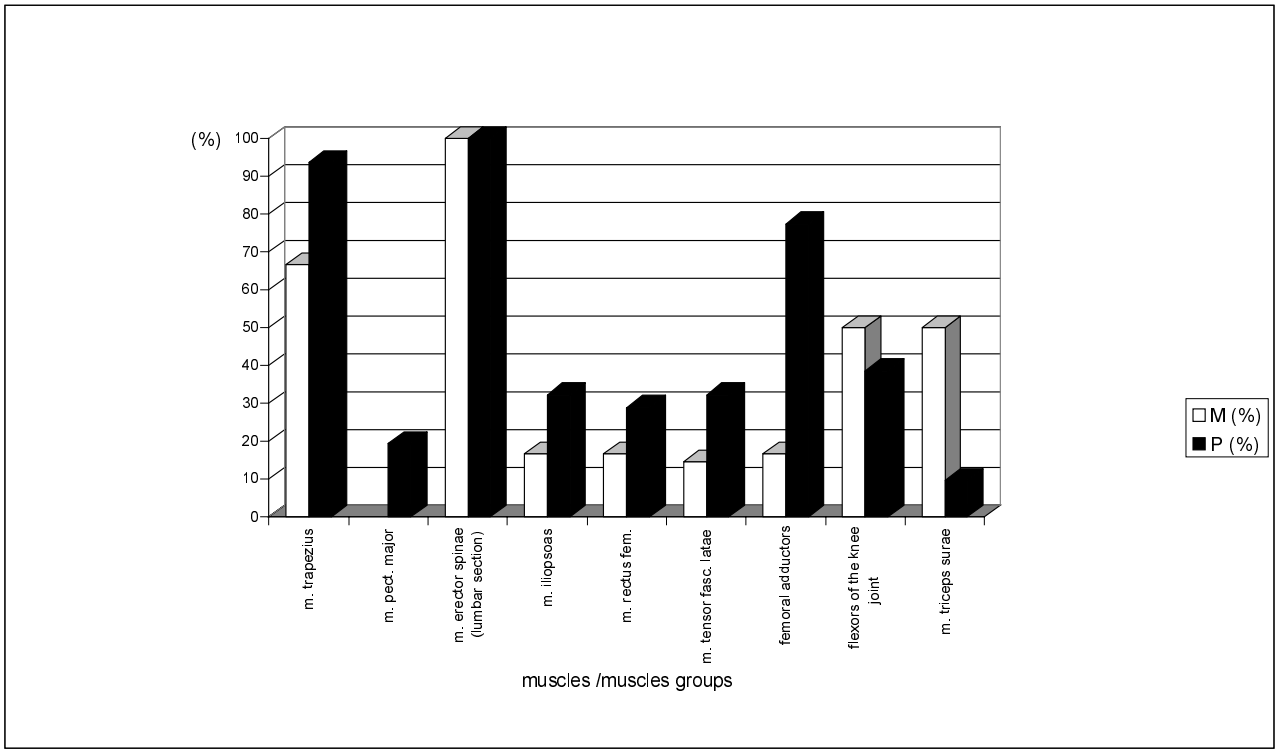
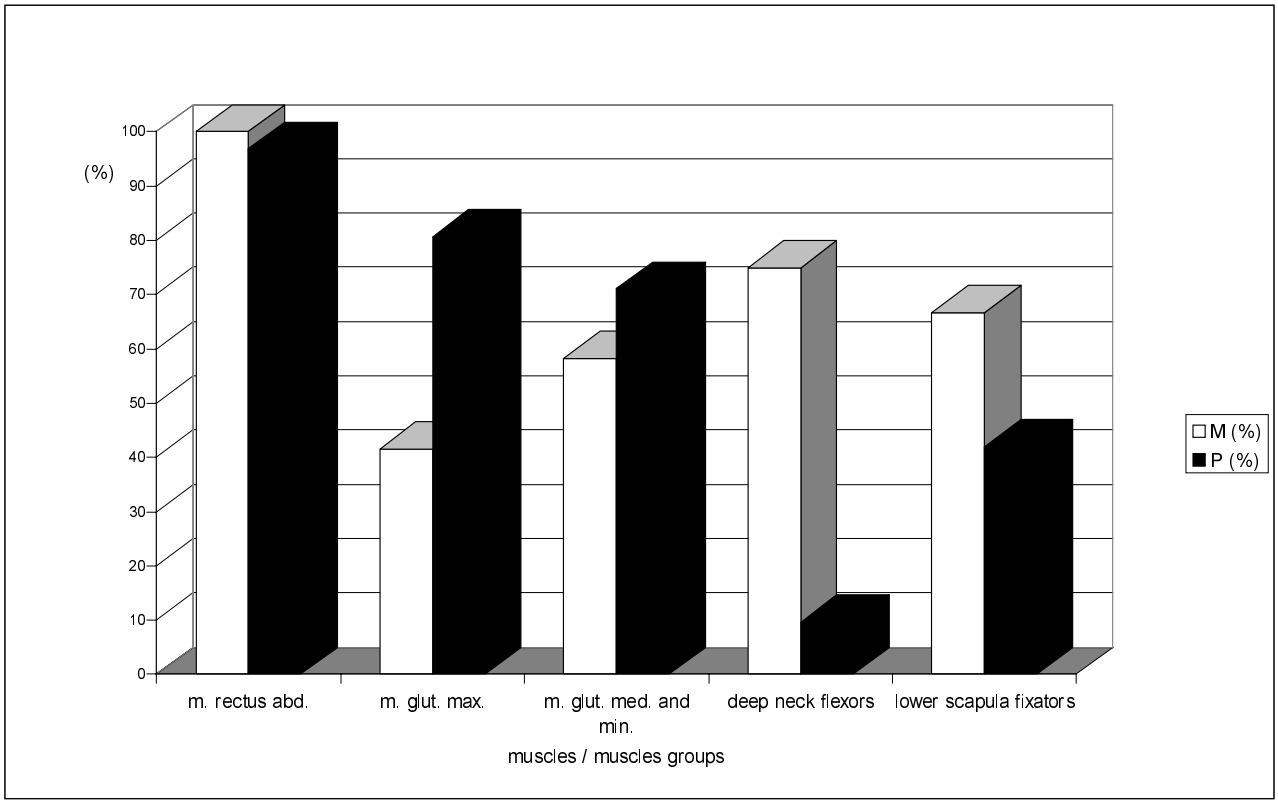


Fig. 4
A comparison of the occurrence of weakened muscles in the group of women in the age of maturus (M, n = 48, average age 32.94) and presenilis (P, n=31, average age 60.83)



We know that the stomach muscles ensure flexibility of individual segments of the spine against each other. The first time composition partial inflexions originated in the kyphosis spine, which is actually a function of the stomach muscles. Kyphotisation (trunk flexation) can carry on without the participating movement of the pelvis. Forward bend pelvis is secured mainly with the help of the m. iliopsoas. Dominant manifestation of the m. iliopsoas in the row movement of the trunk is connected with disruption of the statical relationship in the whole axial system.

The elasticity of the flexors is from a kineziological point of view stated as a compensation mechanism for the stability of the hip joints. Flexors in the hip joints were in the studied group of women shortened in relation to the low percent (m. iliopsoas 32.26%, m. rectus femoris 29.03% and m. tensor fasciae latae 32.26%). At the same time the flexors in the knee joints and m. triceps surae were for the most part in a good state.

The elasticity of the m. iliopsoas rather increases the movement in the hip joints, of course at the expense of overload on the lumbar part of the spine.

The results of the trunk bending tests also correspond with this fact.

Trunk bending exam:

shortening	good condition	substitute hypermobility
11	7	13
35.48%	22. 58%	41.93%

In all of the cases shown tipping pelvis in hip joints, in 41.93% to the end displayed substitute hypermobility. A good condition is demonstrated when the proband bents down to touch the floor, this was found in 22.58%, only 35.48% of probands could not touch the floor. The ascertained percentage corresponds with the occurrence of short flexors in the knee joints.

Stiffness in the lumbosacral segment with us phenomenon like a specific compensator adapter ensuring the stability of the spine. Their disturbance (for example disadvantageous exercise), with regard to the assumed degeneration, age condition change in the section L1–L5 and S1, should accentuate the vertebrae problem.

From clinical syndromes emphasises the lower crossed syndrome type B, where there are short paravertabrae muscles in the lumbar segments (in 100%) and weakened the m. rectus abdominis (96.77%).

Results from the ranking of the postural function in the tested middle aged men and women were published in 1998 (Riegerová, Kvasničková 1998). The resulting data is compared with the findings in the group of women U3rdA and shown in graph 3 and 4.

Differentiation in the frequency of shortened muscles are in the majority of cases insignificant, as is the shortening adductor muscle in the hip joint, in the disadvantaged older group. On the other hand the frequency of short m. triceps surae is in the group of women U3rdA significantly lower. If we talk about the ranking of muscle weakening, we find a significant higher level of substituted movement stereotypes in the older group of women. Older women, however, have a significantly better status of deep neck flexors and lower scapula fixators.

CONCLUSIONS

In the framework of completing the aim of the project supporting health from the Ministry of Health, in 1998 we carried out a physical diagnosis of 31 University female students of the 3rd Age at the Faculty of Physical Culture, Palacký University in Olomouc. The test group finished in the 2nd year with a specialisation "Journey to health, organism regeneration by movement". Their average age was 60.83 years. Somatometrical parameters of the studied women fluctuated within the normal Czech population for the appropriate age category. In 64.51% of the research group obesity was found at lower and middle degrees. At the same time the average somatotype type characterised mesomorphic – endomorphic and was placed at the border of the somatograph. In a ranking of symmetry by breaking down the weight by weighing on two scales in only 22.58% there were found differences higher than 10% mass when comparing limbs on both sides of the body, with a maximum of 16kg on the right side. Analysis of muscle dysbalance and kinetic stereotypes showed in almost 100% a shortening of the m. trapezius in both sides, followed by disorders in axial balance in the area of the cervical and thoracical spinal column. Paravertebrae muscles in the lumbar section of the spine were shortened in all of the research group. Flexors of the hip joints were in relative good condition, with the domination of the m. iliopsoas in the row movement group. In the trunk bending test a tipping pelvis in the hip joints was discovered in all cases, in 41.93% there was even found substituted hypermobility. In the area of clinical syndrome dominated the lower crossed syndrome type B dominated, where are shortened paravertebrae muscles in the lumber segment (100%) and weakened the m. rectus abdominis (96.77%). When the results are probed an interesting comparison can be made with the findings of the relatively younger women, this highlights the possibilities of primary prevention with an appropriately chosen mobility programme.

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SOMATODIAGNOSTIK BEI FRAUEN IM ALTER MATURUS UND PRÄSENILIS – STUDENTINNEN AN DER SENIORENUNIVERSITÄT AN DER FAKULTÄT FÜR KÖRPERKULTUR DER PALACKÝ–UNIVERSITÄT IN OLOMOUC
(Zusammenfassung des englischen Textes)

Im Rahmen der Durchführung des Vorhabens "Projekt der Gesundheitsförderung des Gesundheitsministeriums der CR" führten wir 1998 eine somatodiagnostische Untersuchung bei 31 Studentinnen der Seniorenuniversität an der FTK UP in Olomouc durch. Die Prüfpersonen schlossen den 2. Jahrgang der Spezialisation "Weg zur Gesundheit, Regeneration des Organismus durch die Bewegung" ab. Ihr durchschnittliches Alter betrug 60,83 Jahre. Die somatometrischen Kennlinien der untersuchten Frauen beliefen sich in den Grenzen des Normativs der tschechischen Population der entsprechenden Altersgruppe. Bei 64.51% der Prüfpersonen wurde eine Fettleibigkeit des mäßigen oder mittleren Grads ermittelt. Ebenfalls der durchschnittliche Somatotyp charakterisierte die Mesomorphe–Endomorphe und er befand sich außerhalb der Grenze des Somatographs. In der Bewertung der Symmetrie der Zerlegung des Gewichts durch Wiegen auf zwei Waagen wurde nur in 22.58% eine seitenbedingte Differenz über 10% des Gewichts, mit einem Maximum von 16 kg auf der rechten Seite, ermittelt. Die Analyse der Muskeldysbalancen und der Bewegungsstereotype bestätigte eine beinahe 100% beiderseitige Verkürzung des M. Trapesius, begleitet durch die Störungen des Achsengleichgewichts im Bereich des Übergangs zwischen der Hals- und Brustwirbelsäule. Die paravertebralen Muskeln im Wirbelsäulen–Lendenbereich waren bei allen Prüfpersonen verkürzt. Die Flexoren des Hüftgelenks befanden sich in einem relativ guten Zustand, mit der Dominanz des M. ilipsoas in einer ganzen Reihe von Rumpfbewegungen. Beim Vorbeugen machte sich in allen Fällen ein Kippen des Beckens in den Hüftgelenken, in 41.93% dann sogar eine Substitutionshypermobilität bemerkbar. Von den klinischen Syndromen dominierte das untere Kreuzsyndrom des B–Typs, wo die paravertebralen Muskeln in lumbalen Segmenten verkürzt (100%) und der m. rectus abdominis abgeschwächt ist (96.77%). Interessante Ergebnisse der Sonde und ihr Vergleich mit Befunden bei wesentlich jüngeren Frauen deuten die Möglichkeiten der primären Vorbeugung durch richtig gewählte Bewegungsprogramme an.

Schlüsselwörter: Somatodiagnostik, Muskelfunktionen, Bewegungsstereotype, Population im Alter Maturus und Präsenilis.

SOMATODIAGNOSTIKA ŽEN VE VĚKU MATURUS A PRESENILIS – POSLUCHAČEK UNIVERZITY 3. VĚKU NA FAKULTĚ TĚLESNÉ KULTURY UNIVERZITY PALACKÉHO V OLOMOUCI
(Souhrn anglického textu)

V rámci plnění záměru Projektu podpory zdraví MZ ČR jsme v roce 1998 provedli somatodiagnostické vyšetření 31 posluchaček Univerzity 3. věku na FTK UP v Olomouci. Probandky končily 2. ročník specializace „Cesta za zdravím, regenerace organismu pohybem". Jejich průměrný věk byl 60. 83 let. Somatometrické parametry vyšetřených žen se pohybovaly v mezích normativu české populace příslušné věkové kategorie. U 64. 51% probandek byla klasifikována obezita mírného a středního stupně. Rovněž průměrný somatotyp charakterizoval mezomorfy-endomorfy a byl umístěn za hranicí somatografu. V hodnocení symetrie rozložení hmotnosti vážením na dvou vahách, byl pouze ve 22. 58% nalezen stranový rozdíl vyšší než 10% hmotnosti, s maximem 16 kg pravostranně. Rozbor svalových dysbalancí a pohybových stereotypů prokázal téměř 100% oboustranné zkrácení m. trapezius, provázené poruchami osové rovnováhy v oblasti přechodu krční a hrudní páteře. Paravertebrální svaly v bederním úseku páteře byly zkráceny u všech probandek. Flexory kyčelního kloubu byly v relativně dobrém stavu, s dominancí m. iliopsoas v řadě pohybů trupu. U zkoušky předklonu se ve všech případech projevilo sklápění pánve v kyčelních kloubech, ve 41.93% se dokonce projevila substituční hypermobilita. Z klinických syndromů dominoval dolní zkřížený syndrom typu B, kdy jsou zkráceny paravertebrální svaly v lumbálních segmentech (100%) a oslaben m. rectus abdominis (96.77%). Zajímavé výsledky sondy a jejich srovnání s nálezy u žen podstatně mladších naznačují možnosti primární prevence vhodně zvolenými pohybovými programy.

Klíčová slova: somatodiagnostika, svalové funkce, pohybové stereotypy, populace věku maturus a presenilis.

A COMPARISON OF CZECH AND POLISH STUDENTS IN TERMS OF MUSCLE FUNCTIONS

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Movement activities perceived as a natural and basic demonstration of human organism functions have been recently the centre of close attention, especially in two dimensions: in hypokinesia and in one – sided intensive pressure, as both of them have an unpleasant influence on the supportive – movement system. The examining of ideal movement system operation and its defects within various population groups is incorporated into a long term project (that have started in 1991) at the Department of Functional Anthropology and Physiology, Faculty of Physical Culture, Olomouc. This project was developed with the intention to gain the possibility of adjusting the non – physiological state. This problem can be modified only when the initial state is known. This paper also includes the results of international co-operation with the Department of Anthropology and Biometrics Faculty of Physical Education (FPE) in Poznań. We proceeded from the assumption that the operation of the movement system can be affected by the spectrum, capacity and intensity of the movement activities that can be found within certain groups of the population with variable frequency. An analysis of disorders of the muscular functions of Polish and Czech students was worked out. The students are influenced by similar social conditions affecting the choice of movement activity. The comparison of the movement system state of the Czech students at different time periods was stimulated by the change of social conditions after the year 1989 and the relatively long time period of 9 years. The shortening of postural muscles together with the weakened phasic muscles are manifested by the formation of substitution movement stereotypes with imbalanced requirement on the specific parts of the human body.

Keywords: muscle test, muscle dysbalance, postural and phasic muscles, movement stereotypes.

INTRODUCTION

As for hypokinesia and one – sided intensive pressure it is possible to consider the movement activities as an unpleasant and unhealthy' aspect of an active life – style which can result in disorders and, later, even in structural defects of the supportive – movement system. The reversible changes in the structures of the given system will gradually result in pain problems and uneconomical movement forms.

The defective movement stereotypes are beyond the biomechanical principles and are probably natural for each individual. The problem of the correct posture without any muscle dysbalance or its damages was defined by many authors from various points of views at different time periods (Janda 1996, Kabelíková, Vávrová 1997, Kapandji 1992, Kendall 1993, Kolář 1996, Kolisko et al. 1995, Kováčiková, Beranová 1997, Kučera 1997, Lewitt 1990, Thurzová, Dlhoš 1997, Riegerová 1997, Véle 1997). The defective posture can be manifested by the dysfunction of the respiratory system and can have a negative influence on the psychic of an individual. The examining of postural and phasic functions in selected population groups should draw our attention to the given situation and try to force the society to take preventive activities starting in early childhood.

Hypokinesia is a remarkably frequent problem in contemporary society that appears even among the youngest population and is mainly caused by the prevailing tendency towards passive ways of spending free time (television, videos and computers are an inseparable part of the modern life style) together with excessive caloric intake. These family engrams tend to be sustained well into adulthood. The effect of hypokinesia is often hypotonia, muscle ischemia, plethora of ligaments and also fibrosis. Its external symptom is muscle dysbalance accompanied by a defective posture.

One – sided intensive movement pressure is natural for active sportsmen and can also lead to a maladaptive influence on the supportive – movement system. When it is not suitably complemented by an ideal rate of relaxation and stretching exercises, sportsmen are much inclined to injuries of muscle attachments, ligaments and joint capsule. 'The injured', non-physiological joint is considered to be the limiting factor for reaching maximum sport performance in an

individual. One – sided intensive pressure during the process of training is dangerous especially for children as there arises the danger of uneven development of determined physical fractions during ontogenesis.

THE METHOD

Janda's method (1996) for muscle function testing was applied. The test battery consists of the shortened and weakened muscles tests and also provides analyses of some of the movement stereotypes as well as hypermobility. In the paper we compare the functional state of Czech 1st year male – students (A1, n = 80) and female – students (A2, n = 70) of Faculty of Physical Culture (FPC) UP in 1997/98 to 1st year male – students (B1, n = 69) and female – students (B2, n = 64) of Faculty of Education (FE) UP in 1989/90 (Bartošková et al. 1991) to Polish male – students (C2, n = 72) and female – students (C2, n = 72) of Faculty of Physical Education (FPE) in Poznań in 1997/98. We examined 11 muscle groups tending to shortening, 7 muscle groups tending to be weakened and made 3 hypermobility examinations. The A1, A2, C1 and C2 groups were examined by an identical person and the groups B1, B2 were examined in 1989 by experts from FE UP and only the postural functions were judged. Janda's method was applied in groups A1, A2, C1, C2 and the groups examined in 1989 were tested according to an earlier version, which is not remarkably different. All of the examined students were students of physical education combined with other subjects. They all had a positive attitude to movement activities with higher intensity and capacity.

The results of muscle dysbalance tests were evaluated by case and percentual analysis. The test of 2 relative value differences was applied in the statistical comparison which were tested on the level of importance $p < 0.05$ (*).

RESULTS AND DISCUSSION

The analysis of postural muscle functions and defective movement stereotypes led to following conclusions. As for the students of FPC UP (A1) the shortening of the upper part of m. trapezius was found equal on both sides of the trunk (Fig. 1). On the other hand, the right– side shortening was located in the area of the shoulder joint to a great extent (the test of stretching arms backward). It is important to mention the shortened m. erector spinae and mm. pectorales. In group A1 the shortened m. quadratus lumborum was not very frequent (up to 30%).

Concerning the lower extremities, the shortening of more than 50% of m. rectus femoris, m. tensor fasciae latae, m. semitendinosus, m. semimembranosus and m. biceps femoris was found. The thigh adductors, m. iliopsoas and m. triceps revealed lower density of shortening (20–30%). The shortening of mentioned lower extremities muscles together with the described weakened muscle groups proves the appearance of lower crossed syndrome which is typical for weakened mm. glutei or mm. abdomini and the shortened coxa flexors. The location of muscle dysbalance in coxa flexor implies a disturbance in the walking movement stereotype.

Muscle dysbalance in the axial system considerably affects biomechanical rates in other parts of the human body. The change of movement stereotypes is not only influenced by the disturbance of the shortened and weakened muscle function but also by the change in antagonists, agonists and stabilising muscles functions. The presence of dysbalance is accompanied in a relatively high number of students with hypermobility while testing forward bending (Fig. 3). This sort of hypermobility can be explained by the substitution of moving abilities in the area of the coxa joint.

The situation changed a bit in comparison with the FPC students (A1) and the students examined 9 years ago (B1) who were diagnosed with different types of shortened muscle of much lower frequency. Test results show a relatively better postural muscle state than that of formerly examined students FE (B1).

Students from the B1 group had statistically considerably shortened m. iliopsoas (Fig. 1). In the case of the A1 students group the frequency of this shortened muscle can be considered as negligible. Significantly lower frequency of muscle shortening in the B1 group was found in m. rectus femoris, m. tensor fasciae latae and in the trunk area in m. erector spinae, mm. trapeziii and in the muscles of the right trunk shoulder girdles (the test of stretching arms backwards).

The analysis of weakened muscle function and movement stereotypes was not carried out due to lack of basic data.

When comparing the Polish students (C1) with the FPC students (A1) over the same time period, a significant difference in m. iliopsoas shortening frequency was found. Statistically a significant difference in mm. trapeziii shortening (with numerically stable side symmetry) is accompanied by a false level of shoulder girdle muscles together with poor results in the stretching arms backwards test. On the other hand, a statistically significant lower difference for the benefit of the group C1 concerns m. rectus femoris, knee flexors, thigh adductors and the trunk m. erector spinae. The symptoms of lower crossed syndrome was diagnosed in both A1 and C1 groups. In the evaluation of postural muscles, the students of FPC (A1) appeared relatively in the worst position from all groups in terms of the number of shortened muscles. There is a close relation between the false state of postural muscles and the higher occurrence of lumbar spinal and knee joints pains in group A1 (Fig. 7, 8).

When dealing with the tendency towards weakness, the state of Czech students FPC (A1) is better than the state of Polish students (Fig. 4). Students from the A1 group had better results in all groups of examined

weakened muscles except for the weakness of m. gluteus maximus and the deep flexors of the neck. The state of abdomen muscles of FPE students (C1) seems to be very poor.

Hypermobility of FPC students (A1) appears very rarely in individual cases except for the trunk bending test, but this problem has already been discussed. Significantly higher differences in the mm. pectorales shortening were found in the group of Polish students (C1).

The explanation for the higher frequency of shortened muscles in Czech students when compared to the weakness in Polish students can be found in the intensity of strengthening exercises of Czech students.

Girls from FPC (A2) displayed the highest frequency of coxa flexors muscle shortening (Fig. 2) – m. rectus femoris and m. tensor fasciae latae, which is quite an alarming find, diagnosed in more than 50%. Left shortened m. trapezius muscle was the second most frequent discovery. Other muscle shortenings were under the 25% level – m. iliopsoas, knee joint flexors, thigh adductors, m. triceps surae, mm. pectorales. The lowest frequecy of muscle shortening was surprisingly discovered in the m. erector spinae. It is thus possible to diagnose the better postural muscle state of FPC female – students (A2) in comparison with the male population (A1), as well as the statistically important difference concerning all muscle groups except m. triceps surae and m. iliopsoas.

In comparison with the A2 group (FPC female – students) and B2 group (female –students examined in 1989/90) we discovered a significantly higher difference of shortened m. rectus femoris, m. tensor fasciae latae and in the left or right bowing test examining the m. quadratus lumborum shortening against group A2. On the other hand, the girls from A2 group had better results in the tests for m. iliopsoas and m. erector spinae (Fig. 2).

Defective movement stereotypes (Fig. 5) in the group of FPC female – students (A2) was shown as significantly higher weakness of coxa extensors while the Polish girls (C2) displayed a minimum of these symptoms. Weakened abdomen muscles appeared in 31,3% of group A2. A similar percentage concerning interscapula muscles and a slightly lower frequency was determined for weakened prevertebral neck muscles. Polish girls (C2) were diagnosed with significantly lower difference in the appearance of weakened mm. abdomini, together with deep neck flexors. On the other hand, significantlly higher difference in the appearance of weakened muscles (in comparison with group C2) was diagnosed for interscapula muscles while doing the press – up test. The comparison of A2 and C2 groups shows the generally better postural muscle state of the Czech female – students, but with the frequent appearance of weakened muscles.

In both groups of Czech and Polish girls we noticed high flexibility around the spine (Fig. 6) in the forward bend test. 17% of Czech girls and 34% of Polish girls were hypermobile in the area of mm. pectorales (this difference was also statistically important).

We found intersexual differences in more frequent appearance of shortening in male groups (A1, C1) and higher weakness of female groups (A2, C2). Male and female students in both the Czech and Polish population had significant differences in the shortening of knee flexors, mm. pectorales and shoulder girdle muscles, men and women from FPC (A1, A2) also in m. erector spinae shortening. Male and female students from AWF (C1, C2) proved statistically important differences in the shortening of m. rectus femoris, m. triceps surae and in the trunk mm. trapezii. Significant differences in the weakened muscles and hypermobility were noticed only in Polish groups (C1, C2) – male students had weakened m. gluteus maximus and female students lower scapula fixators and neck flexors. Hypermobility was significant in Polish women rather than in men.

CONCLUSIONS

This long term examination of all students from FPC allows us to conclude that the state of the supportive – movement system is not optimal.

The worst state of postural muscles from all compared groups was discovered within the Czech FPC students (A1), which is probably related to a lack of sufficient stretch and relaxation exercises after extreme training of the given parts of the body. FPC students were diagnosed with lower crossed syndrome. The high frequency of coxa flexors shortening is alarming. The appearance of muscle dysbalance in the coxa joint reveals the damage of the walking movement stereotype. The shortening of the m. erector spinae and the knee flexors also takes an important role. In the upper part of the trunk we noticed a high frequency of mm. trapeziii shortening, which causes the formation of upper crossed syndrome.

In the case of Czech female students the state of the supportive – movement system is of relatively better quality. When testing shortened muscles test the coxa flexors proved the best results. It would be necessary to strenghten certain muscle groups (especially coxa extensors).

The wide range of shortened muscles was gradually changing. The worst results in the B1 group as for muscle shortening were found in the following muscles: m. iliopsoas, rectus femoris and knee flexors. As for the B2 group the greatest shortenings were found again in the above mentioned coxa flexors and m. erector spinae. It was not possible to compare the weakened muscles and thus the quality of the supportive – movement system can not undergo a complex evaluation of its changes.

The presented results have shown that there are certain defects concerning the supportive – movement system in the group of Polish sportsmen as well. Similar to Czech male and female students, the highest

frequency of coxa flexors shortening was diagnosed. This dysfunction of the lower extremities together with significant muscle shortenings in the upper part of the trunk area (mm. trapeziii, inner – side arm rotator, mm. pectorales), indicates upper crossed syndrome.

With respect to the results it is obvious that many intersexual differences were found in Czech and Polish groups, especially with regard to the higher number of shortened muscles of male students and weakened muscles of female students.

In order to prevent these defects, various educational activities are to be introduced with an emphasis on the movement activities of specific intensity and capacity as well as stressing their quality and variety.

The examining of new students at the entrance diagnosis makes it possible to give each student basic information that can be modified over the course of his/her studies. The mentioned solution might be effective in the prevention of supportive – movement system defects.

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Fig. 1
Comparison of muscle shortenings in A1, B1, C1 groups – men

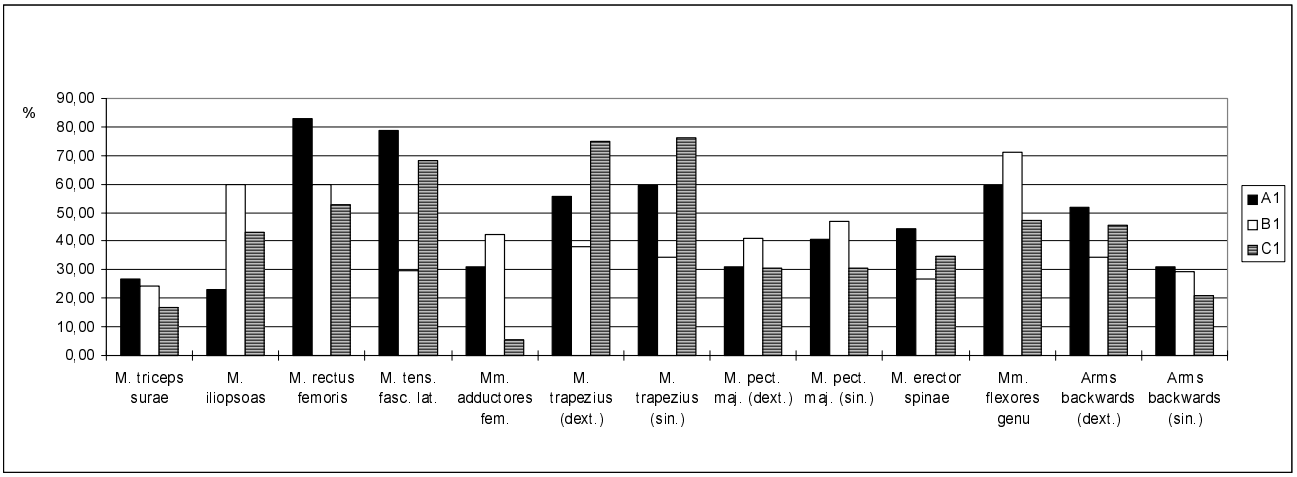


Fig. 2
Comparison of muscle shortenings in A2, B2, C2 groups – women

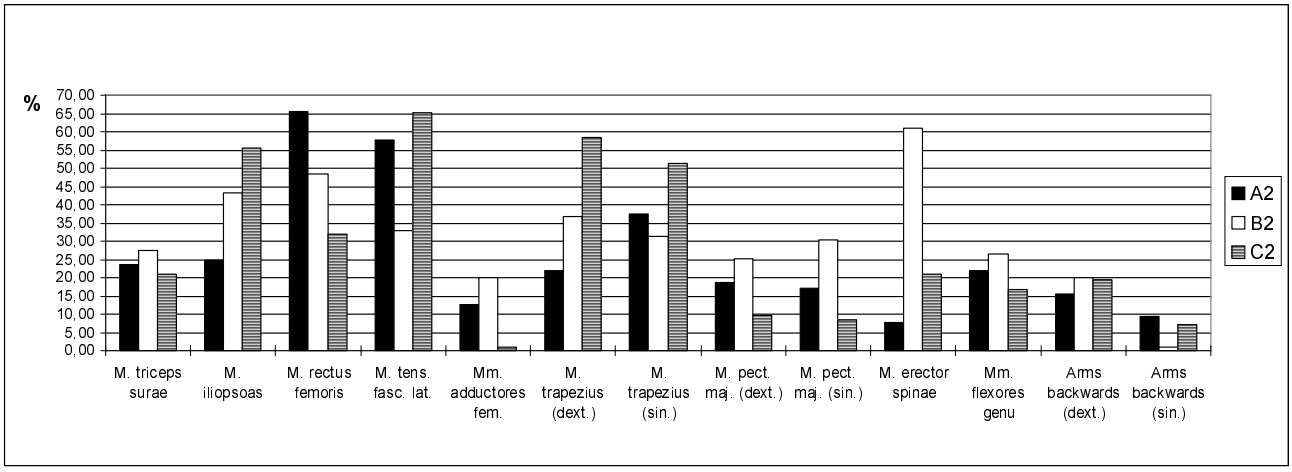


Fig. 3
Comparison of hypermobility in A1, C1 groups –men

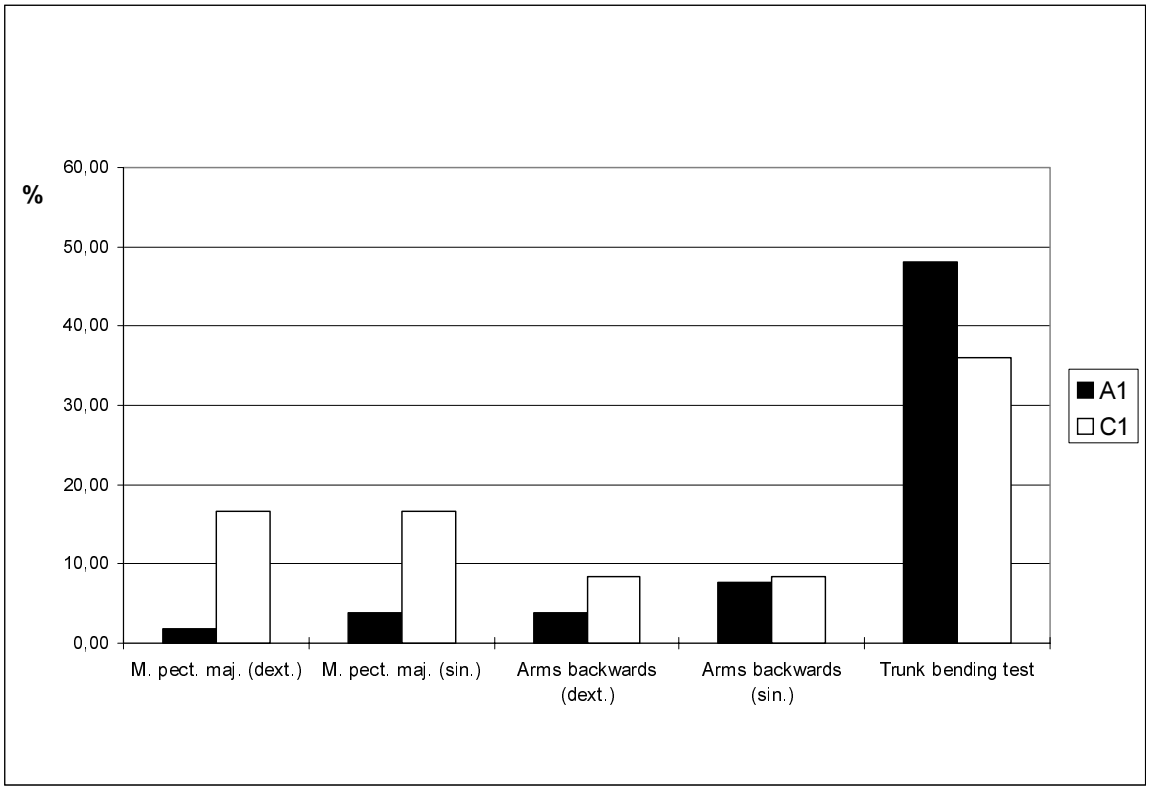


Fig. 4
Comparison of the defective movement stereotypes in A1, C1 groups – men

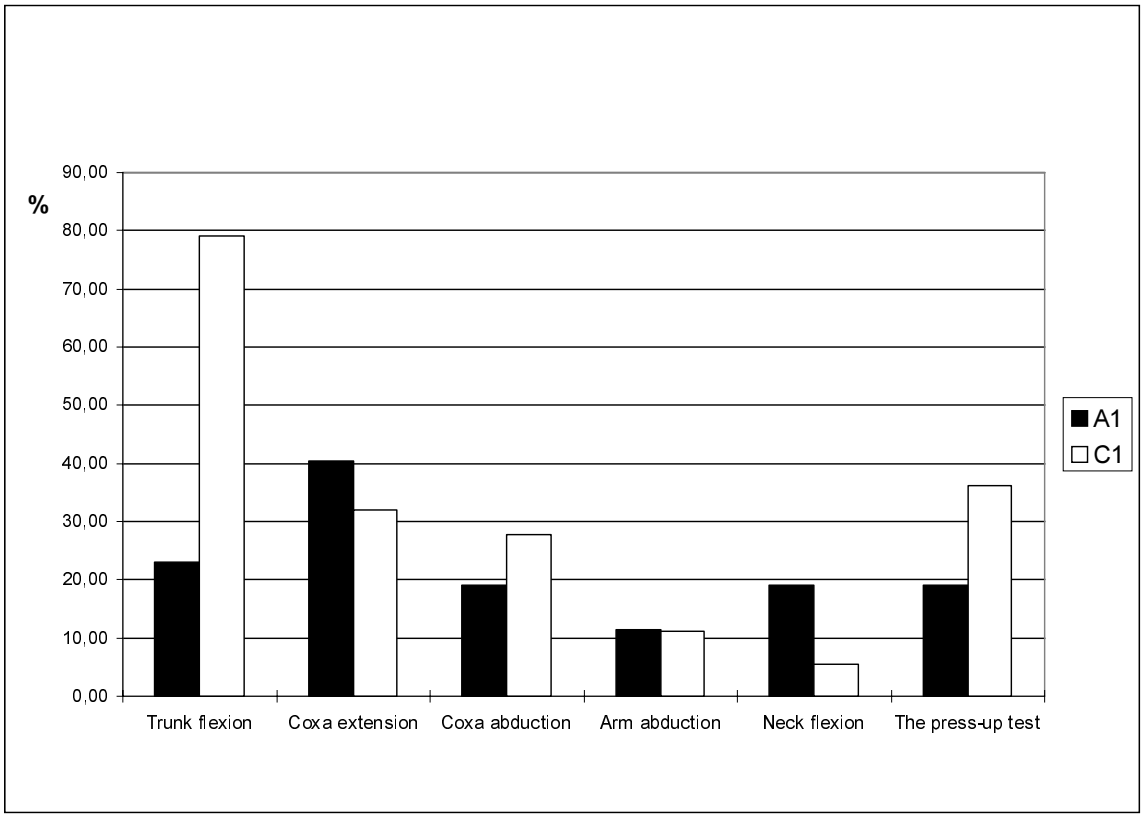


Fig. 5
Comparison of the defective movement stereotypes in A2, C2 groups – women

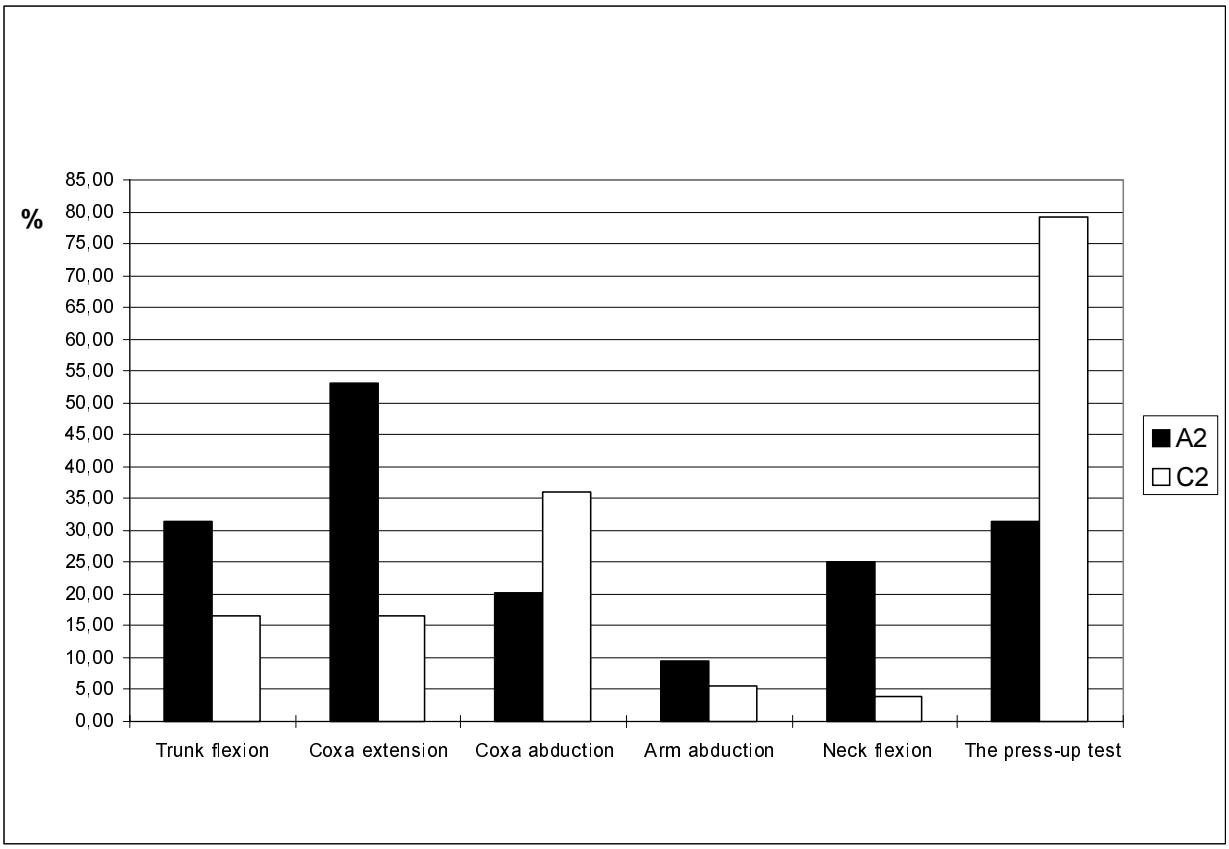


Fig. 6
Comparison of hypermobility in A2, C2 groups – women

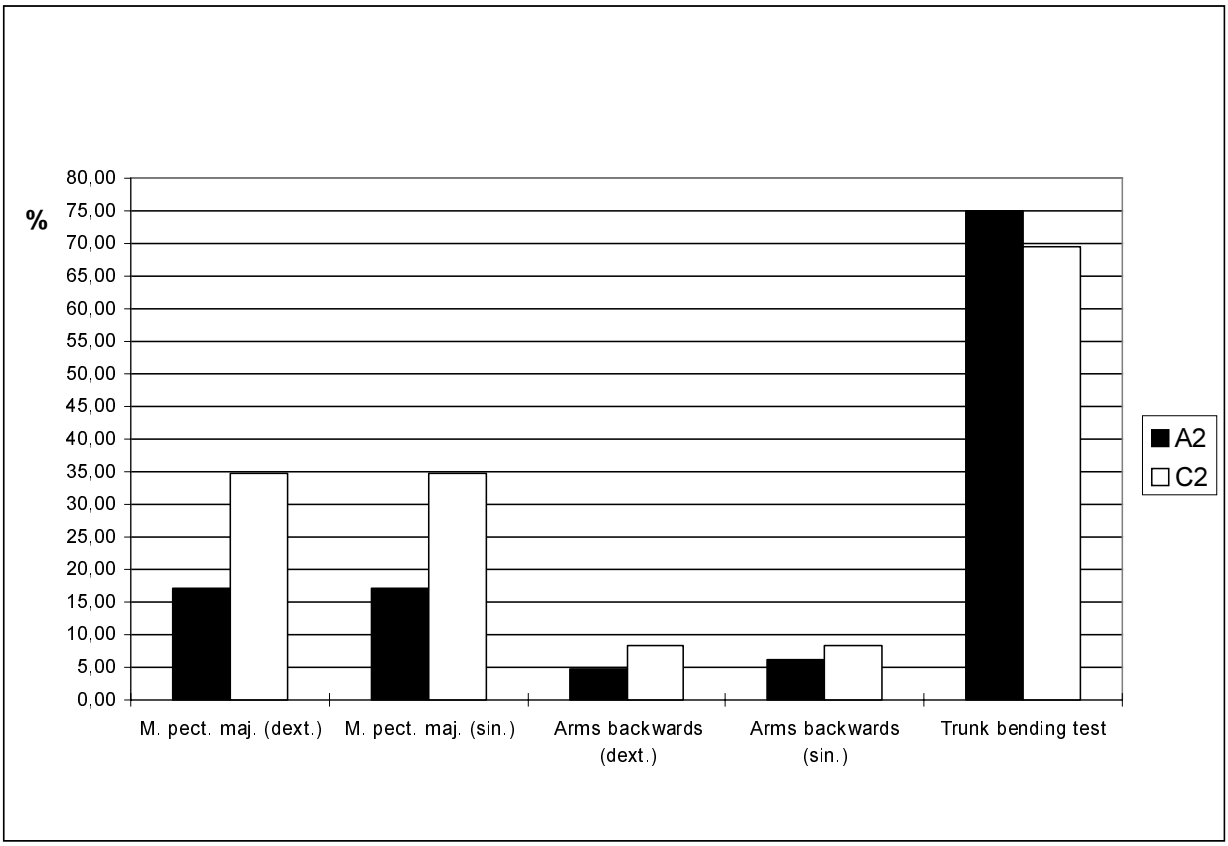


Fig 7
Comparison of the appearance of painful spinal problems in A1 group – men and A2 group – women

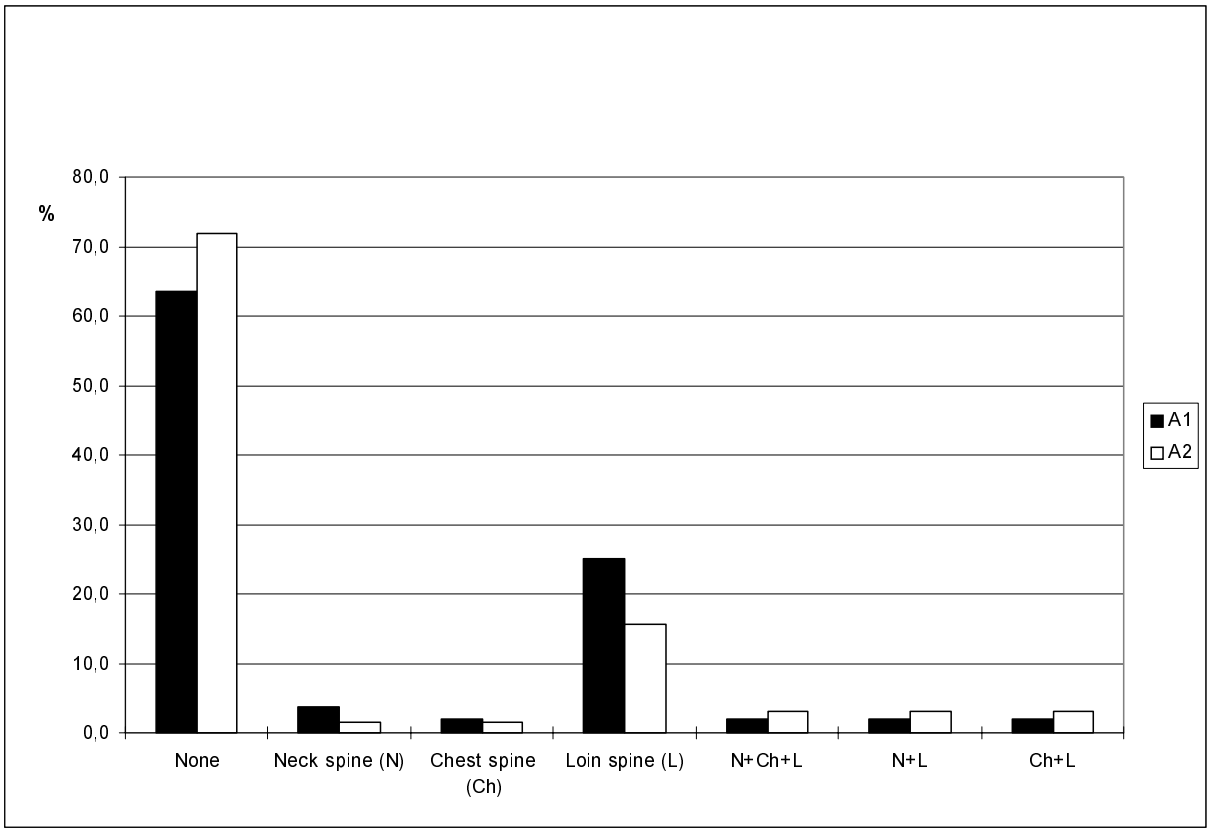
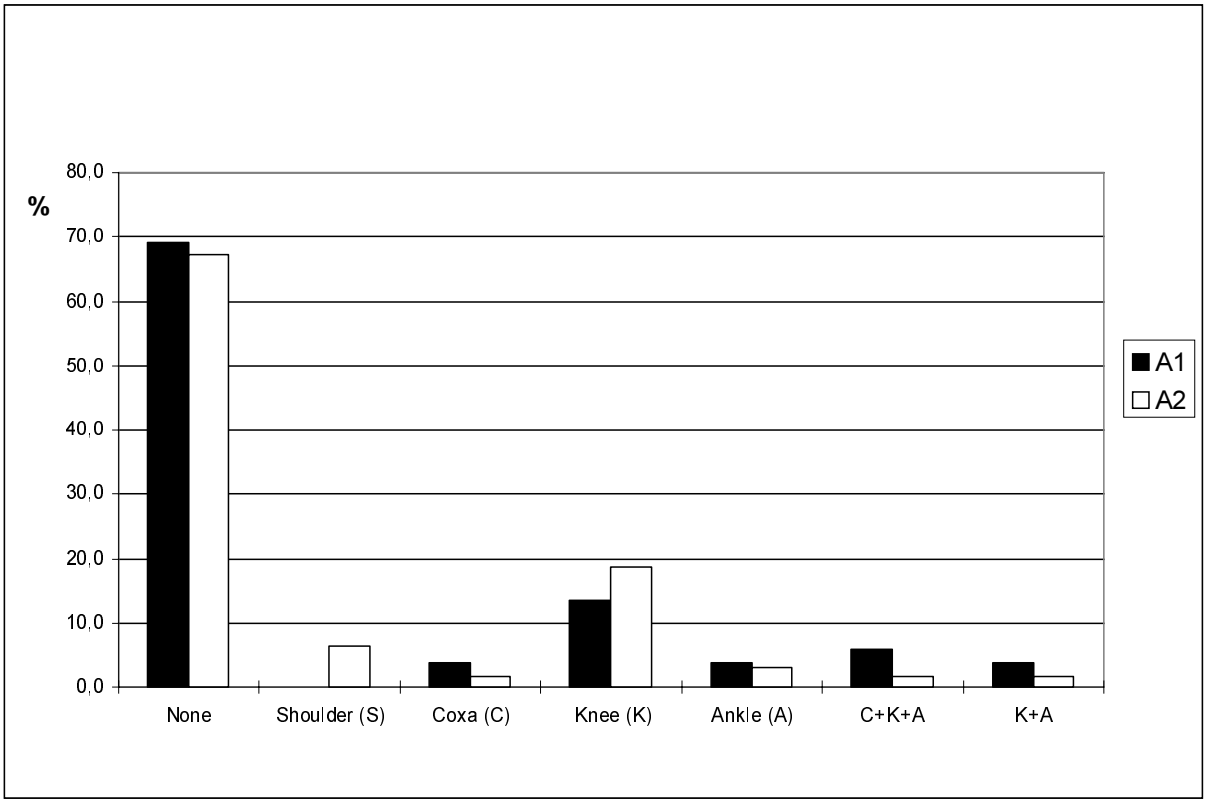


Fig. 8
Comparison of the appearance of painful joint problems in A1 group – men and A2 group – women



DIE VERGLEICHUNG DER MUSKELFUNKTIONEN BEI DER TSCHECHISCHEN UND POLNISCHEN STUDENTENPOPULATION
(Zusammenfassung des englischen Textes)

Den Bewegungsaktivitäten – den natürlichen und primären Äusserungsformen des menschlichen Organismus – wird in den letzten Jahren ein ständig größeres Augenmerk, und zwar in zwei extremen Dimensionen geschenkt: in der Hypokinese und in der einseitigen intensiven Belastung, da beide den Zustand des Stütz – und Bewegungsapparats ungünstig beeinflussen. Der Monitoring der Störungen und der optimalen Funktion des Bewegungssystems bei verschiedenen Gruppen in der Population ist Teil eines langfristigen Projektes (es wird seit 1991 realisiert) des Lehrstuhls für Funktionsanthropologie und Physiologie der Fakultät für Körperkultur in Olomouc. Der Grund dafür ist, dass ein nicht-physiologischer Zustand nur dann korrigiert werden kann, wenn der Ausgangszustand bekannt ist. Die Studie umfasst zugleich die Ergebnisse der internationalen Zusammenarbeit mit dem Lehrstuhl für Anthropologie und Biometrie AWF in Polen. Wir waren bemüht, die Funktionsstörungen bei polnischen und tschechischen Studenten zu determinieren, die durch ähnliche soziale Aspekte und demzufolge auch durch ähnliche soziale Bedingungen beeinflusst werden, die die Wahl der Bewegungsaktivität mitbestimmen.

Beim Test der Muskelfunktionen wurde die Methode von Janda (1996) angewendet. Die Testbatterie umfasst die Tests für die Beurteilung der verkürzten und abgeschwächten Muskeln, sie bewertet ferner einige Bewegungsstereotype und die Hypermobilität. Die Verkürzung von posturalen und die Abschwächung von phasischen Muskeln tritt durch die Entstehung von Substitutions – Bewegungsstereotypen mit nicht ausbalancierten Beanspruchungen von bestimmten Körperteilen zutage.

Die Testergebnisse der Muskeldysbalancen wurden mit Hilfe der Fall – und perzentualen Analyse gewonnen. Für den statistischen Vergleich wurden die Tests auf der Basis der Differenz zwischen zwei Relativwerten (Reisenauer 1970) durchgeführt; getestet wurde auf einer Bedeutungsebene $p < 0,05$ (*).

Der schlechteste Zustand der posturalen Muskulatur von allen verglichenen Komplexen wurde bei den tschechischen Studenten der Fakultät für Körperkultur (A1) festgestellt, bei denen ein unteres Kreuzsyndrom diagnostiziert wurde. Alarmierend ist ein hohes Vorkommen der verkürzten Hüftflexoren. Das Vorkommen der Muskeldysbalancen im Bereich des Hüftgelenks signalisiert eine Störung des Bewegungsstereotyps – des Gehens. Auch die Verkürzung der M. erector spinae und der Knieflexoren kommt erheblich häufiger vor. Im oberen Rumpfteil haben wir ein hohes Vorkommen der verkürzten Trapesmukeln beobachtet, die an der Entstehung des oberen Kreuzsyndroms beteiligt sind.

Bei den tschechischen Studentinnen ist der Zustand des Stütz – Bewegungssystems relativ besser. Beim Testen der verkürzten Muskeln fielen am schlechtesten abermalig die Hüftflexoren aus. Es wäre notwendig, manche Muskelgruppen (insbesondere die Hüftextensoren) zu verstärken.

Das Spektrum des Vorkommens der verkürzten Muskeln hat sich im Zeithorizont einigermaßen verändert. Bei Komplexen B1 sind von dem Gesichtspunkt der Verkürzung aus gesehen nachstehende Muskeln aufgefallen: m. ilipsoas, m. rectus femoris und Knieflexoren. Die größte Verkürzung im Komplex B2 haben wir erneut bei den erwähnten Hüftflexoren und bei M. erector spinae registriert. Die abgeschwächten Muskeln konnten jedoch nicht verglichen werden, auch die Veränderung des Zustands des Stütz – Bewegungsapparates kann nicht komplex beurteilt werden.

Die vorgelegten Ergebnisse dokumentieren, daß der Zustand des Stütz–Bewegungsapparates bei den polnischen Sportlern ebenfalls seine Mängel aufweist. Ähnlich wie bei den tschechischen Studenten und Studentinnen wurde die größte Verkürzung bei Hüftflexoren diagnostiziert. Zu dieser Funktionsstörung im Bereich der unteren Extremitäten kommen noch markante Muskelverkürzungen im oberen Rumpfteil (Trapesmuskeln, innere Rotatoren des Oberarms, ggf. MM. pectorales), die auf das obere Kreuzsyndrom hindeuten.

Wie aus den obigen Ermittlungen ersichtlich ist, wurden bei der tschechischen sowie der polnischen Population zahlreiche intersexuelle Differenzen im Sinne eines höheren Anteils der verkürzten Muskeln bei Studenten und der abgeschwächten Muskeln bei Studentinnen diagnostiziert.

Als Vorbeugung ist nicht nur eine Aufklärungstätigkeit im Sinne der Bevorzugung der Bewegungsaktivität eines bestimmten Volumens und einer bestimmten Intensität, sondern auch ein Akzent auf die Qualität und Mannigfaltigkeit notwendig.

Der Monitoring bei der Anfangsdiagnostik der aufgenommenen Studenten ermöglicht, jeder Prüfperson eine aktuelle Information zu bieten, die im Laufe des Studiums weiterhin ergänzt wird. Hierdurch kann dem progressiven Prozess der Verschlechterung des Zustands und der Funktion des Stütz – Bewegungsapparates vorgebeugt werden.

Schlüsselwörter: Muskeltest, Muskeldysbalance, posturale und phasische Muskeln, Bewegungsstereotype.

SROVNÁNÍ ČESKÉ A POLSKÉ POPULACE STUDENTŮ Z HLEDISKA SVALOVÝCH FUNKCÍ

(Souhrn anglického textu)

Pohybové aktivitě, která je přirozeným a základním projevem lidského organismu, je v posledních letech věnována stále větší pozornost, a to ve dvou krajních dimenzích – v hypokinézi nebo jednostranném intenzivním zatěžování, neboť obě nepříznivě ovlivňují stav podpůrně – pohybového aparátu. Monitorování poruch a optimální funkčnosti pohybového systému u různých populačních skupin je součástí dlouhodobého projektu (probíhá od roku 1991) katedry funkční antropologie a fyziologie Fakulty tělesné kultury v Olomouci a to proto, že nefyziologický stav je možné upravit pouze tehdy, pokud známe stav výchozí. Studie současně zahrnuje výsledky mezinárodní spolupráce s katedrou antropologie a biometrie AWF vPoznani. Snažili jsme se determinovat funkční poruchy u polských a českých studentů, kteří jsou ovlivňováni podobnými sociálními aspekty, a tím také podobnými sociálními podmínkami, ovlivňujícími výběr pohybové aktivity.

K testování svalových funkcí bylo použito metody Jandy (1996). Testová baterie zahrnuje testy na posouzení zkrácených a oslabených svalů, dále hodnotí některé pohybové stereotypy a hypermobilitu. Zkrácení posturálních, a oslabení fázických svalů se projevuje vznikem substitučních pohybových stereotypů, s nevyvážeností nároků na určité části těla.

Výsledky testování svalových dysbalancí byly hodnoceny případovou a procentuální analýzou. Pro statistické srovnání bylo použito testu rozdílů dvou relativních hodnot (Reisenauer 1970), testováno bylo na hladině významnosti $p < 0.05$ (*).

Nejhorší stav posturálního svalstva ze všech srovnávaných souborů byl zjištěn u české populace studentů FTK (A1), u kterých byl diagnostikován dolní zkřížený syndrom. Varující je vysoká frekvence zkrácení flexorů kyčlí. Výskyt svalových dysbalancí v oblasti kyčelního kloubu signalizuje narušení pohybového stereotypu chůze. Jako nezanedbatelný se jeví také výskyt zkrácení m. erector spinae a flexorů kolen. V horní části trupu jsme zaznamenali vysoký výskyt zkrácení mm. trapezii, podílející se na vzniku horního zkříženého syndromu.

U českých studentek je stav podpůrně – pohybového systému relativně lepší. Při testování zkrácených svalů dopadly nejhůře opět flexory kyčle. Bylo by nutné posílit některé svalové skupiny (především extenzory kyčle).

Spektrum výskytu zkrácených svalů se v časovém horizontu poněkud změnilo. Nejhůře u souborů B1 dopadly z hlediska zkrácení tyto svaly: m. iliopsoas, m. rectus femoris a flexory kolen. U souboru B2 jsme největší zkrácení zaznamenali opět u jmenovaných flexorů kyčle a m. erector spinae. Oslabené svaly však nebylo možno srovnat, proto nelze zhodnotit komplexně změnu stavu podpůrně – pohybového aparátu.

Předložené výsledky dokumentují, že stav podpůrně – pohybového aparátu polské sportovní populace má rovněž své nedostatky. Podobně jako u českých studentů a studentek lze diagnostikovat nejvyšší zkrácení u flexorů kyčlí. K této dysfunkci v oblasti dolních končetin dále přistupují výrazná zkrácení svalů v horní části trupu (mm. trapezii, vnitřní rotátory paže, popř. mm. pectorales), signalizující výskyt horního zkříženého syndromu.

Jak je patrné i z předcházejících zjištění, byly diagnostikovány u české i polské populace četné intersexuální diference, ve smyslu vyššího podílu zkrácených svalů u studentů a oslabených svalů u studentek.

Z hlediska prevence je nutná nejen osvětová činnost ve smyslu preference pohybové aktivity určitého objemu a intenzity, ale také s důrazem na kvalitu a pestrost.

Monitoring při vstupní diagnostice přijatých studentů umožňuje předat aktuální informaci každému probandovi, která je doplněna dále v průběhu studia. Tímto lze předejít progresivnímu procesu zhoršování stavu a funkce podpůrně – pohybového systému.

Klíčová slova: svalový test, svalové dysbalance, posturální a fázické svaly, pohybové stereotypy.

RELATION BETWEEN HUMAN PLASMA CONCENTRATION OF LEPTIN AND ADIPOSIS

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Leptin is a protein produced by matured, full fat cells which considerably influence the energy metabolism of the body cells and has probably one of the decisive functions in reduction of body weight. The leptin concentration in serum can be considered as an indicator of the amount of fatty tissue in the cells.

The aim of this study was to find and verify anthropological, age and functional relations to the leptin serum level in a wide population. A complex of 139 probands (sportsmen, sedentary healthy individuals and diabetics) of age from 18 to 82 years (56 men and 83 women) was examined. The recorded and statistically processed values of serum leptin, BMI, body fat (%) and cardiovascular efficiency (indices of CHR-test) were used for calculation of mutual relations to these parameters. Leptin correlated positively with all anthropological indicators and on the contrary, a relation was not established between serum leptin and the indices of cardiovascular system efficiency, both in men and women; in addition a positive relation was also established between leptin and age.

Physical activity together with diet belongs to the most efficient methods in a rational reduction of the superfluous amount of somatic fat. Controlling leptin can help in the identification of efficiency of this method. A return to optimal dynamics for leptin level based on behavioural interventions can in future become an indicator of the success of prevention or therapy of obesity.

Keywords: leptin, obesity, physical load, age.

INTRODUCTION

With the isolation of the obesity gene (Ob gene) in 1994, there was renewed interest in body weight regulation and pathophysiology of obesity. The human Ob gene is located on the 7th chromosome and its product – protein made up of 167 amino acids – was named leptin (from the Greek word "leptos" = thin – Hrnčiar, 1997).

Leptin is produced by mature, full fat cells and works as a signal informing the hypothalamic centres about the fatty–tissue quantity in the body (Hrnčiar, 1997; Lönnqvist et al., 1997; Maffei et al., 1995; McDougland et al., 1995; Saladin et al., 1995). The leptin concentration in serum can be considered as a marker of fatty-tissue quantity in the body (Haluzík et al., 1998; Stejskal et al., 1998a). Its synthesis is provable in brown and white fat (Drbalová et al., 1998).

The function of leptin is mainly body weight regulation. It achieves this by appetite reduction and intense energy disposal by the body. The ingestion center is inhibited, satiety is reached and the sympathetic system is stimulated (Maffei et al., 1995; McDougland et al., 1995; Saladin et al., 1995, 1996).

High serum leptin induces a receptor – or postreceptor resistance to this neurotransmitter which leads to the reduction in energy expenditure and a concurrent increase in appetite, followed by obesity (Hrnčiar, 1997; Muscelli et al., 1996; Stejskal et al., 1997).

Experimental studies proved the significant influence of leptin on the hematological, the immune, reproductive and the endocrine system and on the general progress and maturation of the individual (Drbalová et al., 1998; Haluzík et al., 1998; Hrnčiar, 1997; Malmstrom, 1996; Wabitsh et al., 1996; Stejskal et al., 1998a, 1998b, 1998c; Ryan et al., 1996).

The aim of this study was to verify, in particular, the age and anthropological relations to the leptin level in the plasma in a wide population pattern.

METHODOLOGY

There were 139 probands (56 of men, 83 of women) included in the study (53 university graduates, 27 patients of the exercise laboratory, and 59 patients of the metabolic and diabetological outdoor patients department). The subjects were fasting and the

examinations were carried out between 8 and 10 a. m. under standard conditions of the exercise laboratory.

The study comprised basic anthropological examination (weight, height, BMI, body fat % calculated from 10 skinfolds) and venous blood collection for serum leptin analysis (sandwich ELISA method of the Biovendor company with an accuracy of 0,1 ng/ml). After taking the blood samples, the patients of the exercise laboratory exercised on a bicycle ergometer (CHR-test according to Stejskal et Hejnová, 1994) for 30 minutes at 70 % of the maximum heart rate reserve.

The measured and calculated values were processed by using the programme Statgraphics version 5.0. Since the serum leptin values showed a lognormal pattern of distribution (the normal distribution was verified by the Kolmogorov – Smirnov test), follow-up correlations were made between the particular parameters and the simple logarithm of serum leptin values.

RESULTS

The examined complex consisted of probands of age between 18 and 82 years (the men and women groups did not vary significantly), the BMI between 17 kg/m^2 and 39 kg/m^2 and body fat from 2,7 % to 56,1 %. The average of serum leptin was 8, 1 ng/ml (minimum 0, 2 ng/ml, maximum 85,7 ng/ml). In women, the leptin levels and body fat values were significantly higher as compared to men ($p < 0,01$, resp. $p < 0, 05$) (TABLE 1, 2).

Those with BMI < 25 kg/m^2 had an average leptin level of 4, 3 ng/ml (women 5, 4 ng/ml, men 1, 9 ng/ml), in obese individuals (BMI > 30) 19,2 ng/ml (women 24,5 ng/ml, men 14,8 ng/ml) (Fig. 1).

Serum leptin was found to be significantly related to the body fat (correlation coefficient $r = 0,58$), BMI ($r = 0,44$), and age ($r = 0,46$). Relations between body fat, BMI and serum leptin were, according to correlation coefficients, closer in women than in men (TABLE 3).

We found out by partial correlation analysis that the body fat had a 22 % share in variations of the serum leptin values while BMI, age and sex did not significantly participate in serum leptin variations (Fig. 2).

The values of serum leptin and body fat were significantly lower in physically active persons than in sedentary individuals (patients of the exercise laboratory and metabolic out-patient department), in men and women alike (TABLE 2).

After dividing the examined complex into age subgroups, we ascertained that leptin levels increased with age until 70; likewise all other indices characterising obesity significantly increased with age (Fig. 3). Serum leptin did not increase with age after a statistical adjustment of leptin to the body fat (Fig. 4).

Relations between indices of cardiovascular system efficiency and leptin levels were not statistically significant, both in men and women.

DISCUSSION

The function of leptin is body weight regulation based on the principle of stimulation of the sympathetic system (increase in metabolic rate) and inhibition of the satiety center in the hypothalamus. The exact mechanism of this inhibition is not completely known. The leptin receptor gene probably induces more forms of receptors (for example 5 types of receptors are known in humans so far). Type A is located in plexus chorioideus and is responsible for picking up a circulating leptin and its transport through the hematoencephalic barrier. B-type receptors, located right in the hypothalamus, transferring the leptin influence to the hypothalamic nuclei. Here leptin inhibits expression of mRNA for neuropeptide Y, which positively influences appetite and lowers energy expenditure. Leptin level, both positively and negatively, influences the expression of other hypothalamic peptides, namely galanine, propio-melanocortine, neurotensine, melanocytes stimulating hormone, corticotropin – trigger hormone and cholecystokinin, which through the modulation of neuroendocrine activity participate in the regulation of ingestion. Leptin can directly influence even the insulin receptors by reducing their sensitivity and thus glucose utilization (Guan et al., 1998; Drbalová et al., 1998).

While searching for relations between leptin concentration and anthropological indicators we found a significant relation between body fat and leptin values. In terms of nature of sex, it was found out that in women this relation was closer. In majority of published studies the positive relation between somatic fat percentage and leptin plasma concentration, which was significantly higher in women than in men of the same weight, was proven; it is caused both by higher relative proportion of fat in women than in men and by difference in sex hormones (Haluzík et al., 1998; Hrnčiar J., 1997; Stejskal et al., 1997; Muscelli et al., 1996; Pasman et al., 1998; Ronnemaa et al., 1997; Vettor et al., 1997). The average values of serum leptin obtained by the same biochemical method vary in men of normal body weight by 1 to 11 ng/ml, in women these values are 3–4 times higher (Stejskal et al., 1997).

Serum leptin level was significantly lower in individuals of optimal weight than in the obese. In the latter, deficiency of leptin is not usually shown but surprisingly its abundance is. That is why a receptor resistance in obese individuals to the endogenous leptin influence is considered a fact. Explanation of this resistance is based on the fact, that leptin is transported through the hematoencephalic barrier by a saturable transport system. After reaching a certain serous concentration of leptin this transport to the central nervous system stops (Schwartz et al., 1996). This saturation can be the cause of development of leptin resistance and the following hyperphagia in obese individuals with high serous concentrations of leptin.

The levels of leptin in the neural tissues of obese people are about 30 % higher than non-obese, in serum up to 300 %. In individuals of a normal constitution the serous levels of leptin correlate with levels in cerebrospinal fluid (Drbalová et al., 1998).

It was found that together with age, indices characterizing obesity significantly increased; leptin level increased with age up to 70 years (Fig. 3). According to some of the authors, age does not correlate significantly with serum leptin, whereas according to the others it does (Hua-Li et al., 1997; Kamal, 1997; Matsuda et al., 1997; Ryan et al., 1996). Since leptin levels fluently increase from one's birth and keeps sex difference (Ryan et al., 1996), the possibility cannot be excluded that the age dependence of leptin is caused by an increasing quantity of the fatty tissue and advancing age. We confirmed this assumption by carrying out the statistical adjustment of leptin level to the quantity of fat tissue (Fig. 4).

In women, in the course of life, leptin values are considerably variable, probably in connection with the activity of sex hormones. A function of leptin as a puberty initiator can be considered (accumulation of sufficient fat reserves for the initiation of reproductive functions) (Drbalová et al., 1998).

There is not sufficient data dealing with the influence of physical activity on the serum leptin nowadays. In our study, we did not manage to confirm the relation between indices of cardiovascular efficiency and leptin level, both in men and women. Also the relation between cardiovascular system efficiency and body fat was not proven and that is why the leptin values and values of cardiovascular efficiency indicators did not correlate, nor after the statistical adjustment to the fatty tissue quantity. However, the leptin levels were lower in physically active persons in comparison with sedentary subjects. The latter also had significantly higher amount of body fat than those engaged in exercise or sports (TABLE 2).

Kohrt et al. (1996) studied the effects of a nine month exercise programme (walking, jogging, steps climbing) and hormonal substitutional therapy on the serum leptin level in older women. In persons who exercised, the changes of body fat significantly correlated with changes in the leptin serum concentration. The effect of exercise therefore seems to be dependent on changes of the amount of body fat. On the contrary, Pasman et al. (1998) described the lowering of leptin level independent of the body fat changes and also focused on changes of plasmatic insulin through long-term training for a period of 16 months (3–4 per week, 1 hour per day, medium intensity).

Hickey et al. (1997) followed a long-term effect of an aerobic exercise on leptin level. After a 12 week exercise (4 days per week, 30–40 minutes per day), the serum leptin concentration dropped significantly only in women which, in the first instance, had higher concentration of leptin than men in spite of lower quantity of fat. On the contrary, Pérusse et al. (1997) found out that a 20 week exercise regime for older men and women caused a reduction in the serum concentration of leptin, but only in men.

Hickey et al. (1996) dealt with the question of influence of a single exercise bout on the leptin level and the relation between serum leptin and body fat in case of relatively thin long-term trained sportsmen. In these trained individuals with a low leptin concentration no immediate effect on the circulating concentration of leptin was found after a 20 mile run (70 % VO2 max).

On the contrary Landt et al. (1997) described a significant decrease in leptin concentration during an extremely hard or long exercise which causes negative energy balance. After two hours of hard ride on the bicycle, the average leptin level dropped significantly by 8,3 % and at the same time, resulted in considerably increased levels of free fatty acids, which correlated negatively with the leptin decrease. After 6 hours of rest and taking food, leptin level returned to initial values.

Leal Cerro et al. (1998) focussed on a question whether leptin is regulated by an acute energy output. It was discovered that leptin levels dropped after finishing a marathon race parallelly with reduction of the body fat (the leptin level was reduced after an output of 2800 kcal). Hence it can be inferred that the leptin level can be regulated by a large energy output.

Racette et al. (1997) studied a leptin production in vivo in the abdominal fatty tissue, during the rest and after 60 minutes of exercise on the bicycle ergometer (50 % of maximal heart rate reserve). Blood samples were taken every 10 minutes during the exercise. The concentrations of plasma leptin did not change during the exercise and were identical to the values found during rest conditions.

Koistinen et al. (1998) described the influence of an exercise, both fasting and after taking food, upon the concentration of circulating leptin in healthy men and in diabetics type I with normal body weight and well compensated diabetes mellitus. During a 3 hour ride on the bicycle ergometer in fasting subjects the leptin level decreased by 42 % in healthy men and by 23 % in diabetics. If the exercise was carried out during postprandial conditions and related to a significant growth of serum level of cortisol, the leptin concentrations remained unchanged. These results show that although the circulating leptin can be reduced by exercise, this effect can be compensated with food or with enhancement of cortisol concentration in serum.

The influence of diet and exercise on the level of serum leptin and its relation to the metabolic syndrome X was, in case of postmenopausal women with excess weight, studied by Christensen et al. (1998). No influence on serum leptin in relation to diet was found. It seems that leptin is of no significance to the metabolic syndrome X but rather to the quantity of body fat.

However tests on rats show that the expression of leptin can be influenced by exercise and that these

changes (reduction of expression and secretion of protein) can become independent of changes in insulin sensitivity that leads to obesity (Zachwieja et al., 1997).

According to Tuominen et al. (1997) the serum leptin concentration drops during exercise induced expenditure of glycogen and increases during hyperinsulinemic clamp. Serum leptin level correlates positively with serum insulin, cortisol and triglycerides and inversely with concentration of growth hormone.

Lower concentrations of serum leptin were in general described in sportsmen in comparison with common medium values, namely in long-distance runners but also in rugby players. These low values correlated with the proportionally decreased amount of body fat (Haluzík et al., 1998; Hickey et al., 1996).

Despite differences in the results of the aforementioned experiments, it can be stated that both the single endurance intensive exercise bout and regular persistent training decrease the leptin level in serum. While in case of single exercise bout no leptin level reducing mechanism was definitely established, the drop of leptin level after long – term training and its lower level in sporting population alike are probably closely connected with the lower amount of body fat.

CONCLUSION

Serum leptin can be regarded as a very significant indicator of the quantity of body fat. Many studies show that the leptin level decrease surpasses considerably the drop in the BMI. It was even described that the leptin level decrease is accompanied by lowered reduction in body fat while BMI values remain unchanged. That is the reason why monitoring leptin level could be a more correct indicator of the body fat reserve than the mentioned anthropological indices (Haluzík et al., 1998; Stejskal et al., 1998a).

A long-term research is currently underway concerning changes of leptin level as a result of changes in behavioural habits within physical activity in relatively healthy individuals. Physical activity together with diet is among the most effective methods of rational reduction in the superfluous amount of somatic fats. The return of the optimal dynamics of leptin level based on behavioural interventions can in future become the aim and the indicator of success in prevention or therapy of obesity.

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TABLE 1
Average, standard deviation, minimum and maximum values of plasma leptin levels, BMI, % of body fat, and age.

(n)	**whole group (139)**				**men (56)**		**women (83)**	
	$\bar{x}$	**SD**	**min**	**max**	$\bar{x}$	**SD**	$\bar{x}$	**SD**
Age (years)	41,20	20,03	18	82	43,05	18,84	39,89	20,81
BMI (kg/m^2)	25,10	4,38	17,20	38,96	26,61	3,87	24,08	4,42
Fat (%)	25,50	13,14	2,70	56,07	22,46	12,00	27,59	13,53
Leptin (ng/ml)	8,08	11,58	0,20	85,70	4,97	11,69	10,18	11,10

TABLE 2
Average and standard deviation of serum leptin, age, weight, BMI and % of body fat in individual groups. Statistic significance of the differences between the groups.

$\overline{X}$ = average, **SD** = standard deviation, **S** = statistic significance of the difference, **ST** = students, **ELP** = exercise laboratory patients, **OPMD** = outdoor patients of metabolic department, **M** = men, **W** = women

A	ST-M (16)		ST-W (37)		ELP-M (21)		ELP-W (6)		OPMD-M (19)		OPMD-W (40)
	$\overline{X}$ (SD)	S	$\overline{X}$ (SD)	S	$\overline{X}$ (SD)	S	$\overline{X}$ (SD)	S	$\overline{X}$ (SD)	S	$\overline{X}$ (SD)
Age (years)	19,38 (1,36)	*NS **p<0,001 *** p<0,001 **** p<0,001 ***** p<0,001	19,11 (0,84)	° p<0,001 °° p<0,001 °°° p<0,001 °°°° p<0,001	45,71 (10,84)	♠ NS ♠♠ 0,01 ♠♠♠ 0,001	42,17 (7,52)	•0,01 ••0,001	56,78 (12,23)	+ NS	58,76 (11,25)
BMI (kg/m^2)	23,49 (1,99)	*p<0,001 **p<0,01 *** NS **** p<0,01 ***** p<0,001	20,72 (1,62)	° p<0,001 °° p<0,001 °°° p<0,001 °°°° p<0,001	26,74 (4,27)	♠ NS ♠♠ NS ♠♠♠ NS	26,08 (4,28)	• NS •• NS	28,19 (3,10)	+ NS	26,90 (4,11)
Fat (%)	10,26 (2,73)	*p<0,001 **p<0,001 ***p<0,001 **** p<0,01 ***** p<0,001	14,57 (4,26)	° p<0,001 °° p<0,001 °°° p<0,001 °°°° p<0,001	19,56 (5,78)	♠ NS ♠♠ p<0,001 ♠♠♠ p<0,001	24,3 (4,86)	•p<0,01 ••p<0,001	33,49 (8,40)	+ p<0,001	40,13 (6,46)
Leptin (ng/ml)	1,03 (0,50)	*p<0,001 **p<0,001 ***p<0,001 **** p<0,01 ***** p<0,001	4,41 (4,76)	° NS °° p<0,01 °°° NS °°°° p<0,001	4,21 (4,43)	♠ p<0,05 ♠♠ NS ♠♠♠ p<0,001	10,22 (6,45)	• NS •• NS	6,53 (16,37)	+ p<0,01	15,52 (13,11)

* = ST-M:ST-W, ** = ST-M:ELP-M, *** = ST-M: ELP-W, **** ST-M:OPMD-M, ***** = ST-M:OPMD-W, ° = ST-W:ELP-W, °° = ST-W:ELP-W, °°° = ST-W:OPMD-M, °°°° = ST-W:OPMD-W, ♠ = ELP-M:ELP-W, ♠♠ = ELP-M: OPMD-M, ♠♠♠ = ELP-M:OPMD-W
• = ELP-W:OPMD-M, •• = ELP-W:OPMD-W, + = OPMD-M:OPMD-W

TABLE 3
Correlations of the serum leptin values, anthropological indices and age (significance ***p< 0.001, **p< 0.01, *p<0.05).

(n)	whole group (139)	men (56)	women (83)
Fat (%)	0,58***	0,47***	0,61***
BMI (kg/m^2)	0,44***	0,56***	0,65***
Age (years)	0,46***	0,56***	0,53***

Fig. 1
Comparison of the serum leptin levels in obese and non-obese subjects.

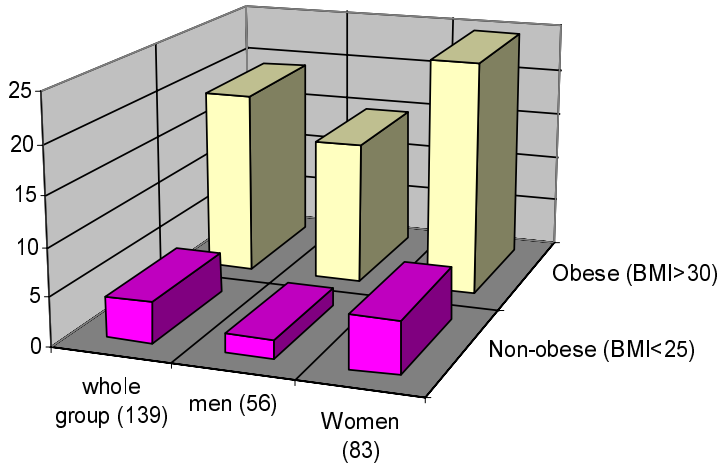


Fig. 2
Contribution of the separated parameters to the leptin level variations.

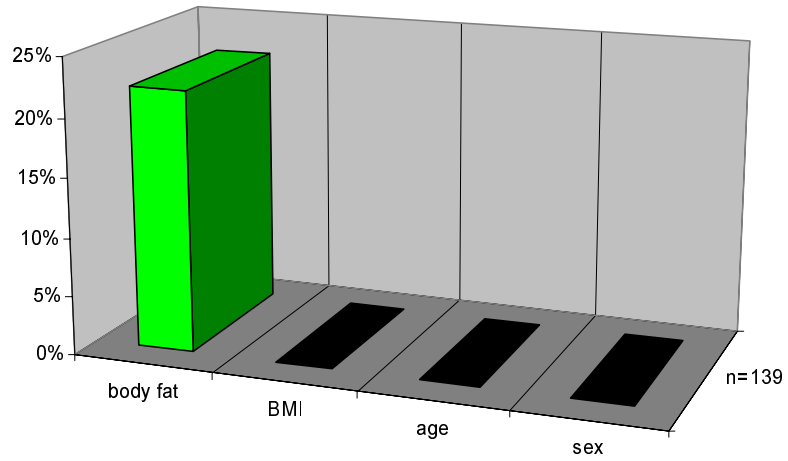


Fig. 3
Averages of the BMI, body fat, and serum leptin concentration in separated age categories.

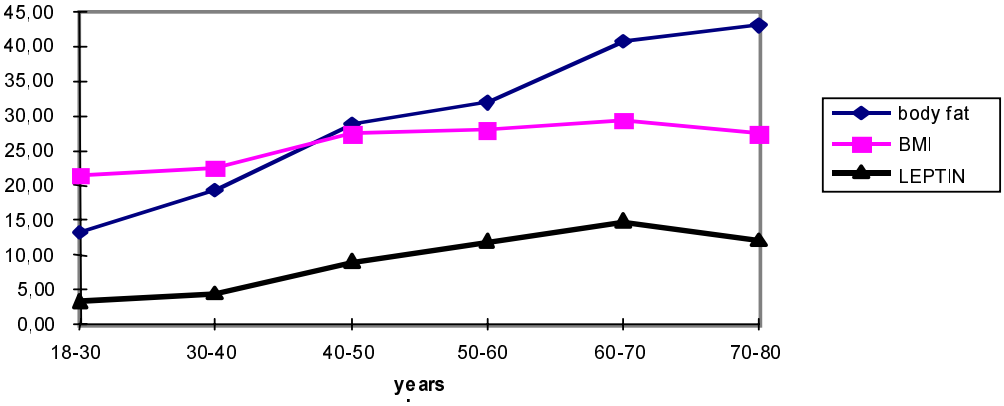
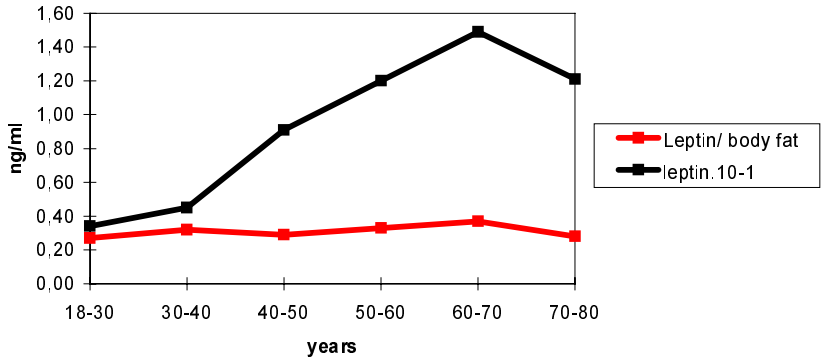


Fig. 4
Average values of the plasma leptin concentration and plasma leptin concentration to body fat ratio in the age groups.



ZUSAMMENHANG ZWISCHEN LEPTINKONZENTRATION IM SERUM UND FETTSUCHT BEI DEM MENSCH

(Zusammenfassung des englichen Textes)

Leptin ist ein von der ausgereiften Fettzellen produzierter Eiweißstoff, der auf grundsätzliche Weise den energetischen Stoffwechsel des Organismus beeinflußt. Die Leptinkonzentration im Serum ist für einen Anzeiger der Fettgewebemenge im Organismus zu halten.

Ziel der Studie war, bei einer breiten Populationsgruppe die anthropologischen, Alters- und funktionellen Zusammenhänge mit dem Leptinniveau im Blutwasser zu finden und zu überprüfen. Es waren 139 Probanden (Sportler, hypokinetisch gesunde Personen und Diabetiker) im Alter von 18–82 Jahre (davon 56 Männer und 83 Frauen) untersucht. Aus den gemessenen und statistisch bearbeiteten Werten der Leptinemie, BMI, relativer Vertretung der Fettkomponente (%) und der Kreislaufleistung (Anzeiger CHR-Test) wurden beiderseitige Zusammenhänge dieser Parameter berechnet. Leptin korrelierte positiv mit allen anthropologischen Anzeigern, und im Gegenteil wurde kein Zusammenhang zwischen Leptinemie und den Anzeigern der Leistungsfähigkeit des kardiovaskularen Systems bewiesen, sowohl bei Männern, als auch bei Frauen, bis auf den Zusammenhang zwischen der Kreislauleistungsfähigkeit und der Leptinemie; eine positive Beziehung wurde ebenfalls zwischen Leptinemie und Alter festgestellt.

Bewegung und Diät gehören zu den bedeutendsten Verfahren der rationalen Reduktion von überflüssiger Menge des körperlichen Fetts. Die Leptinemie-verfolgung kann der Erkenntnis der Wirksamkeit dieses Verfahrens beitragen. Rückkehr der optimalen Leptinemiedynamik aufgrund der behavorialen Interventionen kann künftig ein Anzeiger einer erfolgreichen Vorbeugung oder Fettsuchttherapie sein.

Schlüsselwörter: Leptin, Fettsucht, physische Belastung, Alter.

VZTAH MEZI PLAZMATICKOU KONCENTRACÍ LEPTINU A ADIPOZITOU U ČLOVĚKA

(Souhrn anglického textu)

Leptin je bílkovina produkovaná zralými tukovými buňkami, která ovlivňuje zásadním způsobem energetický metabolismus organismu a má pravděpodobně jednu z rozhodujících funkcí v redukci tělesné hmotnosti. Koncentraci leptinu v séru lze považovat za ukazatel množství tukové tkáně v organismu.

Cílem studie bylo nalézt a ověřit antropologické, věkové a funkční souvislosti s hladinou leptinu v krevní plazmě u široké populační skupiny. Byl vyšetřen soubor 139 probandů (sportovci, hypokinetičtí zdraví jedinci a diabetici) ve věku od 18 do 82 let (z toho 56 mužů a 83 žen). Z naměřených a statisticky zpracovaných hodnot leptinémie, BMI, relativní zastoupení tukové komponenty (%) a výkonnosti oběhu (ukazatele CHR-testu) byly vypočítány vzájemné souvislosti těchto parametrů. Leptin koreloval pozitivně se všemi antropologickými ukazateli a naopak souvislost nebyla prokázána mezi leptinémií a ukazateli výkonnosti kardiovaskulárního systému a to jak u mužů, tak i u žen, až na vztah mezi výkonností oběhu a leptinémií; pozitivní vztah byl zjištěn rovněž mezi leptinémií a věkem.

Pohybová aktivita spolu s dietními opatřeními patří mezi nejúčinnější metodu racionální redukce nadbytečného množství tělesných tuků. Sledování leptinémie může pomoci při poznání účinnosti této metody. Návrat optimální dynamiky leptinémie na základě behaviorálních intervencí může být v budoucnu ukazatelem úspěšnosti prevence nebo terapie obezity.

Klíčová slova: leptin, obezita, fyzická zátěž, věk.

RESULTS OF BIOMECHANICAL ANALYSIS IN SNOWBIKING

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A non-invasive cinematographic method allows determination of selected kinematic and dynamic parameters of the snowbiker-snowbike system in real motion. Slalom turn phases in snowbiking were determined by means of cinematographic analysis. In the analysed transitional phases between individual turns and steering phases, concrete perimeter speed, centrifugal force and reaction force in the snowbiker-snowbike system s interaction with the surface of the course were calculated.

Keywords: snowbike, turn phase, kinematics, dynamics, modelling.

INTRODUCTION

The first inquiry that was to prove possibilities of the high-frequency cinematography in biomechanical elaboration of particular turns and their phases was carried out in January 1998 in Pec pod Sněžkou with the financial support of FPES UK and the GA UK grant agency.

METHODS

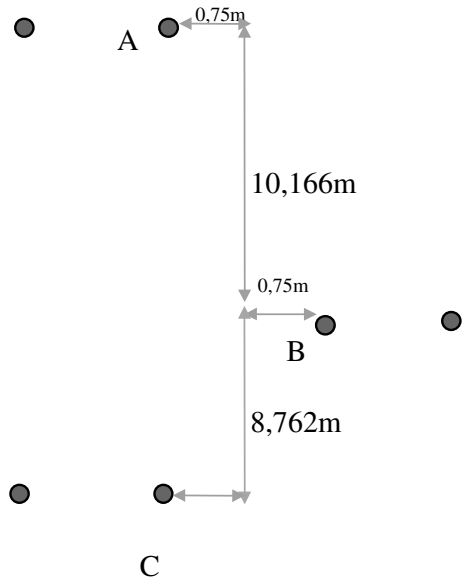
The cinematographic recording method was used for parametric representation of snowbiking – high-frequency cinematographic recording of slalom turns in particular. The alignment of slalom gates in the observed section is shown in Fig. 1.

We focused on a section of three slalom gates, alignment of which was similar to closed slalom turns. Recording frequency was 203 pictures/sec, which means that the time interval (Δt) between individual expositions of film pictures was 4.926 ms. The film recording was analysed by the 160 B film analyser by NAC. For the minimum movement of the net cross used for reading the coordinates of the observed points, the exposition time was 1/1100 sec and the analyser's sensitiveness was 0.05 mm.

The measure used for determining the real distances of the observed points trajectory was given by the standard defined distance. To increase precision, the coordinates of each point were repeatedly (5 times) defined and mean values of the coordinates of the defined standard distance were counted. Followingly we calculated a distance of two points that actually represents 1-meter distance:

$$X^2 + Y^2 = Z^2$$
$$(0,70)^2 + (12, 8)^2 = 166,3844$$
$$Z = 12, 899 \Rightarrow 1m = 12, 899 \text{ mm}$$

Fig. 1
The alignment of slalom gates in the observed section.



The measure was:

scale **M = 1: 77.525**

Distortion due to the camera s position above the movement level can be neglected in this case, as it does not exceed 1%.

A similar method was used for determining the distance of the gates in the observed section. TABLE 2 shows coordinates of the gates defining the observed section.

TABLE 1
Method of the gates' distance determination

	gate A		gate B		gate C	
	X_1	Y_1	X_2	Y_2	X_3	Y_3
	0,0	0,0	126,4	35,4	234,65	67,95
	0,0	0,0	126,2	35,6	234,55	67,65
	0,0	0,0	126,15	35,35	234,5	67,7
av	0,0	0,0	126,25	35,45	234,56	67,76
	A[0;	0]	B[126,25;	35,45]	C[234,56;	67,76]

P_{AB} ..... projection of the A B gate distance
P_{AC} ..... projection of the A C gate distance
AB ..... actual A gate – B gate distance
AC ..... actual A gate – C gate distance
AB ..... actual A gate – B gate distance
M ..... scale

$$(X_2)^2 + (Y_2)^2 = (P_{AB})^2$$
$$(125,25)^2 + (35,45)^2 = 17195,765$$
$$P_{AB} = 131,1326 \text{ mm}$$
$$M = 1 : 77,535 \Rightarrow P_{AB} = 10,166 \text{ m}$$

The projection of the A gate – B gate distance is 10.166 m.

$$P_{AC} = 18,928 \text{ m}$$

The projection of the A gate – C gate distance is 18.928 m, where the projection of the B – C gate is 8.762 m.

The projection of the gates distance and gates alignment directed from the fall line (q = 0. 75 m) was used for determining the actual distance of A –B and B – C gates.

$(AB)^2 = (P_{AB})^2 + (2q)^2$ $\quad$ $(BC)^2 = (P_{BC})^2 + (2q)^2$
$(AB)^2 = (10,166)^2 + (1,5)^2$ $\quad$ $(BC)^2 = (8,762)^2 + (1,5)^2$
$AB = 10,3$ m $\quad$ $BC = 8,9$ m

The actual distance between A gate and B gate is 10.3 m; actual distance between B gate and C gate is 8.9 m.

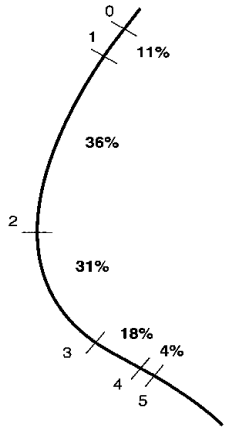
RESULTS

Turn Phases

To define individual turn phases in snowbiking, we used a division model of skiing turns by Příbramský, Jelen and Broda (1987). On the analogy, there are key points in making a turn in snowbiking, that, from the kinematic and dynamic point of view, define all relevant changes in the turning technique. The key points define the time intervals that cover relevant activities of the snowbiker, and snowbike and skis motion – turn phases.

Individual turn phases have their distinctive features. There are 4 phases so far to be distinguished – they are shown in Fig. 2. There are: turn initiation, steering phase (I. and II. part), end phase, and transitional phase between turns. TABLE 3 shows individual phases of the movement from the time viewpoint and their percentual proportion.

Fig. 2
Scheme of the time – space characteristics of the movement phases of the snowbiker making a turn.



Legend:
point 0 – the initiation phase of lowering the centre of gravity, initiation of the snowbike's angulation
point 1 – the initiation of the change of the ski direction angle
point 2 – the maximum lowering of the centre of gravity, the greatest angulation of the snowbike
point 3 – the end phase of the change of the ski direction angle
point 4 – the end phase of the extension of the centre of gravity, vertical position of the snowbike
point 5 = point 0

TABLE 2
Time spent on the individual snowbiker s movement phases

PHASES	TIME	PHASES PROPORTION (percents)
initiation	0,123 sec	11 %
steering phase I. part	0,424 sec	36 %
steering phase II. part	0,369 sec	31 %
end phase	0,207 sec	18 %
transitional phase	0,050 sec	4 %

The speed parameter in the transitional phase and speed in steering the turn – when the centre of gravity is in the lowest position – is one of the biomechanical aspects in snowbiking. For further calculations, it was necessary to consider projection of the trajectory made by a particular point of the snowbiker – snowbike system in a given time (Δt).

The speed determination in the transitional phase

To determine the average speed (which can be, despite some irrelevant inaccuracy, considered the immediate speed) and trajectory in the transitional phase, we analysed the 10 – picture interval, so that the centre of the transition was just in the middle of this interval. The projection of the trajectory made by the snowbike in the observed interval of presented $\Delta t_9 = 0 = 0.044334$ sec is 0.45 m.

$$(P_{K1K2})^2 = (X_2)^2 + (Y_2)^2$$
$$(P_{K1K2})^2 = (5{,}375)^2 + (2{,}325)^2$$
$$P_{K1K2} = 5{,}856$$
$$M = 1{:}\ 77{,}525 \Rightarrow P_{K1K2} = 0{,}454 \text{ m}$$

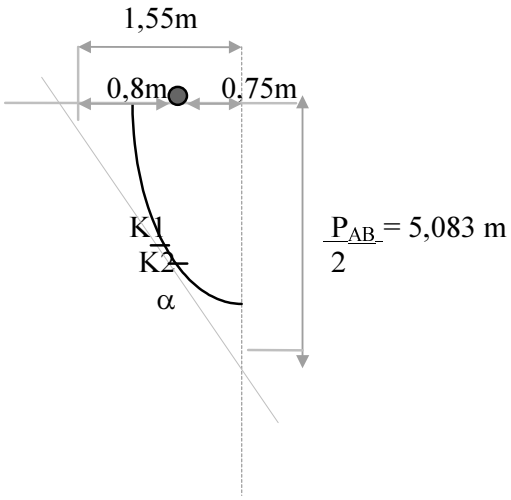
To define the actual distance reached by the snowbike in the observed interval, the following facts were taken into account (Fig. 3a):

1) the skis trajectory is at the distance of 0.4 m from the gate pole.
2) the angle represents the declination of the actual trajectory from its projection in the limited transition.

Fig. 3a

Scheme of the skis trajectory

The actual distance of K_1K_2 points (distance reached by the snowbike in the analysed section) is determined by goniometric functions:



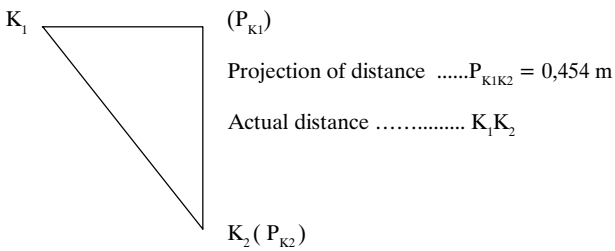
α ..... the declination from the projection

$$\text{tg}\,\alpha = \frac{1{,}55}{5{,}083} = 0{,}04938$$

$\alpha = 19°20'$

Fig. 3b

Scheme of the projection of distances



$$\frac{P_{K1K2}}{K_1K_2} = \cos\alpha \Rightarrow K_1K_2 = \frac{0{,}454}{0{,}9436} = 0{,}481 \text{ m}$$

The actual distance reached by the snowbike in the middle of the transitional phase is 0.481m. The difference between the actual distance of the analysed turn phase and its projection is 27 mm, which represents extension by 5.97% due to the projection.

$$\Delta t = 1 : 203 = 0.004926 \text{ sec.}$$

Δt_9 for 9 intervals in the transitional phase for the middle section – when the skis follow the direct line equals to $9 \cdot 0.004926 = 0.044$ sec.

We also calculated the average speed in the middle of the transitional phase as a trajectory increase in time:

$$\Delta s = 0{,}4811 \text{ m}$$
$$\Delta t = 0{,}044 \text{ sec}$$
$$\Rightarrow \quad v = 10{,}85 \text{ m/sec.}$$

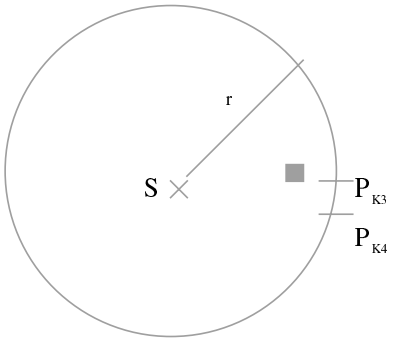
The snowbike s speed in the analysed section of the transitional phase is 10.85 m/sec.

Determination of speed in the steering phase with the centre of gravity in the lowest position

To determine the speed in the steering phase with the centre of gravity in the lowest position, a similar approach as in the transitional phase was used. We had to take into account that the snowbike does not follow a straight line in this phase, so it was necessary to approximate its trajectory to the circular section.

Fig. 4

Schematic description of the snowbike's trajectory in the steering phase.



Projection of the distance reached by the snowbike in the given time period $Dt_9 = 0.044334$ sec is 0.471 m.

To determine the actual trajectory reached by the snowbike, the fact that the trajectory is of a circular shape, had to be considered; the diameter r = 2.6 m.

K_3K_4 ..... the actual trajectory of the analysed turn section
P_{k3K4} .. projection of the distance – the chord length

$$r = 2{,}6 \text{ m}$$

$$P_{K3K4} = 0{,}4712 \text{ m}$$

$$O = 2\pi r$$

$$K_3K_4 = 2\pi r \cdot \frac{\alpha}{360} \Rightarrow \quad \alpha = 10°26'$$

$$K_3K_4 = \frac{2\pi r}{360°} \cdot \alpha = 0{,}473 \text{ m}$$

We calculated the actual length of the chord projection of a section of the circular trajectory, which was approximated to a section of the circle with the diameter = 2.6 m. The actual trajectory length of the analysed turn section is calculated according to geometric rules.

The actual length of the analysed turn section was finally just 2 mm longer than the projection of the length, which represents 0.42%.

The average speed in the analysed turn section is calculated as then trajectory increase in time. That implies:

$$v = \frac{\Delta s}{\Delta t} = \frac{0{,}473}{0{,}044} = 10{,}67 \text{ m/sec}$$

The speed difference between the analysed section of the transitional phase (v = 10.85 m/sec) and the analysed turn section where the centre of gravity is in the lowest position (v = 10.67 m/sec) is 0.18 m/sec, which represents 1.66%. The retardation was caused by the friction increase as the reaction force also increased during the turn.

From the dynamic point of view, the centrifugal force was calculated at the moment of the greatest curvature of the trajectory followed by the snowbike – snowbiker system – in the steering phase in particular. This trajectory was approximated to the circle with the diameter of 2.6 m. These data indicate the centrifugal force quantity as the snowbiker – snowbike system is considered a mass point.

$$F_{od} = \frac{m \cdot v^2}{r}$$

$$m = m_1 + m_2 + m_3$$

F_{od} ..... centrifugal force
M ..... the total weight of the system
m_1 ..... the weight of the snowbiker
m_2 ..... the weight of the snowbike
m_3 ..... the weight of the equipment
r ..... diameter
v ..... perimetric speed

r = 2.6 m
m = 100 kg
v = 10.67 m/sec

$$F_{od} = \frac{100 \cdot (10{,}67)^2}{2{,}6} = 4378{,}8 \text{ N}$$

The snowbiker – snowbike system is affected by centrifugal force that equals to approximately

$$F_{od} = 4\,379 \text{ N}$$

Besides the centrifugal force, the system is also affected by dissipation forces such as aerodynamic resistance, lifting force, friction and ie. Coriolis acceleration. The concrete values of these quantities were not taken into account due to their minimum influence. However, it must be stated that these parameters must be considered in further elaborations of the mathematical – physical model of the snowbiker – snowbike system.

The R reaction force in the observed section equals to approximately:

$$R = 4\,487 \text{ N}.$$

The angulation angle of the snowbiker – snowbike system is:

$$\alpha = 12°35$$

The result implies that, for a very short time period, the snowbiker during the steering phase may be affected by the overload of 4G or more. It may be pressumed that this fact may influence the subsequent reactions of the snowbiker and his/her ability to execute the following activities in an optimum way. This may influence also the total time reached in a race.

CONCLUSION

The presented concrete values point at the possibilities of the biomechanical analysis of the snowbiker s motion by means of cinematographic analysis. Using this non-invasive method, we can obtain the dynamic parameters of the examined system in real sports action. It may be expected that the presented concrete values will be higher in the top competition races, as this pilot study was carried out in the action where the snowbiker reached lower than usual racing speed. The supposed speed in slalom is usually found in the margin of 13 – 15 m/sec. The result implies that, for a very short time period, the snowbiker during the steering phase may be affected by the overload of 5G or more. It may be presumed that this fact may influence the following snowbiker s reactions and his/her ability to slove the following activities in an

optimum way. This may influence also the total time reached in a race.

Mathematical modelling that is indicated in the above mentioned methods allows modelling situations that i. e. are not available as far as actual data are concerned, or may be considered extreme; represent some special cases (e. g. studies describing extreme loads affecting the safety of the action or even the snowbike s construction, modelling the training conditions, etc.).

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INTERPRETATION DER BIOMECHANISCHEN ASPEKTE DES SKIBOBFAHRENS

(Zusammenfassung des englischen Textes)

Die nicht invasive kinematographische Methode ermöglicht, die ausgewählten kinematischen und dynamischen Parameter des Systems Skibob – Skibobfahrer bei der reellen Bewegungsaktivität festzulegen. Mit Hilfe von der kinematographischen Analyse wurden die Schwungphasen im Slalom bei der Skibobfahrt festgelegt. Im Falle der analysierten Übergangsphase zwischen den Schwüngen und der Phase der Schwungleitung wurden konkrete Umfangsgeschwindigkeiten, Zentrifugalkräfte und Reaktionskräfte bei der Interaktion des Systems Skibob – Skibobfahrer mit der Oberfläche der Wettkampfstrecke experimentell durchgeführt und berechnet.

Schlüsselworter: Skibob, kinematographische Analyse, Fehler beim Messen

VÝSLEDKY BIOMECHANICKÉ ANALÝZY JÍZDY NA SKIBOBU

(Souhrn anglického textu)

Neinvazivní kinematografická metoda umožňuje stanovení vybraných kinematických i dynamických parametrů soustavy skibob – skibobista při reálné pohybové činnosti. Pomocí kinematografické analýzy byly stanoveny fáze oblouku ve slalomu při jízdě na skibobu. Dále byly experimentálně provedeny, v případě analyzované fáze přechodu mezi oblouky a fáze vedení oblouku, spočítány konkrétní obvodové rychlosti, odstředivé síly a reakční síly při interakci soustavy skibob-skibobista s povrchem závodní trati.

Klíčová slova: skibob, kinematografická analýza, chyby měření.

PHYSICAL CULTURE AND THE PROCESS OF EUROPEAN INTEGRATION

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The social development is caused by the inevitability of change, which is motivated by man's dissatisfaction with actual state. The result of change does not have to be always positive; it depends on the motive, content, way of realisation and also at the preparedness of the whole society. The actual integration processes in Europe represent the extensive changes in the universal as well as regional character, which intervene in all spheres of life and in all class of European society. This is also the physical culture, as an important social-cultural phenomenon which plays an important role in education, health, economy, politics, entertainment and other spheres of life. It is possible to expect, due to universal values of physical culture, its positive share in the integration process. But, the possibilities of its regional, national and other utilisation and exploitation carries with danger of disintegration tendencies. The positive role of physical culture does not result from itself, but only from our conscious and intentional utilisation of all positive integration values, which are characteristic of it. In addition, it also culminates from the understanding and suppression of possible disintegration tendencies, demonstrated particularly in top level sports.

Keywords: physical culture, physical education, recreation, sport, European integration, change, ritual, conflict, aggressiveness.

INTRODUCTION

After ten-years of European integration process, it comes to the new and qualitative higher period of integration. Due to the introduction of the new currency "euro", the free European states integrated in the European Union move towards further economical and political integration and to the creation of, fundamentally, the other Europe. The new emancipated states of Central and Eastern Europe are in a period of progressive approach aiming at further fusion with the well-developed part of Europe. So, there are two, qualitatively, different integration processes accompanied also by the qualitatively different corresponding solutions to other problems, but with only one goal. Understandably, in the solution of these problems lies a clash with the integration as well as disintegration tendencies. They are not only inevitable as a result of preceding development, but also provoked absolutely intentionally.

In these processes, an important role is played also by physical culture as a whole, as well as their separate spheres. It is understandable because physical culture is perceived as an important social-cultural phenomenon, respectively a system, which intervenes in many domains of social and individual life. And in it, with progressive civilisation, emancipation and liberation of man, plays a more important role. So, it is impossible to eliminate it from these integration processes. The role of physical culture in integration process is a political problem. Physical culture is not apolitical. The physical exercises as such, indisputably yes. Way of their utilisation, the aim to which they are directed, is caused philosophically, so in consequence they have the political character. The whole system of physical culture is a reflection of the political system. It means that it has also the political character. And this reality is not only politically utilised, but very often also abused.

The process of European integration is a political problem. Hence it can be inferred, that the demands of it are not only different, but also opposite. If we accept the integration as a politically positive goal, then we have to appreciate also the integration and disintegration potential of physical culture. But because we are rather well-disposed towards the positive evaluation of physical culture, we perceive more integration potentials: so the sense of this contribution is to refer, above all, to the changes of disintegration tendencies, which are generally disguised in the physical culture and especially in some of their domains.

HISTORICAL DEVELOPMENT OF PHYSICAL CULTURE AND CONTEMPORARY TENDENCIES OF EUROPEAN INTEGRATION

The social development, from the point of view of a global society as well as of particular societies, is a result of incessant changes. From the developmental standpoint the change is inescapable. It is the environment, ideas, culture, people... as well as the

relationship between them, which change step by step. The whole society and its particular parts change. Blanchard (1995) understands the change as a consistent reality of human society, as a dynamics of history and an essence of progress. I suppose that such understanding of change is true from a long-term point of view. But it must not bet from the short-term point of view. History advises us of the fact that the change can have both positive as well as negative effect. It means that the change itself is a problem, which results from reason, sense, goal, way of the realisation of change etc. But positive results cannot be achieved, or only very hardly, with "losses", if the society is not prepared for the acceptance of change. So it is necessary to correspond the change to the possibilities of the given state of society. By Blanchard (1995) the change is a product of invention (the result of processes taking place inside given society) or of diffusion (changes caused by influences from outside – the transfer of ideas and values from one social environment to another etc.). The changes, as a result of diffusion, are, by him, predominant. But, in my opinion, it is not possible to forget the fact, that often (may be most often) it is about the combination of these two processes – see the start of our "velvet revolution".

From the point of view of consequences, it is also necessary to identify and analyse the reasons of developed changes. They can be caused by the world–wide development of civilisation, by the globalisation of society, and so can have "universal" or "global" character. But they can be also caused by "national" interests, by traditions, the level of given culture, economy, political or economical interests and so on, which corresponds to "particular" or "regional" character of changes. And from this reality results the evident danger: "universal" ("global") changes can be opposite to "particular" ("regional") changes. These serious discrepancies manifest themselves as in a world-wide measure, as in the processes of European integration. In my opinion it is only in Europe where this discrepancy is historically typical. Undoubtedly, it is caused by its historical development. In the past, Europe was a set of relatively closed societies, states, the relationships between them were very variable. Unfortunately, in some parts of Europe this state remains unchanged. In such a situation, changes have more regional character, because mutual influence, the processes of "acculturation" are very difficult. The change of this state is possible only through the change in people's thought, so only by his preparation for the historically necessary changes. All changes of general society character manifest themselves in the changes of physical culture. Its entire historical development documents., that the physical culture reflects the developmental stage and level of given society in all historical stages. The social system and the system of physical culture was, and is, very closely bound. It reflects itself in mutual conditioning of changes, the effect of them is also the change in physical (exercise) activity. In all developmental stages these functions as well as their quantity has changed.

The changes in the domain of physical culture manifest themselves:
– in the first place in the formal structure of system,
– consequently in the contents,
– subsequently in the proper realisation of the process (the thing is that it is already dependent on the quality of teachers, trainers etc, so on the people himself).

In all systems of physical culture, originated or gone down in the history, as well as in the existing systems, we can see numerous differences (the philosophical standpoints, directions, ways of realisation, relationships to other systems etc.), which are characteristic for them. But, on the other hand, in spite of all differences, they have some common signs, which are:
– the formulated aims (objectives) to which the system is oriented,
– the arrangement of component parts, which are typical for a given system,
– the intention and prescription resulting from the system,
– the origin of institutions guaranteeing the function of system,
– the ways of preparation of staff and of material security,
– the specificity of relationships to the existing social system.

It seems to be paradoxical that they are just these common signs which differentiate one from the other. From antiquity to the present days we can perceive very close relationship between the level of given society and the level of physical culture in a sense of developmental progress and regress. This reality is caused above all by the changes of universal character, which cannot understandably pass through all parts of world in the some time. The positive tendencies of this development are the effect of the existence of universal values, which are achieved in the processes of physical culture, respectively of physical (exercise) activity. They are such values like tolerance, mutual esteem and respect, help, self-confidence, self-assurance, emancipation etc., as well as health, fitness, efficiency, motor perfection and so on. Surely about such values, no one can doubt their respective importance. They are the qualities, which are very meaningful not only for the usual functioning of advanced society, but also for the needs of European integration processes. But it is not possible to suppose, that these qualities are only the consequence of the existence of physical culture or physical exercises. They themselves are indifferent. It means, that they can be utilised as positively, to induce the values mentioned above or as negatively, to induce the "values" of entirely opposite nature. It is the thousand-year history of physical culture, which convince us of this reality. In spite of the positive

potential we can pursue in some developmental stages the periods, in which the physical exercises had been utilised entirely intentionally to the achievement of negative goals. It happened especially in the cases in which it was about the achievement of partial, particular goals, in discrepancy with the universal tendencies and values, or even when there goals were abused.

We do not see these discrepancies only in the development of ancient and middle-age society and its physical culture. They are pursued also in the new-age. The expression of universal values of physical culture as well as of changes of universal (global) character were its humanistic tendencies aimed at the rebirth of physical culture, its real rebirth in accordance with the origin of the industrial society, as well as its further development reflecting the development of society. But on the contrary we can pursue also the changes of a regional or particular character and aiming the physical culture in spirit of there changes. Enough proofs about this reality give us the comparison of existing systems of physical culture – German, Swedish French, New-Austrian or Czech, which have entirely different purposes and goals. In them they manifest themselves very visibly as discrepancies originated from the preference of one s own, internal (regional or particular) interests over the more general, universal, global interests of all-people character. The danger of negative tendencies is the bigger, the more dominates "regional" over "global", the "particular" over "universal".

The evaluation of this proportion is the easier, the bigger a historical distance from the assessed reality, the harder, the more distant is the future to which it is referred. These discrepancies are also visible in the development of Czech system of physical culture. We can illustrate in it the clash of "universal" and "regional" or even "subregional" tendencies and of changes deduced from them. It is not the purpose of this paper to analyse the result of these clashes, but to refer to them. And, moreover, their assessment is necessarily combined with the assessment of given historical situation as well as of further historical development. But it is also necessarily to be aware of the facts, that they are just these disproportion, which caused:

– emergence of false borders between groups, nation...
– preference of membership to a group over the other much more important phenomena,
– origin of feeling of superiority, intolerance, spite, xenophobia, racism...

All these as well as similar concepts are in entirely opposite to the essence of physical culture. Nevertheless it was also the physical culture which had contributed in its original development. Be it was by the unenlightened or by historically conditioned breach of proportions mentioned above, or by the fact, that it had been intentional, for some particular reasons abused.

But the consequences of this disproportion manifest themselves also in the assessment or self-assessment of people, which is understandably connected with physical culture very closely. What is principal in man's assessment? Is it his appurtenance to a certain nation, city, institution, profession, profession group...? Certainly not. It is only the external sign, the "label" classifying man into a definite group. It is also the expression of his personal identification with something or somebody, the expression of cultural identity and do on. But it is nothing which can in concrete terms testify his personal quality. In the contrary, is it very essential who is the concrete man, how he is, how does he behave, what does he know...? Certainly yes! Only to this basic characteristics can be assigned all the external "group" signs, only this makes sense. The pride of the appurtenance to the certain group have to result from the consciousness of one's own quality and from the quality of other members of group. So, the quality man is not given by the appurtenance to a certain group, but the quality of group is deduced from the quality of its members.

What is it about? It is about not to violate the proportions between the "universal" ("global") and "particular" ("regional") tendencies in the social system as well as in the system of physical culture. And, mainly, it is about not to be these tendencies in mutual discrepancy. Though it does not result from it, that the "regional" tendencies have necessarily the negative effect. If they are not in discrepancy with the "universal", or even against them, they can be a contribution for other societies, for other systems in which they penetrate. In the end they are even a contribution also in the universal sense. This fact is connected with known cultural processes. An individual, living in a given cultural environment, identifies step by step values and norms of this society (eventually he refuses them) and he prepares himself on the real participation in the society. This process is called "enculturation". From the point of view of the development of mankind and society this process is basic and necessary. But it brings also a certain danger. In the case of its rigidity, of the orientation to itself, of overestimation of its level and importance, it very hardly accepts (respectively refuses) of any kind social changes. But in the opposite it is sure, that the mutual influence of separate cultures, the enlargement and transference of positive values (the process of diffusion) which condition the positive developmental changes, is very necessary. Such a process is called "acculturation". Also this process has to be reasonable. Each society has the use of certain level of cultural and social values, which are characteristic and typical of it. They are the expression of identity of a given group, the expression of identifying an individual with a group. The feeling of immoderate haughtiness of the level of society (or group), looking down on others is not useful for its development – the consequence is a retardation of its development and its relative

closeness and isolation. But much worse is a feeling of inferiority, thoughtless acceptance of all which come from outside. It is not only the problem of loss of identity, but also the problem of complications of the developmental process.

In the past, there were the "monocultural" societies, mutually very different, relatively separated. Trough the development of the process of migration and communication, came also the transfer of cultures and their values. It came to the cultural pluralism, which is represented by the existence of diverse cultures beside one another. The actual alternative of this reality is a "multiculturalism" – the state of cultural variety, of penetration of various cultures and, of their mutual affection. This is our future. This is also a future of the physical culture. In the process of speedy social changes, in the integration processes, in the development of multicultural societies, the physical culture can play a very important role. But, as it was mentioned above, it does not result from physical culture itself. On the contrary it depends on:

– our approach to the integration process,
– understanding of relationships between universal and particular tendencies,
– understanding of the real importance of physical culture and its universal values
– understanding that the physical culture has values useful to all,
– understanding that in specific systems exist values typical for them, but can be useful for others,
– understanding of physical culture as a part of "accultural" processes.

Because the physical culture is aimed above all, to man and only through him to the society, the above mentioned depends also on:

– understanding of man as a basic element of society,
– understanding of the philosophy of human body,
– understanding of man as a unity of physical, psychological and social dimension.

So, it is about the understanding of originated changes, of man and of physical culture. It is about education. Blanchard (1995) already mentioned stress the importance of physical culture as a category of cultural behaviour and consider it as a "vehicle for multicultural behaviour" (p. 226). This can be surely accepted.

PECULIARITY OF PHYSICAL EDUCATION, PHYSICAL (EXERCISE) RECREATION AND SPORT IN RELATIONSHIP TO THE EUROPEAN INTEGRATION

From the preceding chapter results the fact that in general level, physical culture disposes of sufficient potential means as well as reached values to be an important integration helper and means of the origin of multicultural society. But all the same they hide in it some dangers, which can be counter productive.

But, in my opinion, the situation is more complicated in its subsystems. It seems to me that the most important (because the most utilised) is the sphere of physical (exercise) activity and its particular kinds-of physical education, physical (exercise) recreation and sport.

Essentially it can be said that the possibilities of physical education and of physical (exercise) recreation are, with regard to the integration and acculturation processes, the same as the possibilities of physical culture generally. It is affected by two principle circumstances. Above all, it is the reality that these kinds of physical (exercise) activity are aimed in the positive sense on a man. Their goal is development of man, his formation, perfection and so on, regardless of appurtenance to any group. So, in this sense the utilisation of physical education and of physical (exercise) recreation is in a harmony with the global, universal tendencies. The second important circumstance is the fact that, namely in actual time, the elements of various systems and cultures are mutually assumed and utilised. Through these activities, physical culture contributes to the acculturation processes and entirely evidently intensifies the integration tendencies. To the opposite tendencies can occur only in the case of their evidently aimed utilisation or of abuse to the "regional" and "particular" goals, which would be in discrepancy with global and universal tendencies. The possibility of the origin of these negative tendencies is similar as in the physical culture generally, but I suppose that in actual stage of social development it is only few probable in democratic societies.

In a different way I perceive the situation in sports, namely in top-level sports. Sports is generally considered as a means of sympathy to people and nations, of friendship etc. With sports is joined many concepts, which belong to the sphere of the highest universal values. This connection is naturally possible, but not ever it corresponds to the reality. They were periods in which, in the term of Olympic Games, did not make ware; in modern time the Olympic Games were not organised owing to war or other problems. What is the cause of this disproportion?

I suppose that much result from the basic characteristics of sports, namely of top-level professional sports. Above all it is a direction of sports. In cases of physical education and of physical (exercise) recreation it is man and his perfection who is the goal and the physical exercises are the means for its achievement. But in the sports it is in the opposite. The goal is the performance and victory, the means for achievement of this goal is a relatively perfectly prepared individual (Hodaň, 1991) This change of relationship is entirely principle and brings the problems, which are their reflection – a performance at all price, an unfair action, a bribery, a manipulation

with the people, doping etc. It goes universally about the phenomena which are inconsistent with the universal values and, in connection to the particular (individual, club, national) interests, they have a disintegration character and are individually and socially undesirable. And comprehensibly, they negate the basic ethical principals and norms. These are very serious problems. But their solution is not the topic of this paper.

Let us return to the essence of sports performance, competition, victory. It is true these are the terms occurring in many human s activities – draft of talents examinations for admission, open competitions (for a post) etc. But the character of these "competitions" is another than in the sport. The "winner" in the science or art does not exist, it is very difficult to label someone as "the best". But the competition, performance and victory are typical, permanent, they are the true "spice" of sports. Without it sports ceases to be the sport. But from this essence of sports result very serious danger, which we do not very often appreciate. Victory can create the possibility of the origin of the feeling of superiority, exceptionality. The possibility of the origin of these feelings, to which the young sportsman resists only very hardly, is supported also by the surroundings, spectators, disproportional incomes as well as by the influence of media. The feelings of superiority and exceptionality can be perceived in two levels:

– the feeling of superiority and exceptionality of individual = the individual feeling which is a manifestation of human failure with individual and interpersonal consequences,
– the feeling of superiority and exceptionality of a group, a nation = the group feeling, which can be a manifestation of social failure with serious consequences.

It is understandable that the group feeling of superiority and exceptionality is more dangerous than the individual feeling. The more the danger, the larger extent this feeling reaches. It is about the fact, that this feeling does not concern the sports groups only, but also their fans, admirers, the people who is (for the various reasons) of the same opinion as his idols. I do not mean by it only the divers groups of fans (and not at all of rowdies). I mean by it above all the moments, when these feelings of "superiority" can effect a large part of the society. With the respect and admiration for sports, we have to admit that for the society exist many more important activities than just sports. But none of them has this emotional charge, none of them can attract such a crowd of fans.

Such fans never endorse any Nobel prize holder or a glorious inventor as they do to a sports hero. Understandably, it emerges from the positive basis of sports. But this advantage ends in the moment, when the sports success (namely in the case of state representation) begins to be something which is all-embracing, for the group or for the nation decisive. In the moment when the sport success compensates various others (and often very important) faults and national "traumas", when it compensates the feelings of inferiority and imperfection and so on. In the moment when the knowledge that the group of "our" sportsman (naturally are they in present time "our"?) is in given moment and in given tournament the best, outgrows in the feeling that "we" (group, nation) are the best (Hodaň, 1998). And just in this moment originates the feeling of group superiority, exceptionality etc. These realities are utilised and abused by the politicians as well to their benefit. Coghlan (1990) says, that sports is linked with government and polities and that it is naive to believe or wish it to be otherwise. In these cases occur not only the undesirable consequences of sports generally and sports events, but also to their abuse. And than the positive "universal" values of sports are suppressed by the "partial" interests. The natural integration values of sports change so very easily (even perhaps if not purposely in disintegration tendencies. The existence of various economic or political failures, of national inferiority complexes and "traumas" leads to the "closeness" of the group into itself, to its delimitation towards others, to the origin of different phobias and so on. Of course, this trend can be still raised by the "use" of success in sports mentioned above.

The extreme example of these tendencies were the Olympic Games at Berlin, the political problems around the Olympic Games at Munich, Moscow and Los Angeles, the abuse of sports in the "representation of socialist system" etc. "Panem et circenses" was valid very long time ago. In the modern integration world this thesis has lost its place.

Any human activity can be utilised for positive or negative goals, or even abused. The greater the danger of incorrect direction or even of intentional abuse, the attractive is the basis to given activity. Attractiveness of sports flows from many circumstances. Above all, it is a reality, that in its original form it is the manifestation of all basic signs of human life, which is related with the whole development of humankind from its origin. With these beginnings is linked the derivation of sports from rituals which are a part of human naturalness. The ethnographic investigations shows, that the rituals of primitive nations have the movement, many times "sporting" character. But do not have the character of competition, which is the basic sign of sports. Cultural anthropologists show, that the sport and the ritual manifest similar behavioural patterns, and that the actual sport behaviour has its roots in ritual performance. They understand sports as a certain "specialisation" in ritualises in which was stressed the competition which, in this time dominates over the essence itself. Sansone (1998) understands the sports as a ritual sacrifice of human energy. From the reflections of interested anthropologists it results, that they understand the sport as a phenomenon in which the whole cultural background manifests itself and which functions as ritual or as a "transmitter" of culture. But by me just this conclusion is not correct. From the

mentioned relations between ritual and sports and from their concomitant signs it results that sports is neither a "manifestation of cultural background" nor a "transmitter" of cultural values. It cannot be thought of apart from culture or beside it. It is an integral part of culture. The understanding of the ritual as one of the roots of sports is very precious. It explains the natural essence of sport, its cultural dimension as well as their attractiveness. Nevertheless, it is just the presence of the competition, which makes the difference between the ritual and the sports in our interpretation. In our contemporary sports, competition dominates. It is, for example, Guttmann (1978), who highlights these basic differences between ancient (Greek) sport (as a religious ritual and artistic expression) and contemporary sports. But in spite of this distance the ritual basis of sports are perceived. I suppose that the knowledge of relationship between sports and ritual is precious from the point of view of integration processes. It is often the "ritual" opening of competitions (for example the Olympic games) which contributes to it. The understanding of ritual like expression of human nature, all-human culture etc., the using of all its cultural values, indisputably has the accultural character. But also in this case can arise a danger, and they are some other human activities which turns our attention to this reality. In extreme cases, still, the ritual can become a group affair, which differentiates the given group from others. Namely in the case of the relation to the feelings of superiority and exceptionality mentioned above. They are the tendencies which have not only disintegration, but even socially dangerous nature. None the less, it concerns activities other than sports, but it can be in this sense, abused .

I perceive greater danger in the fact that it is the conflict, which is an important sign of sports. So a competition like a conflict. Like a conflict of rivals, which has, in its essence, the character of the social conflict. According to Nisbet (1970) the competition is a form of conflict in which two or more persons struggle to attain an objective. He identifies with my preceding assertion, that the stress is given more on the competition (struggle) and its result than on the persons themselves. Certain moderating process of this conflict is the opinion, that the matter is the cooperative conflict. On the other hand, this tendency runs more in the head in case of sports, where the rivals are competing against one another in the mutual clash, even in the physical contact. This fight is very often compared to a war. By some anthropologists and ethnographers in those societies with a high frequency of warfare activities there is a strong likelihood of extensive combative sport behaviour. Proofs as well as one's our experience persuade us about the fact, that a sporting "fight" has very often political, or even national character. A victory in the sporting "fight" compensates other lost, presumed or real, struggles, even very distant ones. Surely it is not necessary to stress the negative consequences of this reality. The comparison of the sporting conflict and the war flows from one of the basic signs of sports as well as man. It is the aggressiveness. The sports struggle is the expression of aggressiveness but it is also, and this is very important, necessary opportunity for release of the natural man's aggressiveness. To be positively understand the relationship man-aggressiveness-sports, cannot cross a certain limit. This limit I perceive in two directions. Above all it is a sense of aggressiveness. The release of the natural man's aggressiveness via sports is desirable. It lowers the level of aggressiveness in usual man's relationship. It cultivates the inter-individual relationships. But with the increase of sports efficiency we can see the contrary to this process. The aggressiveness is perceived as the intention, as behaviour, which helps towards achievement of the goal. The aggressiveness is intentionally inculcated, it is stressed for the achievement of required performance, in the process of sporting struggle is roused again and again. It is understood as an important part of the behaviour of sportsman (also already not as a "vent"). This behaviour is roused even in very young sportsmen and children. It is indisputable that the impact on the result of sporting struggle is positive. Nevertheless, in this form it brings the danger of transmission of educated aggressive behaviour into everyday life, into the inter-individual relationships. The level of all-social aggressiveness increases (which understandably has negative consequences) and the sporting behaviour is an example it. Educated aggressive behaviour can also increase the feeling of superiority and exceptionality. And these features surely do not help towards integration tendencies. The second direction I see in the danger of crossing the measure of identifying a spectator with aggressiveness of a sportsman. This identification can have two forms. The first form is represented by "rowdies" – the perceived sporting activity as an impulse and pretence of their aggressive behaviour. The second form-the group of fans associated, also in the sense of aggressiveness, with "their" sports club and begin to fight against another group. So the origin of group aggressiveness, which can reach large proportions and cause conflicts of inter–national character. These examples are well known from the history of sports. The aggressiveness as a goal is a disintegration danger to sports in any form. It also contributes to the growth of aggressiveness of society generally – the aggressive behaviour, the aggressive advertising, the aggressive music etc. It is a picture of contemporary days. At all events, these tendencies are in inconsistency with toleration, mutuality, consideration, respect etc.

CONCLUSION

The physical culture (and its separate spheres) is a social-cultural phenomenon, which influences very considerably the human society in the course of

historical evolution. It manifests itself also in the present time, when this sphere of man's activities is a very important subject in negotiations between governments as well as many institutions of the European Union. Number of regulations and norms regulating these activities in a way to help the integration processes were accepted. Similar to other activities, the activities of physical culture can have their positives and negatives. The positives are more obvious, and they depend upon the more are the activities aimed at man. We all know that physical culture can play a very important role in the European integration processes. Of course, only in the case of premise, if we will approach it critically and if we will evaluate responsibly its possibilities and trends. And also, it we all are professionally interested in this sphere, will develop just the positive and universal trends, and suppress the negative trends mentioned above, which can act independently or in any combinations. The integration possibilities of the activities of physical culture are not in themselves, but in ourselves, who realise them.

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DIE KÖRPERKULTUR UND DER EUROPÄISCHE INTEGRATIONSPROZEß
(Zusammenfassung des englischen Textes)

Die gesellschaftliche Entwicklung ist ein Ergebnis ständiger Veränderungen. Die Veränderung selbst ist ein Problem der Beziehung zwischen den einzelnen Gesellschaftselementen und der gesellschaftlichen Umwelt. Der Effekt der Veränderung kann sowohl positiv als auch negativ sein. Dies hängt von der Beziehung zwischen den "universalen" ("globalen") und "partikulären" ("regionalen") Gründen und Veränderungstendenzen ab. Die Körperkultur ist einer von den bedeutenden Faktoren, die an den Veränderungen beteiligt sind. Ihren wichtigen Platz findet sie auch in den Prozessen der europäischen Integration. Die übliche Vorstellung über die positiven Einflüsse der Körperkultur ist nicht immer dementsprechend. Die Geschichte belehrt uns darüber, daß in verschiedenen Systemen die partikulären Interessen über die globalen markant die Oberhand gewinnen, was von dem heutigen Gesichtspunkt aus in integrationsfeindlichen Tendenzen mündet. Ich persönlich bin der Meinung, daß in der Körperkultur allgemein, in der Körpererziehung sowie der Bewegungserholung, hinsichtlich ihrer Orientierung auf den Menschen, die positiven, also die integrationsfördernden Tendenzen vorherrschen. Eine größere Gefahr kann im Sport, insbesondere im Spitzensport, wahrgenommen werden. Hier bestehen markante Mißverhältnisse zwischen den globalen und regionalen Interessen, die Erfolge im Sport werden anderen, häufig bedeutenderen Ergebnissen der menschlichen Tätigkeit übergeordnet. Dies führt zu Überordnungs- und Außergewöhnlichkeitsgefühlen, zur Xenophobie, zum Nationalismus und Rassismus. Diese Tendenzen werden durch den Mißbrauch von grundlegenden Ausgangspunkten und Merkmalen des Sports wie Ritual, Wettbewerb, Konflikt, Aggressivität u. ä. verstärkt.

Die Möglichkeit der Beteiligung der Körperkultur an den Integrationsprozessen geht daher nicht von ihr selbst, sondern von ihrer Deutung und ihrer vorsätzlichen Nutzung aufgrund der Analyse der Möglichkeiten aus, die sie besitzt.

Schlüsselwörter: Körperkultur, Körpererziehung, Bewegungsholung, Sport, europäischen Integration, Veränderung, Ritual, Konflikt, Aggressivität.

TĚLESNÁ KULTURA A PROCES EVROPSKÉ INTEGRACE
(Souhrn anglického textu)

Společenský vývoj je výsledkem neustálých změn. Sama změna je problém vztahu mezi jednotlivými elementy společnosti a prostředí. Efekt změny může být pozitivní i negativní. Záleží to na vztahu mezi "univerzálními" ("globálními") a "partikulárními" ("regionálními") důvody a tendencemi změny. Tělesná kultura je jedním z významných činitelů, kteří se na změnách podílejí. Její významné místo je i v procesech evropské integrace. Běžná představa o pozitivních vlivech tělesné kultury není vždy adekvátní. Historie nás poučuje o tom, že v různých systémech výrazně převládaly zájmy partikulární nad globálními, což

z dnešního pohledu vyúsťuje do protiintegračních tendencí. Domnívám se však, že v tělesné kultuře obecně, v tělesné výchově i pohybové rekreaci, vzhledem k jejich zaměření na člověka, převládají tendence pozitivní, tedy integrační. Větší nebezpečí je možno vnímat ve sportu, zejména vrcholovém. Tam dochází k výrazným disproporcím mezi globálními a regionálními zájmy, k nadřazování sportovních úspěchů nad ostatní, a často významnější, výsledky lidské činnosti, k pocitům nadřazenosti, výjimečnosti, xenofobie, nacionalismu i rasismu. Tyto tendence jsou posilovány zneužíváním základních východisek a znaků sportu jako je rituál, soutěž, konflikt, agresivita apod.

Možnost podílu tělesné kultury na integračních procesech tedy nevychází z ní samé, ale z jejího výkladu a záměrného využití na základě analýzy možností, které má.

Klíčová slova: tělesná kultura, tělesná výchova, rekreace, sport, evropská integrace, změna, rituál, konflikt, agresivita.

THE REFLECTION OF SPECIAL OLYMPICS SPORTS INTERVENTIONAL PROGRAMME IN INNER EXPERIENCE OF ADOLESCENTS WITH MENTAL RETARDATION

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The article presents a part of extensive longitudinal project** undertaken during the years 1995–1997. The used methodology was described (Válková, 1996; Válková, 1998). The content of article is focused on the development of inner experience of adolescents with mental retardation. Members of the SOI group (SOI) were involved in Special Olympics sports programme, the members of NON did not participate in any sports activities. Research project lasted more than 2 years, the Special Olympics sports programme constituted a minimum of 4 hours per week more than the programme for general education in NON group in residential homes. The "Technique of incomplete sentences" was used for analysis of inner personal experience of adolescents with mental retardation. Research assessment was applied during March 1995 and repeated in June 1997. SOI and NON groups presented different picture both in the first and later in repeated assessments, above all in the categories: meal and board orientation, performance orientation, home and house, hypercriticism, attituted towards sports activities, ideals, etc.

After two years of different programmes, different developmental trends were found in SOI and NON groups in subjective personal experience categories. We can hence deduce that the influence of inner enrichment in experience of adolescents with mental retardation as well as socialization seems to be very important.

Keywords: mental retardation, incomplete sentences, Special Olympics, socialization.

INTRODUCTION

The significance of physical activities for health and social benefit of individuals, for their spiritual enrichment, in general, is a very often discussed topic as well as an interesting topic in textbooks. However, the results confirming this theses with exact data are very rare (Svoboda, 1971, 1991; Bartko, 1980; Hošek & Macák, 1989; Rychtecký & Fialová, 1996; Singer et al., 1993). In this area we can highlight two problems:

– who can be considered as individual participating in physical activities and sports (participant for how many years, how many hours per week, what intensity of participation etc.),
– while variables of health level or motor competence (fitness, skills, amount and intensity of physical activities) are perceptible (unmistakable) and measurable, the features of socialization and inner experience are more latent, burdensome to uncover with exact methodological tools. This particular inner, subjective experience of actual situation forms the behaviour of each individual in real as well as potential future time. Participation in physical activities and changes in social behaviour are considered as bilateral:
  a) physical activities can influence inner experience, secondarily on social behaviour features,
  b) determined features of social behaviour (and experience) can influence selection of sports activities and adherence to participate in.

These parameters are used in relation to common population. The validity of this one in relation to mentally retarded minorities is investigated and discussed very rarely (Rijsdorp, 1984; Seekins, 1984; Vermeer, 1990; Válková, 1998; Winnick, 1990). The recent development of adapted physical activities and attention to disabled sports pushed forward the idea about possible enrichment of social dimensions and spiritual development of individuals with mental retardation through physical activities. Therefore the said project became an important part of international comparative study of SOI sportsmen–NON sportsmen adolescents with mental retardation.

Life-experience, life-process is imprinted in individual's psyche (Janoušek, 1986, 9), either experience of happiness or suffering and pain formed

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the individual's integrity/halving, stability/instability (Kowalik, 1998). Then, if physical culture is considered as an important phenomenon of the life-span process the topic of inner experience should be placed in the light of the physical culture concept. Otherwise, the physical culture phenomena would be narrowed down to physical exercise, fitness, performance and physiological variables only.

RESEARCH DESIGN, MAIN AIM

The source of research design is the concept of term *"motor competence"* and *"motor behaviour"* which the social dimension is included in (Vermeer, 1984, 1990; Seekins, 1984; Shephard, 1990; Marcellini, 1993; Winnick, 1990; Sherill, 1995). The complex project comparing dimensions of motor competence (variables of fitness, psychomotor level and social behaviour) as well as more detailed explanation of used methodology and techniques were described previously (Válková, 1996, 1998).

Only analysis of social dimensions of motor behaviour including inner experience growth and development in the framework of physical activities and sports (in SOI–NON groups) are presented in this study.

The main aim of investigation was to describe the state and developmental trends between SOI–NON groups after two years Special Olympics sports programme (SOI) and after general educational programme in residential homes (NON).

We supposed the following hypothesis:

1. differences between each group in categories and intensity of experience on levels of investigation:
   - differences between SOI–NON in 1995 before starting the programme,
   - differences between SOI–NON in 1997 after finishing the programme;
2. differences in categories and intensity of experience in each groups after two years of various programmes:
   - differences in SOI between 1995–1997 (pre-post assessment),
   - differences in NON between 1995–1997 (pre-post assessment).

Further, we supposed the quality of life-span of persons with mental retardation would be possible to analyse on the back-ground of different programmes and secondarily the impact and benefit of eitler general or Special Olympics programme.

RESEARCH SAMPLE

The participants of were recruited mostly from residential homes (13) and private centers for the mentally disabled (2), alltogether 15 institutions from localities all over Czech Republic. The only criterion for selection of those 15 localities was whether the Special Olympic coaches or educators were willing to participate in the investigation only with symbolic financial award (only in 1997, during second part of investigation). Only one differential criterion was requested: in SOI group at least 4 hours of physical activities extra under Special Olympics regulations, at least two times participation in National SO games. Sports and tourist summer/winter camps as well as competitions with opportunity to travel were included in SO programme. General educational programme usually consisted from 2 PE lessons weekly and more ballanced arts, crafts and self-helped activities.

The participants were informed neither about the purpose of programmes, assessments nor membership SOI–NON groups for this purpose.

The level of mental disability oscillated between the mild level (70–50 IQ) and moderate (49–34 IQ), average of age in 1995 was 25,1, two years elder in 1997. The groups were ballanced from items of mental level, ethiology of mental disability, age, high and weight and original family background, 39 identical individuals in each group. Two persons less were in NON in 1997 (37) due to health problems.

METHODS

ARGUMENTS FOR SELECTION OF INCOMPLETE SENTENCES TECHNIQUE

SOI Research Board which lead the international investigation offered several opportunities to analyse social behaviour: Q-techniques verbal or pictorial, projective techniques. As we cannot suppose the independent verbalisation of introspective experience of individuals with mental retardation projective technique seemed to be more available. The principle of projective techniques is among psychologists discussed as their advocates as well as their opponents. However, projective techniques can be used successfully in diagnostic process of special groups when the risk of purposefull simulation / dissimulation have not been real. Švancara (1980, 108) has presented *technique of incomplete sentences* as additional and partially associative projective techniques with minimal stress on verbal skills. He has stated positive results in children diagnostics from aspects of relations to parents, school surrounding, things, in detection of subconscious fear, ulterior emotion, motives, deprivations, even unpronounced desires. Švancara has used the latent time of reply, oral or written reply. The technique was used and warmly recommended by Rembowski (1975) as well as childrens' psychiatrists. The authors (e. g. Fischer et al., 1963, 398) supposed the motives of respondents, their attitudes and perception of the context of social relations determine the finishing of patterns of incomplete sentences. Those authors recommend to work out the exact system of scoring the findings. Clinical psychologists (e. g. Říčan, Krejčířová et al., 1995, 303) recommended incomplete sentences mainly as an additional instrument, as

a source of ideas and themes of recognition of personality. Pichot (1970, pp. 74–81) has paid attention to projective techniques in a separate chapter. Those techniques are classified according to Eysenck's approach towards the background for interpretation. Techniques with adding/completing are considered as available in complex evaluation mainly of social surrounding of individuals further in situation to maintain maximal objectiveness of replays.

The problem of objectivity of the content analysis of verbal sources (e. g. family documents, biografies, incomplete sentences) was solved by Janoušek et al. (1986, 9, 118–124) and Svoboda (1992, 114–116, 144–145). Both the quoted authors considered definition of content categories and categorial units as a crucial point. From one side categories must be entired, from the other side not atomised, they must exclude each other and express their consequence (frequency or intensity). Missing of the category can be a relevant finding as well.

Therefore the process of creation of categorial units system was the first important step in presented analysis.

ADMINISTRATION OF INCOMPLETE SENTENCES TECHNIQUE

For the purpose of cross-cultural comparison the version of incomplete sentences (TABLE 1) offered by SOI Research Board was accepted (similar versions are commonly used in Czech Republic). The mentioned version contains 9 incomplete sentences and "3 desires". Translation into Czech language and standardisation procedures, lists of administration and evaluation were provided in 1995 as a component of methodology manual/guide of described project (Válková, 1996). The assessment was presented as a play. Administrator initiated the person with the part of incomplete sentence and wrote down the authentic verbal replies including agrammatism, repeating words, features of behaviour, necessity to stimulate them during assessment. All of our research participants mastered their role and passed this assessment.

Then, categorial analysis of replies contents was worked out.

I. level of classification: extract of real categories expressed by every participant (activities, relations, things).

II. level of classification: 15 categories were defined (TABLE 2). 13 categories expressed real contents, category 14 the reply "I don't know", any replay or reticence, category 15 (Xx) amount of repetitions for replay stimulation (TABLE 2).

III. level of classification and statistical evaluation: each replay included in some category was considered as categorial unit (one person maximally 12 categorial units, *9 sentences + 3 wishes,* classified in some of 15 categories). Due to this way both a number of persons and frequency of units in determined categories could be summarized as well as figure out of percentage of persons scored in category in relation of number of group participants (39), further the percentage of frequency of categorial units in the group's framework. Maximal number of categorial units in SOI group were 468 (it means: 12 possible replays times 39 equal 468). In case of 37 persons in NON group it was 444 (12 replays times 37). Simply statistical evaluation was finished on percentage level:

– % of persons presented determined categories in the group SOI or NON,
– % of categorial units in the group SOI or NON which express a value importance of this category. TABLE 3 showed the complete survey about number of persons selecting the determined category and number of categorial units including statistics on percentage level.

NOTICE: evaluation of proposed categories valid for adolescents with mental disability was done by means 3 diploma thesis in 1994 and 1995. Proposed categories according to analysis of replies of other investigated groups were typical findings of all mentally disabled adolescents.

RESULTS AND EXPLANATION

The differences between groups SOI/NON are appearent on both level 1995 and 1997 (TABLE 3). Except expected differences in focusing on common daily activities, sports activities and achieving performance high frequency on *HOME, relatives relations, OWNERSHIP private things, to have got OWN "something"* appeared as a very important finding. We can deduce that the results may present home desire, image of closer family community as reaction on commonly shared a little anonymous life. By this way deep and rich subjective inner life, intensive experience and latent desires is possible to reveal.

In the TABLE 4 there are shown only categories selected by the statistical significance: either in relation to other group (SOI–NON relation) or in relation to time trend (95–97 relation). Bold letters marks significant finding. The numbers in columns means:

a a number of persons replayed the content category,
b a percentage of those persons (towards No 39, resp. 37),
c a frequency of categorial units in determined content category,
d a percentage of those units (towards No 468, resp. 444).

2. Food: SOI group was more orientated on food and delicacies (sweet, ice-cream etc.) in 95 than NON one. After two years programme the preference of that category decreased. In the same time more frequent orientation on general ideals including the value of health appeared (see cat. 12). May be the sports programme and life style during competitions could formed this orientation. However, speculation should be necessary to verify.

3. Common activities: both groups were concentrated on the desire to be active and to do anything in sports-out activities (drawing, listening music, sewing, knitting, gardening etc.), NON with a little higher intensity (in 1995 year NON 89 units, 19%, SOI 59 units, 12,6%). SOI sportsmen probably can be full of sports activities and they cannot feel activity deprivation. After the two years programme, the results were similar in SOI and NON, however, an increase of sports interests in NON have to be considered (see cat. 11).

4. Performance orientation: SOI in 1995 a little higher intensity than NON. After two years, of similar orientation in SOI, rapidly decreasing trend in NON. There is a question: what determinants influence the trend to be more passive? Less opportunities of NON to present anything in audience, to present their skills, to achieve any public reputation? SOI more often replay "to try to be good, to make effort to win", etc.

6. Home: home dimension was very intensive inner experience both in SOI and NON group, NON a little intensively. We can deduce more frequent contacts with "extra-mural" surrounding of SOI participants than NON, more chances to meet "extra-mural" people, more contacts and joint friends during sports training outside of residential home, during travelling and competitions. Therefore the accent on home category only in SOI after two years was unexpected for us. In the content of replies new phenomenon was marked: sexual partnership. Logical explanation can be two years biological maturity, but this phenomenon was active for each group. Next explanation can be in relation with recognition of partnership with social contacts in common sports surrounding. Further, more intensive physical activities can stimulate sexual activity. The 26 year limit was a little bit fatal boundary in Czech residential homes (not so much now, but stereotype maintains). The reason is because clients up to 26 are located in youth institutions, after this age limit clients either continue their stay there longer in others residence for adults, or try to be independent in sheltered rooming system. During the time of investigation there were massive discussion and support to the development of sheltered accommodation and partnership.

8. Hypercriticism: self-evaluation of SOI was more negative than NON (weak, silly, stupid, disabled, fat, bad, but also alone, needless etc.). Trends of hypercriticism showed a decline in each group. Maybe first SOI competitive experiences in 1995 can lead to understanding of weak skills, limits and differences. During two years programme their repeated winning and loosing as well as other participants, improving their skills, become daily reality, understand as reality and can find real "myself".

10. Behaviour: categorial units dealing with behaviour manners appeared unexpectedly very often. Proper behaviour is probably one of the crucial points of education in residential homes. Proper behaviour could be inner corrective which is perceived by our SOI, NON participants as strongly important. It could be O. K. unless the clients are living under continuous tension and stress. Inner experience of behaviour importance increased after two years.

11. Sports activities: the category was more used with SOI what seems to be logical. Increasing trend in NON in second assessment could be explained as follows: in spite of separate interventional programmes, a sports atmosphere could be perceived in residential homes in general and could be copied by NON.

12. Ideals: NON is more frequent in this category, unfortunately in naive or imaginative ideas. Frequency of ideal experience and "the health" desire increasing in 1997 in SOI group.

The last 3 content categories (abstract image, I don't know, repetition) were in harmony in each group on both levels of investigation. The percentage of persons as well as categorial units can be consider as reasonably balanced. The finding can document the identical intellectual potential of both SOI and NON groups.

CONCLUSIONS

1. The diagnostic technique of incomplete sentences seems to be available for purpose of applying in individuals with mental disability (mild and moderate level of mental deficit). It is possible to compare small groups if standardized model and classification is used. The technique opens a lot of opportunities for recognizing rich inner experiences and future educational applications and approaches to persons with mental disability.

2. After two years of different programmes (SOI – sports Special Olympics programme, NON – general educational programme) the trends of diversification or unification were found between SOI and NON groups in determined content categories. Therefore we consider the hypothesis about differences between groups as well as changes after two years programme as valid.

3. The differences between SOI and NON show the Special Olympics sports programme with competitions, travelling and a lot of social contacts can strongly influence inner experience of the individuals: in SOI mainly perception of home deseign, decrease in hypercriticism, forming of ideals, life-style features including value of health, in NON increasing of interests in physical activities. Therefore it is worth to apply physical activities programmes for the benefit of individuals with mental disability.

4. Findings of inner experience would be used in therapy, education and training, but also in public relation in order to improve relation to people with mental disability.

TABLE 1
The Technique of Incomplete Sentences

Brief Incomplete Sentences Task

Instructions:
Please, read each stem out loud to the client and record their answers verbatim. To avoid bias, and to prevent the client from giving answers that (s)he thinks you want to hear, please do not give your client any feedback as they offer their answers (like "good", "hum", "I did not know that", "oh really?". If your client says "I don't know", encourage them to think about for a moment. If they are still stuck, go on to the next one, and then go back to that one at the very end and try the stem again.

Begin by telling the client "I am going to read the beginning of a sentence out loud, and I want you to finish it with whatever you think or feel, whatever comes to mind. Any answer that you give is the right one because it is your opinion, your thoughts or feelings. I will write your answers down. Ready? Here is the first one".

1. **I would like to** _____
2. **I wish that I** _____
3. **If I only** _____
4. **I hope** _____
5. **I am** _____
6. **I would like most to** _____
7. **I am best when** _____
8. **People think that I** _____
9. **Sometimes I think about** _____
10. **If I had three magic wishes that could come true, I would wish for**
    1. _____
    2. _____
    3. _____

TABLE 2
Content category explanation

1. Animals: to own them, to play with them, to take care of them.

2. Food: food and meal preference including delicacy, sweets, ice-cream, to want it, to like it, to look forward to it, to buy them, to consume them.

3. Common activities: working (in general or specified), mainly drawing, drawing and painting, sewing, embroidering, listening to music, singing, but also garden works, self-help or entertainment and social activities (balls, disco, country-fair), activities joint to daily regime: to sleep, to lay, to have a rest: 95/97 SOI–3/3, NON–8/6.

4. Performance orientation: to try st., to achieve st., to be successful, to win, to finish st., to master st., to learn st., don't be failure.

5. Things: (to want them or own them): small things like knife, earrings, toys), fairy-tale things (princess' veil, mystery ring, gold fish), more expensive things (cassette player, camera, videorecorder, car motor-bike, satellite).

Fairy-tale things: 95/97 SOI–11/3, NON–3/2.

6. Home: to be there for some time, to be together with brothers/sisters or relatives, to leave the institution for home, to do typical housework and activities related home independence: to own dishes and cook, to do shopping themselves, cleaning, washing up for family, to walk with partner, to be with partner, share accommodation with him/ her, to take care of a child. Partner: 95/97 SOI–0/20, NON–0/16.

7. Weather: the weather, seasons of the year, time of the day (lik sunshine, snow-season, don't like rain, windy).

8. Hypercriticism: I-negative, hostile: dull, ugly, disabled, fat, other negative features, they don't like me, I'm alone, Hadn't I only exist!
Aloneness: 95/97 SOI–3/5, NON–3/1.

9. Indiscrimination: I-positive, elate: clever, skillful, hard-working, I can read/write.

10. Behaviour: My behaviour: nice, good, well-behaved, obedient.

11. Sport activities: to practice sport activities including dancing, travelling (also abroad), training and exercising, but also to have sports equipment, to be ready for competition.

12. Ideal: to help others, to live in peace, so that people don't kill others, don't quarrel, but also unreal wishes and ideas (flying to the space, to be a wizard or a fairy-tale hero) and also some "health values" themselves and others.
Health: 95/97 SOI–6/12, NON–8/10.

13. Abstract contents no chance to be classified: own name, incoherent and repeated words, adding words without any context with first part of sentence: I, Joseph, I am Joseph, repeating of one's name, I am here, I like, look at me.

14. I don't know, reticence or silence even if the sentence was repeated twice.

15. Repetition: it was necessary to repeat the sentence since the individual did not respond for the first time. The number of repeated sentences was reported.

TABLE 3
The survey of categorial units and their percentage in 1995 and 1997 yrs.

	1995								1997							
	SOI				NON				SOI				NON			
	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d
1	7	17,9	10	2,1	7	17,9	16	3,5	5	12,8	10	2,1	11	29,7	16	3
2	13	33,3	17	3,6	9	23,1	12	2,6	7	17,9	9	1,9	8	21,6	15	3
3	28	71,8	59	12,6	35	89,7	89	19,0	26	66,7	50	10,7	28	75,6	63	14
4	13	33,3	23	4,9	8	20,5	12	2,6	13	33,4	22	4,7	3	8,1	4	0
5	23	59,0	53	11,3	26	66,6	61	13,0	22	56,4	53	11,3	24	64,8	59	13
6	26	66,6	59	12,6	29	74,3	74	15,8	32	82,0	77	16,5	27	73,0	74	16
7	14	35,9	16	3,4	7	17,9	12	2,6	9	23,1	10	2,1	10	27,0	14	3
8	24	61,5	40	8,5	17	43,6	22	4,7	19	48,7	25	5,3	11	29,7	12	2
9	11	28,2	11	2,3	12	30,7	16	3,4	14	35,8	16	3,4	16	43,2	23	5
10	8	20,5	17	3,6	15	38,5	15	3,2	23	59,0	32	6,8	22	59,4	38	8
11	26	66,6	66	14,1	16	41,0	29	6,2	28	71,8	62	13,2	24	64,8	36	8
12	12	30,7	17	3,6	19	48,7	32	6,8	21	53,8	44	9,4	20	54,0	47	10
13	27	69,2	45	9,6	26	66,6	48	10,3	22	56,4	29	6,2	16	43,2	24	5
14	14	35,9	35	7,5	11	28,2	30	6,4	9	23,1	29	6,2	8	21,6	19	4
X	10	25,6	25	5,3	8	20,5	24	5,2	7	7,9	17	3,6	9	24,3	29	6

a *No of persons* **c** *No cat. units*
b *% persons* **d** *% cat. units*

a a number of persons replayed the content category
b a percentage of those persons
c a frequency of categorial units in determined content category
d a percentage of those units

TABLE 4
The survey of important differences between SOI and NON in 1995 and 1997 yrs.
*(The **extra bold figures** mean important differences.)*

	SOI				NON			
	a	**b**	**c**	**d**	**a**	**b**	**c**	**d**
	2 FOOD							
1995	13	33,3	17	3,6	9	23,1	12	2,6
1997	7	**17,9**	**9**	**1,9**	8	21,6	15	3,4
	4 PERFORMANCE ORIENTATION							
1995	13	33,3	23	4,9	8	20,5	12	2,6
1997	**13**	**33,4**	**22**	**4,7**	**3**	**8,1**	**4**	**0,9**
	6 HOME							
1995	26	66,6	59	12,6	29	74,3	74	15,8
1997	**32**	**82,0**	**77**	**16,5**	**27**	**73,0**	**74**	**16,7**
	PARTNER 95/97: SO – /20, NON – /16							
	8 HYPERCRITICISM							
1995	**24**	**61,5**	**40**	**8,5**	17	43,6	22	4,7
1997	**19**	**48,7**	**25**	**5,3**	**11**	**29,7**	**12**	**2,7**
	10 BEHAVIOUR							
1995	8	20,5	17	3,6	**15**	**38,5**	**15**	**3,2**
1997	**23**	**59,0**	**32**	**6,8**	**22**	**59,4**	**38**	**8,6**
	11 SPORTS ACTIVITIES							
1995	26	66,6	66	14,1	**16**	**41,0**	**29**	**6,2**
1997	28	71,8	62	13,2	**24**	**64,8**	**36**	**8,1**
	12 IDEAL							
1995	12	30,7	17	3,6	19	48,7	32	6,8
1997	**21**	**53,8**	**44**	**9,4**	20	54,0	47	10,5
	(HEALTH 95/97: SO 6/12, NON 8/10)							

a *No of persons* **b** *% persons* **c** *No cat. units* **d** *% cat. units*

a a number of persons replayed the content category
b a percentage of those persons
c a frequency of categorial units in determined content category
d a percentage of those units

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DIE WIEDERSPIEGELUNG DES INTERVENIERENEN SPORTPROGRAMS DER SPEZIELLEN OLYMPIADEN IN DEN ERLEBNISSEN DER GEISTIGBEHINDERTEN ADOLESCENTEN

(Zusammenfassung des englischen Textes)

Die Studie präsentiert einen verbreiteten Teil des langdauernden Projektes, dessen Methodik schon früher prasentiert wurde (Válková, 1996; Válková, 1998). Die Studie vergleicht die Entwicklung der inneren Erlebnisse bei den geistigbehinderten Adolescenten, die an dem Program der Speziellen Olympiaden (SOI) teil nahmen, mit den Personen, die nie Sport treiben (NON). Der Projekt dauerte zwei Jahre. Das Sportprogram enthielt mehr Bewegungsaktivitäten (mehr als 4 Stunden pro Woche) als das klasische, erzieherische Program der NON Gruppe. Die Innenerlebniskategorien wurden mit der Technik der unvollendeten Sätze, bei dem Anfang und bei dem Ende des Projektes im Jahr 1995 and 1997, gewertet. Die Forschung hat ein reiches Innereslеben bei der geistlichbehinderten Gruppe festgestellt. Kein Unterschied wurde zwischen den Gruppen in den Kategorien: orientierung zum Essen, Leistung, Heim, Hyperkritik, Stelungsnahme zur Sportaktivitaten und Ideale gefunden. Während des zweijahrigen Pause, geschahen bei der SOI Gruppe and NON Gruppe änderungen in den Innerenerlebnissen und darum Sie hatten andere Betonung auf einige Erlebnisskategorien. Es ist mőglich zu deduzieren, das der Einfluss der Bewegungsaktivitäten, auf innere Bereicherung der geistlichbehinderten Personen und ihre Sozialisierung bedeutend ist.

Die Schlüsselwőrter: die Spezialle Olympiade, die Sozialisierung, die unvollendeten Sätze, die geistige Behinderung.

ODRAZ INTERVENČNÍHO SPORTOVNÍHO PROGRAMU SPECIÁLNÍCH OLYMPIÁD V PROŽITCÍCH ADOLESCENTŮ S MENTÁLNÍM POSTIŽENÍM

(Souhrn anglického textu)

Studie prezentuje dílčí část širšího longitudinálního projektu, jehož metodika již byla popsána (Válková, 1996; Válková, 1998). Srovnává vývoj vnitřních prožitků u skupin mentálně postižených adolescentů, zapojených do sportovního programu Speciálních olympiád (SOI) a skupiny nesportujících (NON). Projekt trval dva roky. Sportovní program obsahoval nejméně o 4 hod. týdně pohybových aktivit více než klasický výchovný program skupiny NON. Kategorie vnitřních prožitků byly hodnoceny technikou nedokončených vět při zahájení a ukončení projektu v roce 1995 a 1997. Šetření prokázalo obecně bohatý vnitřní život osob s mentálním postižením. Skupiny SOI a NON se od sebe lišily na obou hodnocených úrovních, především v kategoriích: orientace na jídlo, orientace na výkon, domov, hyperkritičnost, postoj ke sportovním aktivitám, k ideálům. Během dvouletého odstupu došlo u skupiny SOI a NON k odlišnému vývoji ve vnitřním prožívání a tudíž k odlišnému důrazu na některé prožitkové kategorie. Lze dedukovat, že vliv pohybových aktivit na vnitřní obohacení osob s mentální postižením a jejich socializaci je významný.

Klíčová slova: mentální postižení, nedokončené věty, Speciální olympiády, socializace.

RESEARCH OF DETERMINANTS OF THE VIEWS ON PHYSICAL TRAINING OF PUPILS FROM SCHOOLS FOR EDUCATIONALLY DISABLED

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This paper deals with exercise activities of the mentally retarded children in the Czech Republic and Poland. The views of mentally retarded pupils of schools for educationally disabled are obtained and compared by means of questionnaires elaborated by us in both countries. On the basis of this broadly conceived questionnaire, this paper presents and interprets views of the pupils in the context of the following determinants: physical training lesson, physical training teacher and his/her activity, and out-of-school exercise activities.

Keywords: mentally retarded pupil, school for educationally disabled, physical training, physical training teacher, out-of-school exercise activities.

INTRODUCTION

If we desire exercise activities to be a vital part of life style of the adult population, then we have to be interested in an attitude towards such activities early in childhood. This is important not only with the healthy section of a population, but also for individuals with different kinds of disabilities.

A positive attitude towards exercise activities becomes more important with children with slight mental retardation (IQ 70–50), who attend schools for the educationally disabled to get primary education. Among others reasons for this are the work of mentally retarded persons focused on manual activity, interest in exercise activities that takes the retarded person away from the possibility of delinquent behaviour, culminating in an effort to control his/her socialisation in a desirable direction.

In shaping a child's attitude towards exercise activities the family takes its role first, followed by the school. A child's experience gained from physical training lessons in school considerably determines such an attitude.

It is a well-known fact that everyone including a mentally disabled person, develops his/her attitudes on the basis of his/her experience. What a pupil experiences during a physical training lesson evokes his/her positive or negative attitudes not only towards physical training as a teaching subject, but also to exercise activities in general.

There have always been formulated a number of targets and tasks for physical training and shaping positive attitudes towards exercise activities is one of the very first ones. Unfortunately, up-to-now our experience indicates that physical training at school, not only for disabled pupils but also for healthy pupils, does not achieve the desired results in this respect (Frömel, 1997; Hošek, 1997).

How to change this situation? No situation can be changed effectively without employing diagnostic observations. With our presentation of partial research results in this paper we want to contribute to the mapping of mentally retarded pupils' views on physical training at school. A comparative approach has been selected since we believe that in countries with similar historic traditions there are similar current problems and that possible solutions might be mutually beneficial.

RESEARCH PLAN

The aim of our research work is to characterise the views of mentally retarded pupils from schools for educationally disabled in the Czech Republic on exercise activities in comparison to those in Poland.

Our research plan is implemented in the context of the following determinants:

– Physical training school lesson
– Physical training teacher and his/her activity
– Out-of-school exercise activities

Research methods

Pupils' views were obtained by means of anonymous questionnaire in the Czech and Polish territories. Our own elaboration of the questionnaire have enabled us to word the questions according to the mental capacity of the respondents. Questionnaire reliability coefficient ranged between 0.36 and 1.00.

Research set

Research set consisted of randomly selected 627 pupils from schools for educationally disabled in the Czech Republic at the ages of 12–15 years and 328 pupils of the same age from schools for educationally disabled in Poland (TABLE 1).

RESULTS AND DISCUSSION

Views of pupils on exercise activities in the context of physical training lesson (TABLE 2)

Mentally retarded pupils in the Czech Republic are happier in the extent of physical training at school. They usually look forward to the physical training lessons, especially boys. Reasons for this are (in order of preference) the following: they enjoy them, they enjoy games, they do not have to learn other subjects. Those pupils rather uninterested in lessons state the following reasons for their approach: they do not enjoy them, they do not like them, they are not willing to get involved.

Pupils are less afraid of physical training lessons and if some fears occur, they are mostly connected with difficult exercises and possible injury. The most favourite exercise activities in physical training lessons are unambiguously games; for girls also dance, and for boys gymnastic apparatus work, which is adequate to the age of the studied pupils.

Mentally retarded pupils of school for educationally disabled in Poland consider the extent of physical training lessons appropriate or even excessive; nonetheless, they usually look forward to the lessons (good atmosphere, they do not have to learn other subjects). However, they are afraid of difficult exercises and of obtaining bad marks. Physical training lessons are quite tiring for them, especially for girls. They like best warming up exercises; girls also like dance and boys like games. The fact that warming up exercises are liked so much is probably due to its less exacting character, which evokes a subjective feeling of perfection.

Views of pupils on exercise activities in the context of physical training teacher and his/her activity (TABLE 3)

In general, mentally retarded pupils of school for educationally disabled in the Czech Republic more readily accept a female teacher. The advantages of a female teacher as they see it are: she is kind, nice; the advantages of a male teacher are: he is stricter and can do exercises better. We think, together with Dallermassl (1999) that girls should get in contact with female teachers and boys with male teachers (not female teachers with masculine behaviour) on physical training lessons.

Pupils in the Czech Republic put a considerable emphasis on the teacher's sense of fairness, apparently due to the fact that they have some experience with unfair teachers. Such an act evokes pedagopathogenic impacts and is clearly undesirable (Mareš, 1993). Further, pupils do not like if their teacher is too strict, shouts, or has a lack of sense of humour. The reason for that we find in the fact that schools are over–staffed with women. It can be expected that a male teacher also employs his natural authority when managing didactic action in lessons, while a female teacher substitutes it with orders and, if they are not obeyed she raises her voice. Boys prefer a teacher-sportsman, by which they understand a teacher of a sportsmanlike appearance, with good exercise capability, willing to participate in exercise activities of pupils. Responses to the question: "If I were a teacher of physical training, I would…" were of a wide range. The most frequent responses were: "I would understand pupils more, I would be fair, I would organise games they enjoy. Most pupils expect to get more encouragement from their teachers. A relatively large group of pupils prefer if their teachers do not take notice of them. This fact seems to be interesting due to the impacts of mental retardation.

On the other hand, mentally retarded pupils in Poland would more willingly accept a male teacher. What they expect from their teacher is fairness (similarly Kedzia, 1989), but also being a sportsman. Like Czech pupils, they do not like shouting (similarly Siwinski, 1988) and if the teacher is too strict. What they expect most from their teachers is to get encouragement. Unlike Czech pupils, 5% of Polish pupils responded to the question: "What should your ideal teacher be like?": like our teacher (in the item: "other"). We also noticed occurrence of responses: "We like everything about our teacher".

Views of pupils on exercise activities in the context of out-of-school exercise activities (TABLE 4)

A small percentage of the pupils in study are involved in organised out-of-school exercise activities in the Czech Republic. In Poland, the situation is even worse. A reason mostly given by pupils is the lack of opportunities. This is seen by us as alarming for responsible social organisations. However, at the same time it means that school physical training is the only place of intentional exercise activities for most of mentally retarded pupils.

In the field of out-of-school exercise activities, pupils are influenced most by their friends. The influence of teachers is relatively small. From this it is apparent that functional effects are stronger than intentional influence of school physical training. Svoboda (1992) calls such an effect a hidden curriculum. Stimulation by family environments to out-of-school exercise activities is, as expected, small. In this respect the family mostly leaves initiative to school, which complies with conclusions of research by Dohnal (1993) done with Czech pupils and Kruk-Lasocka (1991) with Polish pupils.

Similar views on out-of-school exercise activities were found in the case of group of Polish pupils. Only,

there is a slightly higher influence of family environments on pupils in this respect.

Views of pupils, which would not attend physical training lessons (TABLES 5, 6, 7)

One of the questions raised was whether pupils would attend physical training lessons, if they were optional (TABLE 2). We excluded pupils whose response was positive and here we present responses of the other studied pupils (TABLES 5, 6, 7).

There appear to be two distinctive groups among them. One, smaller group, are pupils who participate in sports also out of premises; in their opinion there is not enough physical training at school; they look forward to physical training lessons and after the lessons they are in a good mood. However, they also seem to be bored during the lessons. The other group is that of pupils, who do not participate sports and in their opinion there is too much physical training at school etc.

In the context of physical training lessons, it can be generally stated that these pupils like games and warming up exercises best and are afraid of difficult exercises. Polish pupils are also afraid of bad grades.

In the context of physical training teacher, there are evident differences between Czech and Polish pupils. The Czech pupils put a great emphasis on the sense of humour with their teacher, while Polish pupils prefer to have a sportsman as a teacher, who, however, is not too strict.

A considerable number of pupils prefer when their teachers do not take notice of them. It can be expected that pupils with a rather uninterested approach to physical training at school are encouraging those with poorer dispositions to exercise activity. The quality of their performance in school lesson probably evokes a teacher's more dominant approach, which can then evoke the negative responses from the pupils. However, the explanation is speculative and such empirical data require a more thorough analysis.

In the context with out-of-school activities, we note a naturally higher passivity of the studied pupils. There are various reasons for that (TABLE 7); in the case of the Czech pupils they include financial reasons. Friends have a positive influence in this respect.

Views found with pupils with less interested approach to physical training at school confirmed trends found for the entire studied set.

CONCLUSION

The presented research results suggest some similar, but also different trends in the views of the studied pupils in the Czech Republic and Poland.

– In the Czech pupils' views: the physical training lesson is less tiring for them, but they look forward to it less. A teacher should create a cheerful atmosphere, give the pupils more freedom, encourage them more and criticise them less.
– In the Polish pupils' views: the physical training lesson is more demanding as to difficulty and probably also load. They seem to take physical training, including its teacher, more seriously.

A p hysical training lesson in schools for educationally disabled.

– In the development of the mentally retarded pupil's view on physical training lesson, it is the emotional side of his/her mental process which is dominant.

Physical training teacher and his/her activity.

– A determining factor for development of the mentally retarded pupil's view on physical training lesson is the course of interaction between teachers and pupils. The primary criterion is human dimension of the teacher's and then aspects of his/her professional competence.

Out-of-school exercise activities.

– Mentally retarded pupils of schools for educationally disabled do not have enough institutionally established opportunities enough for out-of-school exercise activities, which is inconsistent with Article 2, II. International Charter of Physical Training and Sports.

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TABLE 1
Research set characteristcs

	Boys	Girls	Total
Czech Republic	413	214	627
Poland	174	154	328

TABLE 2
Views of the studied girls and boys in the context of physical training lesson (%)

	Girls		Boys	
	CR	Poland	CR	Poland
n	214	154	413	174
Physical training at school				
too much	8	31	8	5
just enough	54	60	38	68
not enough	38	9	54	28
I				
look forward	57	70	67	68
do not look forward	3	5	3	1
sometimes look forward	40	25	30	31
to the physical training lesson				
On physical training lessons I am afraid				
difficult exercises	15	44	10	20
being laughed by my schoolmates	8	1	4	14
bad marks	5	21	6	14
injury	7	7	9	7
that my costume does not suit me	2	3	2	2
other: nothing	62	25	70	44
In like best in physical training lessons				
warming up exercises	12	23	10	23
acrobatics	13	18	3	5
apparatus work	14	10	18	12
athletics	7	7	12	8
games	31	14	54	50
dance	23	27	3	3
If physical training lessons were optional				
I would attend them	59	61	58	78
I would attend them if they were different	32	23	29	13
I would not attend them	9	16	13	9
After physical training lessons I mostly feel				
in a good mood	76	36	70	48
tired	24	64	30	52

TABLE 3
Views of the studied girls and boys in the context of physical training teacher and his/her activity (%)

	Girls		Boys	
	CR	Poland	CR	Poland
n	214	154	413	174
Teacher should be				
female	80	64	30	19
male	20	36	70	81
The best teacher should be				
friend	14	17	19	17
sportsman	15	26	36	41
with sense of humour	22	10	14	11
fair	48	44	22	18
What I do not like about my teacher				
he/she shouts	31	36	23	30
he/she has no sense of humour	26	21	20	16
he/she is too strict	32	27	36	22
he/she ridicules me	7	4	8	1
he/she neglects me	2	8	6	22
I prefer if teacher				
improves what I do wrong	36	30	39	39
mainly encourages me	42	58	37	54
does not take too much notice of me	22	12	24	6

TABLE 4
Views of the studied girls and boys in the context of out-of-school exercise activities (%)

	Girls		Boys	
	CR	Poland	CR	Poland
n	214	154	413	174
I have out-of-school activity in				
organised sports activity	12	13	20	10
with friends	53	23	50	61
alone	18	20	19	15
I do not participate in sports	17	44	11	12
My sporting is obstructed by				
my parents	15	18	9	7
health conditions	18	16	17	16
lack of opportunities	43	42	38	35
lack of money	10	12	21	7
other: nothing	14	13	15	35
I am led to the sports most by				
my parents	12	29	16	26
siblings	15	21	17	17
friends	58	18	51	40
teacher	15	31	16	13

TABLE 5
Views of the studied girls and boys in the context of physical training lesson (%)

	CR		Poland	
	Yes	No	Yes	No
n	363	264	228	100
Physical training at school				
too much	6	26	2	12
just enough	45	44	65	68
not enough	49	30	33	20
I				
look forward	79	31	76	43
do not look forward	1	14	0	13
sometimes look forward	20	55	24	44
to the physical training lesson				
On physical training lessons I am afraid				
difficult exercises	11	20	27	36
being laughed by my schoolmates	5	8	8	11
bad marks	3	11	16	26
injury	7	11	5	7
that my costume does not suit me	1	4	4	3
other: nothing	73	46	40	17
In like best in physical training lessons				
warming up exercises	10	18	22	26
acrobatics	9	4	13	10
apparatus work	15	11	12	9
athletics	11	6	9	5
games	45	53	29	33
dance	10	8	15	17
After physical training lessons I mostly feel				
in a good mood	82	31	48	37
tired	18	69	52	63

Note:
Yes – he/she would attend physical training lessons
No – he/she would attend physical training lessons, if they were different

TABLE 6
Views of the studied girls and boys in the context of physical training teacher and his/her activity (%)

	CR		Poland	
	Yes	No	Yes	No
n	363	264	228	100
The best teacher should be				
friend	19	18	22	19
sportsman	22	19	31	42
with sense of humour	18	34	9	7
fair	39	28	36	29
What I do not like about my teacher				
he/she shouts	44	29	42	24
he/she has no sense of humour	38	36	25	20
he/she is too strict	10	22	18	38
he/she ridicules me	2	9	2	7
he/she neglects me	6	4	13	11
I prefer if teacher				
improves what I do wrong	43	26	34	32
mainly encourages me	40	36	65	42
does not take too much notice of me	17	38	1	26

Note:
Yes – he/she would attend physical training lessons
No – he/she would attend physical training lessons, if they were different

TABLE 7
Views of the studied girls and boys in the context of out-of-school exercise activities (%)

	CR		Poland	
	Yes	No	Yes	No
n	363	264	228	100
I have out-of-school activity in				
organised sports activity	21	2	13	12
with friends	51	40	45	33
alone	20	15	19	13
I do not participate in sports	8	43	23	41
My sporting is obstructed by				
my parents	11	15	4	27
health conditions	15	25	13	21
lack of opportunities	40	29	47	21
lack of money	17	20	13	7
other: nothing	17	11	22	24
I am led to the sports most by				
my parents	16	12	30	25
siblings	15	15	19	20
friends	54	50	32	29
teacher	15	23	18	26

Note:
Yes – he/she would attend physical training lessons
No – he/she would attend physical training lessons, if they were different

UNTERSUCHUNG DER DETERMINANTEN DER ANSICHTEN DER SCHÜLER AN SPEZIALSCHULEN ÜBER DIE KÖRPERERZIEHUNG

(Zusammenfassung des englischen Textes)

Bei der Herausbildung der Einstellungen eines Individuums zu den Bewegungsaktivitäten spielt die Schule eine wichtige Rolle. Sofern wir wollen, daß sich sowohl die gesunde als auch die behinderte erwachsene Population mehr den Bewegungsaktivitäten widmet, dann müssen wir uns auch für Erfahrungen interessieren, mit denen ein Schüler die Körpererziehung in der Schule verbindet.

Mit Hilfe eines speziellen Fragebogens wurden die Ansichten der geistig zurückgebliebenen Schüler der Spezialschulen in der Tschechischen Republik und in Polen über die Bewegungsaktivitäten ermittelt und verglichen. Aus einem breiter verfassten Fragebogen präsentiert der Beitrag die Ansichten der Schüler im Kontext mit den Determinanten: Stunde der schulischen Körpererziehung, Persönlichkeit und Tätigkeit der Sportlehrers, außerschulische Bewegungsaktivitäten.

Die Ergebnisse deuteten einige übereinstimmende Tendenzen in den Ansichten der geistig zurückgebliebenen Schüler der Spezialschulen in der Tschechischen Republik und in Polen an.

Es scheint, daß die Schüler an Sonderschulen in der Tschechischen Republik im Vergleich zu den Schülern an Spezialschulen in Polen einen höheren Bedarf an Bewegung und weniger Angst vor den Sportstunden haben, sie sind nach den Sportstunden weniger müde, sie freuen sich jedoch weniger auf sie. Die Ursache dafür liegt wahrscheinlich nicht im Inhalt der Tätigkeiten, sondern im Geschehen in der Sportstunde. Die Schüler in der Tschechischen Republik akzeptieren gemeinhin eher eine Lehrerin – eine Frau, die polnischen Schüler einen Lehrer – einen Mann. Sie erwarten übereinstimmend, daß ihr Lehrer vor allem gerecht ist und daß er sie in den Unterrichtsstunden aufmuntert. Im Gegenteil gefällt ihnen ein Schreien des Lehrers nicht. Für die meisten tschechischen und polnischen Schüler ist die schulische Körpererziehung der einzige Ort, wo sie sich zielbewußt mit Leib und Seele den Bewegungsaktivitäten widmen. In diesem Bereich werden sie am meisten von ihren Freunden beeinflußt. Die Einflußnahme des Lehrers halten wir für unzureichend.

Für beide Gruppen der Prüfpersonen gemeinsame Schlüsse:

- Der emotionale Aspekt der kognitiven Prozesse ist bei der Hrausbildung der Ansicht bei geistig zurückgebliebenen Schülern über die Sportstunde dominierend.
- Der determinierende Faktor bei der Herausbildung der Ansicht der zurückgebliebenen Schüler über die Person und Tätigkeit des Lehrers ist die Interaktion zwischen dem Lehrer und dem Schüler.
- Geistig zurückgebliebene Schüler an Spezialshochschulen haben wenig institutionelle Gelegenheiten für außerschulische Bewegungsaktivitäten.

Schlüsselwörter: geistig zurückgebliebene Schüler, Spezialschule, Körpererziehung, Sportlehrer, außerschulische Bewegungsaktivitäten.

VÝZKUM DETERMINANT NÁZORŮ ŽÁKŮ SPECIÁLNÍCH ŠKOL NA TĚLESNOU VÝCHOVU

(Souhrn anglického textu)

Při formování postoje jedince k pohybovým aktivitám sehrává významnou roli škola. Jestliže chceme, aby se zdravá i postižená dospělá populace více věnovala pohybovým aktivitám, pak nás musí zajímat i zkušenosti, se kterými žák spojuje již školní tělesnou výchovu.

Prostřednictvím dotazníku vlastní konstrukce byly zjišťovány a komparovány názory mentálně retardovaných žáků speciálních škol v České republice a v Polsku na pohybové aktivity. Ze šířeji koncipovaného dotazníku prezentuje příspěvek názory žáků v kontextu s determinantami: hodina školní tělesné výchovy, osoba a činnost učitele tělesné výchovy, mimoškolní pohybové aktivity.

Výsledky naznačily některé shodné, ale i rozdílné tendence v názorech mentálně retardovaných žáků speciálních škol v České republice a v Polsku.

Zdá se, že žáci zvláštních škol v České republice v komparaci se žáky speciálních škol v Polsku mají větší potřebu pohybu, méně obav z hodiny tělesné výchovy, méně je i unavuje, ale přitom se na ni méně těší. Příčinou tedy bude pravděpodobně nikoliv obsah činností, ale dění v hodině tělesné výchovy. Žáci v České republice by obecně přijali spíše učitelku – ženu, polští žáci učitele – muže. Shodně očekávají, že jejich učitel bude především spravedlivý a bude je v průběhu hodin povzbuzovat. Naopak nelíbí se jim křik učitele. Pro většinu českých i polských žáků je školní tělesná výchova jediným místem záměrného pohybového vyžití. V této sféře jsou nejvíce ovlivňováni svými kamarády. Vliv učitele pokládáme za nedostačující.

Závěry společné pro obě sledované skupiny probandů:

- Emocionální stránka poznávacích procesů je dominující při utváření názoru mentálně retardovaných žáků na hodinu tělesné výchovy.
- Determinujícím faktorem utváření názoru mentálně retardovaných žáků na osobu a činnost učitele je interakce učitele se žákem.
- Mentálně retardovaní žáci speciálních škol nemají dostatek institucionálních příležitostí k mimoškolním pohybovým aktivitám.

Klíčová slova: mentálně retardovaný žák, speciální škola, tělesná výchova, učitel tělesné výchovy, mimoškolní pohybové aktivity.

ACTA
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