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OBSAH

DEPENDENCE OF SHOOTING ACCURACY IN BIATHLON ON PARAMETERS OBSERVED AT THE MOMENT OF SHOT

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Knowledge of proper shooting rhythm and heart rate (HR) parameters at the moment of shot, as well as the level of relaxation rate (RLX), are of essential importance for improvement of shooting performance in the biathlon. We searched for relations between the selected parameters, characteristic for continuous recovery processes, and shooting accuracy, by means of simulation of various levels of heart rate in cross-country skiing in one selected female biathlon competitor. Results of our research confirm that the shooting success of biathlon competitors may be forecast to a certain extent on the basis of observation of those parameters. Shooting success has improved, based upon shooting rhythm feedback, and determination of the optimum range of heart rate variability.

Keywords: biathlon, shooting accuracy, shooting rhythm, R-R intervals, heart rate, heart rate variability.

INTRODUCTION

The achievement of top sports performance in the biathlon is conditioned by demonstration of various specific abilities and skills. Each athlete must know how to optimally distribute his/her power and strength in order to achieve maximum output in both cross-country skiing and shooting. Demands put on an athlete's motor, physiological, and psychological abilities by biathlon sports performance have been characterised by several authors (Fencl, 1979; Kryl, 1979, 1987; Hošek, 1979; Mundil, 1984; Loužecký et al., 1985; Vojtišek, 1985 abc; Brych, 1985; Petrovič, 1988; Nitzsche, 1988; Ondráček, 1995; Paugschová, 2000). Reduction of time spent on the shooting range was also indicated as an option of how to achieve higher quality of results in shooting. Kašper (1976); Dunayev & Dokutchayev (1981) ascertained, that the shooting of highly trained competitors is not negatively affected by a shorter time of preparation for as well as quick execution of shots. In consideration of the new structure of the Anschutz Bi-7 gun, the previously published intervals of 7–8 seconds between individual shots are considerably shorter now.

Results of the research of heart rate (HR) and breath rate (DR) effects on shooting performance were summed up by Fořt (1979, 1983) as follows:

1. The shooting success of highly trained biathlonists is not dependent on heart rate. During the first shot, the heart rate (HR) is kept within 130–170 beats per min, depending on the athlete's state of health and readiness, effort exerted in the race, and the character of the ground in front of the shooting range. Then the heart rate gradually falls down to 110–140 beats per min. during the last shot.
2. Shooting success is affected by both the apnoea interval and the interval between individual shots. Intervals of 4–6 seconds between individual shots, and apnoea intervals of 1.5–2.5 seconds before each shot are considered optimum. In most cases, shooting becomes unsuccessful if this stereotype has been impaired. The shortest reported interval of 2.5 seconds between two shots is connected with an exceptional level of the competitor's conditioning.

METHODS

The nineteen year old candidate Z. H. meets all prerequisites to become a member of the Slovak women team soon. Her biggest sports achievement was placement in the 2002 European Championships in Kontiolahti, Finland, from which she gained two silver medals.

Observation of her shooting took place in the shooting range Osrblie which meets the strict parameters of the International Biathlon Union (IBU). She was shooting at electronically driven Hora 2000 brand targets from a 50 m distance. Analysis of her shooting with training load simulation on different levels of intensity was carried out during two training sessions with a time difference of 28 days. Z. H. always ran a 500 m circle first, and then executed a series of five shots, two times from the prone position and two times from a standing position, after reaching about the scheduled levels of heart rate of about 100 beats

per min, 130 beats per min, 160 beats per min, and max HR per min. Her racing heart rate was analysed during two runs in pursuit races (shot series performed two times in the prone and two times in the standing position) which took place within the Slovak Cup. From racing heart rate records (R-R intervals data), only the results of one shot series in the prone and standing positions could be included in calculations, given the total capacity of memory of the sport tester used – Polar VANTAGE NV Heart Rate Monitor. So we obtained a total of 180 records of individual shots (n = 180).

The success rate of individual shots according to their order was analysed on the basis of ten measurements during the several following practices (n = 250 shots in the prone position, and 250 shots in the standing position), i. e. 10 repeated measurements of 5-shot series performed in both prone and standing positions at five levels of heart rate.

The competitor was instructed to turn the Heart Rate Monitor on always at the specified place, about 1 minute before shooting, and to turn it off about 10 seconds after the last shot. She always pressed the button of the HR record interval to inform us about her arrival at the shooting point. After each shooting item, she took a 1 minute rest. Each section run at a higher heart rate was always preceded by a 3 minute break. This time was usually used by the competitor for gun reloading. If possible, examinations took place under standard weather conditions, such as calm and sunny with an air temperature of about 0 to ±2 °C.

The issue of the accurate shot moment determination was solved by means of shooting trainer and sport tester/monitor synchronisation under laboratory conditions. It has been ascertained that the shot was always released on the top of the R-R interval curve (pulse by pulse).

Correlation between the observed shooting parameters and the success rate was assessed with the help of the Spearman correlation coefficient – ρ (Reisenauer, 1970). Shooting performance was assessed from the viewpoint of shooting in the prone position, in the standing position, and in the both prone and standing positions.

RESULTS AND DISCUSSION

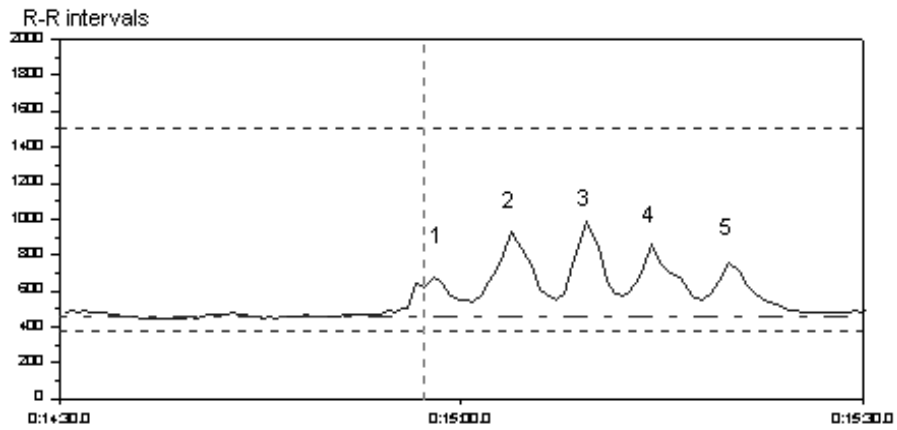
R-R intervals data recorded during the race show that in biathlon, there are no doubts about the connection between the highest heart rate oscillation and variability, and shooting (Fig. 1). In this case, the probationer's heart rate did not fall under 170 beats per min even during long downhill runs. Also a systematic racing load monitoring is useful for our purposes, as it allows us to re-analyse the sports performance, and then to correct the training load in individual heart rate bands. The individual search for optimum solution of motor tasks in the biathlon is connected with both skiing within the relevant heart rate band, and immediate preparation for and execution of shooting. As to skiing, it is enough to monitor heart rate changes. Heart rate variability assessment and search for its relation to the following shooting is, however, impracticable. Heart rate variability has been considerably reduced under the continuous motor load, or after the load with insufficient relaxation intervals (0–4 ms).

Therefore, our research was mainly aimed at selected parameters, hypothetically determining the accuracy of shooting as late as in the moment of the individual shot's delivery.

An important condition of successful shooting in the biathlon is the ability to synchronise shooting with one's heart rate. Heart rate drop occurs at the end of energy exhalation (expiration) upon finishing preparation for shooting, while the probability of shot occurrence in the diastolic interval between two systoles grows. Heart rate drop relates, however, to only several heart contractions.

On the basis of detailed shooting analysis under laboratory conditions and then in the field, it has been ascertained that Z. H. shows a highly developed autoregulatory system of driving mechanisms of the body, significant for target behaviour achievement. By

Fig. 1
Record of heart rate course during the race (R-R intervals)



gradual improvement of this system, this competitor has learned how to appropriately direct her breathing, cardiovascular system, and state of mind while shooting to such an extent that she can push the trigger exactly at the moment of reaching the lowest value of her heart rate, or the highest values of R-R intervals (Fig. 2). Software Polar Precision Performance (1998) also offers a graphical record of heart rate curve on the basis of individual R-R interval duration in miliseconds. It can be said that the competitor has reached the state of the relatively highest degree of relaxation in the moment of the shot. Repeated shots nearly always occur at the highest point of the R-R interval curve, at which the relatively highest values of heart rate variability have also been recorded.

The hierarchy (significance) of certain individual factors relating to shooting success rate has been determined by means of pair correlation analysis (TABLE 1). We observed the dependence of shooting success on R-R (1) interval (arithmetical mean of two values closest to the shot), R-R (2) average interval (from arrival at the shooting point to the 1st, 2nd, 3rd, 4th and 5th shot), relaxation rate RLX (the arithmetical mean of standard deviations of the last 8 values of R-R intervals before the shot, considered an indicator of heart rate variability). We have also searched for relations between the time lapsed (shooting rhythm – the fourth independent variable) between arrival at the shooting point to the 1st, 2nd, 3rd, 4th and 5th shot, and shooting success rate. The shooting rhythm calculation provided for the standard deviation of individual time intervals, considering the total success rate of five-shot items. With the option of a high number of shots (n = 180), all those correlation coefficients appeared to be significant at a 1 % level of statistical importance. From the material point of view, however, the share of individual figures in explanation of shooting success fluctuation is relatively small. The highest correlation coefficient was found between the time interval from arrival at the shooting point to the 1st, 2nd, 3rd, 4th and 5th shot, and shooting accuracy $\rho = 0.49 > \rho_{0.01}$.

By means of a more detailed analysis of success rate with individual shots (according to the order of 5 shots in one shooting item R (2), it has been ascertained that the highest number of inaccurate hits by Z. H. refer to the first and the last shots in the prone position, and to the last shot in the standing position (TABLE 2, 3). The tables were set up on the basis of results of ten repeated examinations where the candidate was shooting only one series of five shots in the prone position, and one series of five shots in the standing position at each of the five simulated heart rate levels after the run. Shooting success at a racing heart rate was assessed during 10 speed races.

Fig. 2
Course of R-R interval duration with marked shot moments (pulse by pulse)

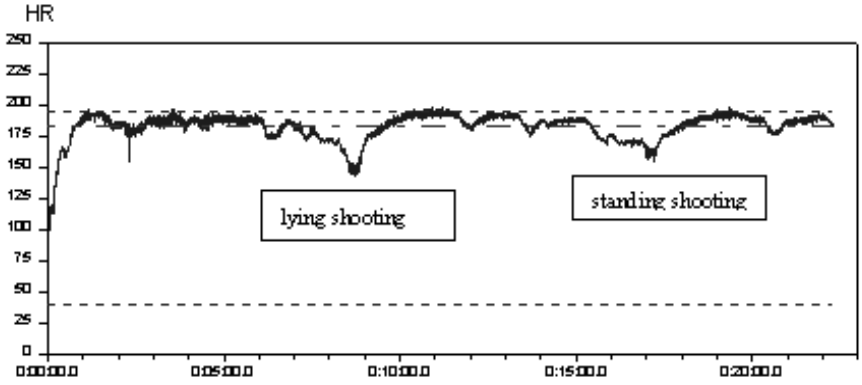


TABLE 1
Coefficients of correlation between the observed parameters and shooting accuracy at the moment of the shot

Parameters observed at the moment of shot	ρ
R-R (1) (ms)	0.27**
R-R (2) (ms)	0.26**
(RLX) – from the last 8 R-R intervals before the shot (ms)	0.31**
Time elapsed from arrival at the shooting point to the 1st, 2nd, 3rd, 4th and 5th shot (s)	0.49**

** –1 % level of statistical importance

TABLE 2
Success rate of individual shots according to their order

Shooting in the prone position (total 250 shots)

Order of shots	Number of missed hits	%	Order of unsuccessful shots
1	17	6.8	1
2	15	6.0	3
3	4	1.6	4
4	3	1.2	5
5	16	6.4	2
Total	55	22.0	

TABLE 3
Shooting in the standing position (total 250 shots)

Shooting in the standing position (total 250 shots)

Order of shots	Number of missed hits	%	Order of unsuccessful shots
1	10	4.0	2
2	7	2.8	3
3	2	0.8	5
4	3	1.2	4
5	25	10.0	1
Total	47	18.8	

When shooting, the competitor should not pay attention to whether she hit the target or not, but concentrate on the activity itself until the very end. Shot assessment may take place as late as on departure from the shooting range. On the basis of the competitor's heart rate records and variability during the last shot, it has been ascertained that Z. H., often subconsciously dealing with her departure from the shooting range, was not concentrated enough on the last shot and thus obtained forfeit points in vain.

CONCLUSIONS FOR TRAINING PRACTICE

Results of the observation of this top female biathlon competitor show that in most cases, she is able to push the trigger in the moment of top relaxation due to her auto-regulatory system activation. Significance of knowledge of heart rate changes and variability with respect to shooting accuracy was confirmed in part. From all the observed parameters, however, shooting accuracy is determined by proper shooting rhythm observation from arrival at the shooting point to the 1st, 2nd, 3rd, 4th and 5th shot, rather than by R-R intervals fluctuation and heart rate variability.

The suggested diagnostic procedure of R-R intervals monitoring allowed certain errors in shooting, made by the observed competitor, to be revealed to observers. They include irregular shooting rhythm, overly long preparation time for shooting, imperfect concentration till the last shot, causing inaccuracy of any of the shots performed in the both standing and prone positions. In respect of improvement of training process management, especially in the field of top sports, knowledge of factors determining the sports performance of the particular individual is considered rather important. It is certain that shooting practice aimed at the elimination of indicated mistakes made by the observed competitor will speed up the improvement of her performance.

REFERENCES

Brych, J. (1985). *Sportovní střelba.* Praha: Svazarm.

Fencl, S. (1979). *Jednotný tréningový systém SZBZ a DZBZ.* Praha: Svazarm.

Fořt, P. (1979). Sledování hodnot dechové a tepové frekvence v průběhu fyzické přípravy a soutěžních výkonů u špičkových biatlonistů. *Teor. Praxe Těl. Vých., 1*, 55–62.

Fořt, P. (1983). Zkušenosti s využitím radiotelemetrie tepové a dechové frekvence u biatlonistů. In *Celostátní tělovýchovné lékařské dny*. Sborník referátů (pp. 16–31). Praha: FTVS UK.

Hošek, V. (1979). *Psychologie sportovní střelby.* Praha: Svazarm.

Kašper, Z. (1976). *Ze zkušeností sovětských trenérů biatlonu a střelby.* Met. Listy. Praha: Svazarm.

Kryl, L. (1979). *Fyziologie sportovní střelby.* Praha: Svazarm.

Kryl, L. (1987). Využití dynamometrie při kontrole trénovanosti vrcholových biatlonistů. *Zpravodaj vědecké rady ÚV Svazarmu*, 3, 12–24.

Loužecký, J. et al. (1985). *Tělesná příprava v branně technických sportech.* Praha: Svazarm.
Mundil, L. (1984). Zkušenosti ze střelecké přípravy biatlonistů. *Obzor MBS, 11*, 20–21.
Nitzsche, K. (1988). *Biathlon, technik, training, taktik.* Berlin: Sportverlag.
Ondráček, J. (1995). Využití stabilometrie v tréninku biatlonu. In *Nové poznatky v kinantropologickém výzkumu*. Sborník z vědeckého semináře (pp. 30–34). Brno: ÚTK PdF MU.
Paugschová, B. (2000). *Teória a metodika športovej prípravy v biatlone.* Banská Bystrica: UMB.
Petrovič, P. (1988). *Strelecká príprava biatlonistov.* Bratislava: FTVŠ UK.
Reisenauer, R. (1970). *Metody matematické statistiky.* Praha: Práce – SNTL.
Scatterogram (1998). In *Polar precision performance-software version 2.0 for Windows* (pp. 35–39). Finland: Second edition.
Vojtíšek, Z. (1985a). Efektivita střelecké přípravy v biatlonu. In *Sborník studií VK ÚV Svazarmu 2* (pp. 27–47). Praha: Svazarm.
Vojtíšek, Z. (1985b). Rozbor taktiky v biatlonu. *Zpravodaj VK ÚV Svazarmu, 4*, 17–27.
Vojtíšek, Z. (1985c). Vyhodnocení vztahu mezi tréninkovými testy a výsledky v závodech biatlonistů. *Zpravodaj VK ÚV Svazarmu, 3*, 3–12.

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ZÁVISLOST PŘESNOSTI STŘELBY V BIATLONU NA SLEDOVANÝCH PARAMETRECH V OKAMŽIKU VÝSTŘELU
(Souhrn anglického textu)

Při zlepšovaní střeleckého výkonu v biatlonu významně pomáhá zjištění individuálně nejvhodnějšího rytmu střelby a parametrů tepové frekvence (HR) v momentu realizace jednotlivých výstřelů. U vybrané závodnice v biatlonu jsme modelováním rozličné úrovně tepové frekvence při běhu na lyžích hledali souvislosti mezi přesností střelby a vybranými parametry průběžně charakterizujícími úroveň relaxace jejího organismu (RLX). Výsledky výzkumu potvrdily, že na základě sledování těchto parametrů můžeme upřesnit předpověď její střelecké úspěšnosti. Informace o rytmu střelby determinují přesnost střelby ve vyšší míře než tepová frekvence a její variabilita.

Klíčová slova: biatlon, přesnost střelby, rytmus střelby, pulsová frekvence, variabilita pulsové frekvence.

SPECTRAL ANALYSIS OF HEART RATE VARIABILITY: NEW EVALUATION METHOD

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Individual indices of spectral analysis (SA) of heart rate variability (HRV), which are used to diagnose the autonomic nervous system (ANS) activity, often give somewhat inconclusive and antagonistic results. Based on the results of age dependence (Šlachta et al., 2002), and dependence of exercise intensity (Stejskal et al., 2001) on the short-term SA HRV, the authors developed a new evaluation procedure. It consists of three complex indexes, which combine all age dependent parameters gained from the orthoclinostatic test: complex index of vagal activity, complex index of sympatho-vagal balance, and total score of SA HRV. The total score-to-age ratio was designated as the so-called functional age of ANS. The new evaluation method enables easier orientation in the comparison of standard parameters, simpler interpretation of the results, and clear identification of less perceptible changes in the power spectrum.

Keywords: spectral analysis of heart rate variability, age-dependent indices, complex indices of spectral analysis of heart rate variability.

INTRODUCTION

Spectral analysis (SA) of heart rate variability is a non-invasive method for the evaluation of the functional state of the autonomous nervous system (ANS). Although it is broadly used in research as well as in clinical practice (3205 MEDLINE references in past five years), there are some major discrepancies in the interpretation of individual parameters of spectral power (Saul et al., 1988; Sleight & Casadei, 1995). This leads the users of this method to a certain degree of caution, which causes a reduction in the use of parameters which yield a higher number of discrepancies (total spectral power, absolute and relative power of LF and HF component and their ratio LF/HF).

This approach often results in overlooking the VLF component (0.0033–0.04 Hz) and derived parameters during short-term examination. Despite of all the discrepancies VLF carries a lot of important information (Bigger et al., 1992; Francis et al., 2000; Musaeva et al., 2001; Tateishi et al., 2002), which can significantly extend the use of this method in clinical practice. In some cases it is probable that the spectral power in the very slow frequency zone can reflect more discreet changes than the fluctuation in the faster zones (Suda et al., 2001; Fleishman et al., 2001). According to Mamii et al. (2002) the VLF fluctuation closely communicates with the changes that occur in LF and HF zones ("cooperation spectrum") during 15 to 150 seconds, and thus is very important for their proper interpretation.

Regular exercise increases physical fitness and brings positive changes to ANS activity in patients (Pietila et al., 2002) as well as in healthy individuals (Levy et al., 1998; Stein et al., 1999). However, some authors, dealing with the effect of regular exercise on HRV, did not find the changes of individual parameters of SA HRV, though the indices of fitness, which are connected to the increase of vagal activity, were significantly improved (Boutcher & Stein, 1995; Davy et al., 1997; Duru et al., 2000). Such results are proving the low or insufficient sensitivity of the used SA HRV parameters.

The HRV spectral power is influenced by a variety of internal and external stimuli/conditions. The most significant is the influence of age (Ferrari, 2002; Okuda et al., 2002; Šlachta et al., 2002) and certain diseases that effect the ANS function ANS (Huikuri & Makikallio, 2001; Liao et al., 1998; Villareal et al., 2002; Ziegler et al., 2001; Doulalas et al., 2001; Quilliot et al., 2001; Hayano et al., 2001; Osaka et al., 1996; Kop et al., 2001; De Angelis, 2001); age and diseases influence the HRV spectral power in a similar way. Thus we can hypothesize that certain diseases and aging have a negative influence on ANS efficiency, and the parameters that decrease with disease and age can be identified as "positive" parameters, the opposite trend characterizes the "negative" parameters.

In practical use of laboratory methods we are trying to simplify the results to the point that their interpretation is unambiguous. It is common practice that the use of a larger number of parameters characterizing one phenomenon from different angles increases the

value of the obtained information. Combining these parameters can lead to an increase in the sensitivity of the method.

This reasoning leads us to an attempt to use all the age-dependent parameters of SA HRV obtained from the orthoclinostatic maneuver and combine them into a minimum number of complex indexes. This study follows the research of the influence of age on individual parameters of SA HRV (Šlachta et al., 2002).

METHOD

To verify the proposed method we chose a group of healthy individuals (n = 216, age 12 – 70, $\bar{x}$ = 35.05 ± ± 14.30 years) who were the subject of our research on the influence of age on the SA HRV parameters (Šlachta et al., 2002). The entirely new method of evaluation of SA HRV was closely described in Šlachta's dissertation (1999). In this study we present the basic fundamental updates about the new relationships resulting from the changes of individual parameters during physical activity (Stejskal et al., 2001). The R-R intervals were monitored and the evaluation of the HRV data (minimum monitoring interval of 5 minutes and 300 R-R intervals) was carried out by the original diagnostic system VariaCardio TF4/TF3 (Salinger et al., 1995; Salinger et al., 1999). We used the orthoclinostatic stimulation (supine-standing-supine) procedure, which was described in previous study (Šlachta et al., 2002).

We modified the typically defined zone of 0.0033–0.04 Hz to 0.02–0.05 Hz. The reason for changing the lower zone limit was that we are unable to use the fluctuations slower than 0.02 Hz with the short-term examination. The reason for the shift of the upper zone limit to 0.05 Hz is to use the whole spectrum; there is no reason for omitting the 0.04–0.05 Hz range.

For the evaluation of SA HRV we used all the typically used parameters (spectral power, percentage share of individual components on the total spectral power, and ratios between individual components). In addition to these we used the coefficient of variation of individual components (CCV) (Hayano et al., 1991) to minimize the influence of different heart rate values on the SA HRV spectral field. Furthermore, the CCV has a closer correlation with the workload intensity than the component's power (Stejskal et al., 2001), and in factor analysis the CCV prove higher levels of communality (they present individual factors – TABLE 1).

The referential values were calculated for the age-dependent parameters. The age-dependent parameters were combined into five factors, as well as independently based on their relation to age (% HF in supine position, R-R, and LF/HF in standing) (TABLE 1) The regression equations were given 50 % and 95 % intervals of reliable accuracy in the age intervals in which the values of individual parameters were changing (e. g. the CCV HF in supine position in the age from 12 to 47 – Šlachta et al., 2002). For the interpretation of these values we assumed that in the 50 % interval are normal (physiological) values, between 50 % and 95 % are border values and values that are off the 95 % interval are abnormal.

TABLE 1
Parameters with similar course of age-dependence compound into five factors (underlined are the parameters with higher communality – "factor representative")

Factor	Parameters
F1	*L CCVHF*, *L* P_T, *L* P_{HF}
F2	*S CCVLF*, *S* P_T, *S* P_{LF}
F3	*S CCVHF*, *S* P_{HF}, *S % HF*,
F4	*L LF/HF*, *L % LF*
F5	*L VLF/HF*, *L VLF/LF*, *L % VLF*

L – supine position, *S* – standing position, *CCV* – coefficient of variation of a parameter, P_T – total spectral power, P_{HF} – HF power, P_{LF} – LF power

In the age intervals in which the values were not dependent on age (e. g. in CCV HF in supine position from the age of 47 and up – Šlachta et al., 2002) fractiles were calculated at 2.5 %, 25 %, 75 %, and 97.5 % of the normal distribution of data. For the interpretation of these values we assumed that between 25 % and 75 % fractiles are the normal (physiological) values, between 25 % and 2.5 % and between 75 % and 97.5 % fractiles are the border values and values above 97.5 % fractile are abnormal.

These obtained values were transformed into point values: physiological range was between –2.5 points and +2.5 points; the border values were between –4.75 and –2.5 points and between +2.5 points and +4.75 points; the abnormal values were smaller than –4.75 and bigger than +4.75 points.

Based on the course of age-dependency of parameters we were able to divide the age-dependent parameters into four following groups (G1 – G4):

G1: supine position, descendent course (F1 + % HF)
G2: post orthoclinostatic stimulation, descendent course (F2 + F3)
G3: supine position, ascendant course (F4 + F5)
G4: post orthoclinostatic stimulation, ascendant course (R-R intervals, LF/HF)

The statistically significant dependence on age of the individual factors or parameters itself was highly variable (TABLE 2). We took notice of this in combining the parameters and based on the value of the coefficient of correlation of the factor or parameter with age ($\underline{r}$) we gave individual factors or parameters distinct weight (TABLE 2). In the calculation of the weight of a parameter (V_i) we assigned the range of

weight from 5 (smallest value of r) to 100 (highest value of r):

$$V_i = ((b_i - \underline{b} / \underline{a} - \underline{b}) \cdot 95) + 5, \qquad \textit{equation 1}$$

where $\underline{b}$ – minimal absolute value of r; a – maximum value of r; b_i absolute value of r for the chosen parameter.

TABLE 2
Correlation coefficient (r) between the chosen SA HRV parameters (representing F1–F5 factors or independent parameters) and age and from them derived weight of the parameters

Parameter	r	α	weight
L CCV HF	–0.4994	p < 0.001	100
L VLF/HF	0.4934	p < 0.001	99
S CCV HF	–0.4466	p < 0.001	88
L % HF	–0.4017	p < 0.001	77
S CC-V LF	–0.3958	p < 0.001	76
L LF/HF	0.3616	p < 0.001	68
SRR	0.3272	p < 0.001	60
S LF/HF	0.2863	p < 0.01	5

α – level of statistical significance

By combining G1 with G2 and G3 with G4 we acquired two complex indexes, which associate factors and individual parameters with different courses of age dependence. The first complex index (CI1) combines the factors and parameters that decrease with age (F1, F2, F3, and % HF in supine position). The second complex index (CI2) combines the factors and parameters that increase with age (F4, F5, R-R in standing, and LF/HF in standing).

In the previous study, which described the changes of individual parameters during exercise (Stejskal et al., 2001), we found that some parameters change in close relation to the intensity of the exercise (based on the maximum heart rate reserve MHRR): values of % VLF, VLF/HF, and VLF/LF significantly increased with increasing exercise intensity, controversially the values of TS, power of individual components, and % HF decreased.

Significant changes in the values of individual components were already detected in the alteration of the exercise intensity of 10 % MHRR (Stejskal et al., 2001; Hrdličková, 2002). Due to the decrease of vagal activity with increasing exercise intensity, we may presume that the parameters with descending dependence on the exercise intensity are the indicators of vagal activity. This vagal activity decrease, which is up to certain level of exercise intensity joined with the increase of sympathetic activity, moves the sympatho-vagal balance towards sympathetic activity; thus the parameters increasing with exercise intensity can be interpreted as indicators of sympatho-vagal balance.

Parameters that show significant decrease with age and are combined in CI1 correspond with the parameters that decrease even with the increasing exercise intensity (P_T, power of individual components P_{VLF}, P_{LF}, P_{HF}, % HF). Thus we can call the CI1 the indicator of vagal activity (taking some exception since the exercise took place in seated position). Accordingly the CI2 could be called the indicator of sympatho-vagal balance.

For further combination of the complex indexes into SA HRV total score (TS) we have to submit to a hypothesis that the ANS changes occurring during aging are negative. Thus we have to subtract the value of CI2, which combines parameters of age ascending course (complex index of sympatho-vagal balance – negative interpretation), from the value of CI1, which combines parameters descending with age (complex index of vagal activity – positive interpretation). E. g. the acquired value of CI2 = –4.8 points (it means significantly lowered values of % VLF and % LF in supine position and R-R a LF/HF in standing) will be transformed as stated above to +4.8 points and interpreted as positive (similarly to the positive interpretation of positive CI1 values).

$$TS = CI1 - CI2 \qquad \textit{equation 2}$$

TS value, which reflects all of the combined age-dependent parameters, can be also described by the age that would correspond with its value. With some circumspection we could call the altered TS the functional age of ANS (FA). The computation of FA is based on the overall valuation of the age-dependent parameters expressed in TS, on the age spectrum of the whole group of tested individuals, and on the calendar age of each of the tested individuals. The computation of FA is as follows:

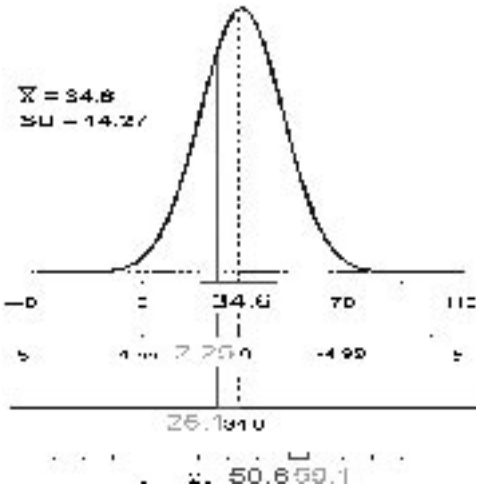
First we convert the TS point value onto $\underline{p}$ value according to the equation $\underline{p} = 1 - (5 - TS)/10$ (conversion from the –5 to +5 scale to 0 to 1 scale). Then we assign the $100\underline{p}$ % fractile x_p normal distribution of the age values of the monitored group N (μ, σ), where μ = 34.6 years and σ = 14.27 years (Šlachta et al., 2002). FA is calculated from the following equation:

$$FA = \text{calendar age} + (\mu - x_p) \qquad \textit{equation 3}$$

E. g. TS = 2.25 corresponds with the age 8.5 years lower than the mean age value. Thus if the calendar age of an individual is 59.1 years, the FA would be 50.6 years (Fig. 1).

Statistical analyses were done via the computer programs STATGRAPHICS version 5.0 and MS Excel 97.

Fig. 1
Graphic representation of transfer of the total score point values to the functional age of ANS



DISCUSSION

Based on our experience from the longitudinal monitoring of the differences among the SA HRV results it seems that the complex indexes are significantly more sensitive than the usually used SA HRV parameters. To prove this statement we summon the changes of the SA HRV parameters that were monitored in an age-homogenous group of 30 non-smoking men (55–62 years, 57.83 ± 1.80 years), who had a qualified risk for developing ischaemic heart disease. The results from before and after short-term complex intervention were compared. The 2 months intervention was based on laboratory testing and included physical activity, diet, food supplements and cognitive-behavioral treatment. The risk was quantified on a 7 points scale (–3 to +3 points), based on blood lipid levels, blood pressure, physical activity, and diet. The risk score was expressed not only as an absolute value of the risk parameter, but also by its dynamics during the intervention.

Significant decrease of the risk was noticeable after the intervention (entrance values –2.63 ± 3.21 points; after the intervention 1.73 ± 4.53 points; difference 4.37 ± 4.72 points, $p < 0.001$). As TABLE 3 shows, it is evident that, except for the total power, all other normally used parameters demonstrated significant changes: the values of CCV VLF, CCV LF, %VLF, % LF and LF/HF decreased, values of CCV HF and % HF increased. Theses changes prove that although the HRV changes were not significant (the intervention interval might have been too short), the spectral power has moved to the area with the fastest fluctuations, which indicates the increase of vagal activity. From the point of the statistical significance of the data before and after the intervention it is evident that the complex parameters reflect these changes significantly.

Correlating the changes of the risk point values and the SA HRV parameters, we found that the relation of the complex indexes to the risk changes is much closer in comparing the typically used parameters (TABLE 3). The very close relationship which was found, for example, between the risk and the TS ($r = 0.9018$) brings hope that its use may reveal even discreet changes and enable the discovery of statistically significant relations with even smaller amounts of compared data.

TABLE 3
Individual and complex SA HRV parameters and R-R intervals before (BI) and after complex intervention (AI)

Parameter		BI	AI	D	α	r
P_T (ms^2)	x	1495	1481	–14	NS	0.4474
	SD	735	648	423		$p < 0.05$
CCV VLF	x	1.445	1.176	–0.269	$p < 0.05$	–0.4002
	SD	0.757	0.478	0.681		$p < 0.05$
CCV LF	x	1.549	1.355	–0.193	$p < 0.05$	–0.1458
	SD	0.387	0.373	0.421		NS
CCV HF	x	2.099	2.371	0.272	$p < 0.05$	0.6333
	SD	0.396	0.538	0.617		$p < 0.001$
VLF (%)	x	22.78	16.10	–6.68	$p < 0.05$	–0.4885
	SD	15.10	10.11	16.76		$p < 0.01$
LF (%)	x	27.56	21.24	–6.32	$p < 0.05$	–0.3422
	SD	11.25	9.93	15.20		NS
HF (%)	x	48.66	62.67	14.01	$p < 0.01$	0.4914
	SD	15.92	14.40	20.10		$p < 0.01$
LF/HF	x	0.6378	0.3891	–0.2487	$p < 0.01$	–0.4098
	SD	0.3649	0.2769	0.4508		$p < 0.05$
CI1 (bod)	x	0.766	1.492	0.726	$p < 0.01$	0.8440
	SD	0.767	1.034	1.109		$p < 0.001$
CI2 (bod)	x	1.937	3.101	1.164	$p < 0.001$	0.7999
	SD	1.486	1.031	1.641		$p < 0.001$
TS (bod)	x	1.198	2.017	0.818	$p < 0.001$	0.9018
	SD	0.880	0.850	1.186		$p < 0.001$
RR (min^{-1})	x	1.086	1.092	0.007	NS	0.2142
	SD	0.104	0.131	0.089		NS

CI1 – complex index of vagal activity, *CI2* – complex index of sympatho-vagal balance, *TS* – total score of SA HRV, x – mean, SD – standard deviation, D – difference between AI and BI, a – statistical significance level D, NS – insignificant, r – correlation coefficient D of a parameter with a point value of a quantified risk

CONCLUSION

The new evaluation method enables easier orientation and simpler interpretation of the SA HRV results. In the case of a longitudinal study it enables unambiguous identification of less vivid changes of the power spectrum, which may not be pronounced while using the standard procedures. For further specification and verification of the accuracy and utilization of this method it is necessary to enlarge the group

of tested individuals not only within the age area (12–70 years), but also above and below this limit.

REFERENCES

Bigger, J. T., Fleiss, J. L., Steinman, R. C., et al. (1992). Frequency domain measures of heard period variability and mortality after myocardial infarction. *Circulation, 85*, 164–171.

Boutcher, S. H., & Stein, P. (1995). Association between heart rate variability and training response in sedentary middle-aged men. *Eur. J. Appl. Physiol. Occup. Physiol., 70(1)*, 75–80.

Davy, K. P., Willis, W. L., & Seals, D. R. (1997). Influence of exercise training on heart rate variability in post-menopausal women with elevated arterial blood pressure. *Clin. Physiol., 17(1)*, 31–40.

De Angelis, C., Perelli, P., Trezza, R., et al. (2001). Modified autonomic balance in offsprings of diabetics detected by spectral analysis of heart rate variability. *Metabolism, 50(11)*, 1270–1274.

Doulalas, A. D., Flather, M. D., Pipilis, A., et al. (2001). Evolutionary pattern and prognostic importance of heart rate variability during the early phase of acute myocardial infarction. *Int. J. Cardio., 77(2–3)*, 169–179.

Duru, F., Candinas, R., Dziekan, G., et al. (2000). Effect of exercise training on heart rate variability in patients with new-onset left ventricular dysfunction after myocardial infarction. *Am. Heart J., 140(1)*, 157–161.

Ferrari, A. U. (2002). Modifications of the cardiovascular system with aging. *Am. J. Geriatr. Cardiol., 11(1)*, 30–33.

Fleishman, A. N., Filimonov, S. N., & Klimina, N. V. (2001). The novel method for selection of preparations for treatment of arterial hypertension based on spectral analysis of heart rhythm variability. *Ter. Arkh., 73*, 33–39.

Francis, D. P., Davies, L. C., Wilson, K., et al. (2000). Very-low-frequency oscillations in heart rate and blood pressure in periodic breathing: role of the cardiovascular limb of the hypoxic chemoreflex. *Clin. Sci. (Lond), 99*, 125–132.

Hayano, J., Mukai, S., Fukuta, H., et al. (2001). Postural response of low-frequency component of heart rate variability is an increased risk for mortality in patients with coronary artery disease. *Chest, 120(6)*, 1942–1952.

Hayano, J., Sakakibara, Y., Yamada, A., et al. (1991). Accuracy of assessment of cardiac vagal tone by heart rate variability in normal subjects. *Am. J. Cardiol., 67*, 199–204.

Hrdličková, J. (2002). *Srovnání spotřeby kyslíku při CHR-testu na bicyklovém ergometru a na běhátku.* Diplomová práce, Univerzita Palackého, Fakulta tělesné kultury, Olomouc.

Huikuri, H. V., & Makikallio, T. H. (2001). Heart rate variability in ischemic heart disease. *Auton. Neurosci., 90(1–2)*, 95–101.

Kop, W. J., Verdino, R. J., Gottdiener, J. S., et al. (2001). Changes in heart rate and heart rate variability before ambulatory ischemic events (1). *J. Am. Coll. Cardiol., 38(3)*, 742–749.

Levy, W. C., Cerqueira, M. D., Harp, G. D., et al. (1998). Effect of endurance exercise training on heart rate variability at rest in healthy young and older men. *Am. J. Cardiol., 82(10)*, 1236–1241.

Liao, D., Sloan, R. P., Cascio, W. E., et al. (1998). Multiple metabolic syndrome is associated with lower heart rate variability. The atherosclerosis risk in communities study. *Diabetes Care, 21(12)*, 2116–2122.

Mamii, V. I, & Khaspekova, N. B. (2002). The nature of very low frequency component of the heart rate variability and the role of sympathetic-parasympathetic interactions. *Ross. Fiziol. Zh. Im. I. M. Sechenova, 88(2)*, 237–247.

MEDLINE/PubMed (1997–2001). Retrieved 9th August 2002 from the World Wide Web http://www.ncbi.nlm.nih.gov/entrez/query.fcgi.

Musaeva, Z. A., Khaspekova, N. B., & Vein, A. M. (2001). Variability of heart rhythm in dynamic study of the psychovegetative relationship in neurogenic syncope. *Zh. Vyssh. Nerv. Deiat. Im. I. P. Pavlova, 51*, 749–751.

Okuda, T., Satoh, A., Oogaku, S., et al. (2002). Effect of aging on heart rate and blood pressure variabilities in healthy men and women. *Rinsho Byori, 50(2)*, 186–190.

Osaka, M., Saitoh, H., Sasabe, N., et al. (1996). Changes in autonomic activity preceding onset of nonsustained ventricular tachycardia. *Ann. Noninvasive Electrocardiol., 1(1)*, 3–11.

Pietila, M., Malminiemi, K., Vesalainen, R., et al. (2002). Exercise training in chronic heart failure: beneficial effects on cardiac (11)C-hydroxyephedrine PET, autonomic nervous control, and ventricular repolarization. *J. Nucl. Med., 43(6)*, 773–779.

Quilliot, D., Fluckiger, L., Zannad, F., et al. (2001). Impaired autonomic control of heart rate and blood pressure in obesity: role of age and of insulin-resistance. *Clin. Auton. Res., 1(2)*, 79–86.

Salinger, J., Pumprla, J., Vychodil, R., et al. (1999). Microcomputer system for telemetric assessment of short term heart rate variability in time and frequency domain, type VariaCardie TF4. In A. Murray & S. Swiryu (Eds.), *Computers in Cardiology 1999* (pp. 599–602). Los Alamitos: The Institute of Electrical and Electronics Engineer (IEEE) Computer Society Press.

Salinger, J., Vychodil, R., Novotný, J., et al. (1995). Telemetric, computer-aided system for non-invasive examination of heart rate variability, type VariaPulse TF3. In A. Murray & R. Arzbaecher (Eds.), *Computers in Cardiology 1995* (pp. 437–440). Los Alamitos: The Institute of Electrical and Electronics Engineers (IEEE) Computer Society Press.

Saul, J. P., Albrecht, P., Berger, R. D., & Cohen, R. J. (1988). Analysis of long-term heart rate variability:

Methods, scaling and implications. *IEEE Trans. Biomed. Eng., 88*, 419–421.

Sleight, P., & Casadei, B. (1995). Relationships between heart rate, respiration and blood pressure variabilities. In M. Malik, & A. Camm (Eds.), *Heart rate variability*. (pp. 311–327). New York: Futura Publishing Company, Inc.

Stein, P. K., Ehsani, A. A., Domitrovich, P. P., et al. (1999). Effect of exercise training on heart rate variability in healthy older adults. *Am. Heart J., 138(3.1)*, 567–576.

Stejskal, P., Rechbergová, J., Salinger, J., et al. (2001). Power spectrum of heart rate variability in exercising humans: the effect of exercise intensity. *Sports Med. Training Rehab., 10*, 39–57.

Suda, Y., Otsuka, K., Niinami, H., et al. (2001). Changes in ultra-low and very low frequency heart rate variability after coronary artery bypass grafting. *Biomed. Pharmacother., 55(1)*, 110–114.

Šlachta, R. (1999). *Sledování závislosti hodnot ukazatelů spektrální analýzy variability srdeční frekvence na věku vyšetřovaných osob.* Disertační práce, Univerzita Palackého, Fakulta tělesné kultury, Olomouc.

Šlachta, R., Stejskal, P., Elfmark, M., et al. (2002). Age and heart rate variability. *Acta Univ. Palacki. Olomuc., Gymn., 32(1)*, 59–67.

Tateishi, O., Shouda, T., Honda, Y., et al. (2002). Apnea-related heart rate variability and its clinical utility in congestive heart failure outpatients. *Ann. Noninvasive Electrocardiol., 7(2)*, 127–132.

Villareal, R. P., Liu, B. C., & Massumi, A. (2002). Heart rate variability and cardiovascular mortality. *Curr. Atheroscler. Rep., 4(2)*, 120–127.

Ziegler, D., Laude, D., Akila, F., & Elghozi, J. L. (2001). Time- and frequency-domain estimation of early diabetic cardiovascular autonomic neuropathy. *Clin. Auton. Res., 11(6)*, 369–376.

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NOVÁ METODA HODNOCENÍ SPEKTRÁLNÍ ANALÝZY VARIABILITY SRDEČNÍ FREKVENCE
(Souhrn anglického textu)

Jednotlivé ukazatele spektrální analýzy (SA) variability srdeční frekvence (HRV), používané k diagnostice aktivity autonomního nervového systému (ANS), vykazují často málo průkazné a někdy i protichůdné výsledky. Na základě výsledků sledování vlivu věku (Šlachta et al., 2002) a intenzity zatížení (Stejskal et al., 2001) na krátkodobý záznam SA HRV navrhli autoři nový postup hodnocení pomocí tří indexů sdružujících všechny věkově závislé ukazatele získané při ortoklinostatickém vyšetření: komplexní index vagové aktivity, komplexní index sympatovagové rovnováhy a celkové skóre SA HRV. Vztažení celkového skóre k věku probanda nazvali autoři funkční věk ANS. Nová metodika hodnocení umožňuje při srovnání se standardními ukazateli snadnější orientaci, jednodušší interpretaci výsledků a jednoznačnou identifikaci méně výrazných změn výkonového spektra.

Klíčová slova: spektrální analýza variability srdeční frekvence, ukazatele závislé na věku, komplexní ukazatele spektrální analýzy variability srdeční frekvence.

EFFICACY OF WEIGHT LOSS EXERCISES IN TREATMENT OF OVERWEIGHT AND EXOGENOUS OBESITY

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The objective of this study was to assess the influence of a 6 month cycle of so-called weight loss exercises on the general health state and overall feeling of obese women. Patients were divided into three groups: 6 overweight women, 10 women with exogenous obesity, and 4 women with normal body weight. The following parameters were evaluated: Body Mass Index (BMI), some circumferential measurements, selected elements of physical fitness, Heart Rate (HR), value of Diastolic and Systolic Blood Pressure. Additionally, patients' self-evaluation and their general feeling were assessed. A similar evaluation was performed after 6 months of treatment. It was concluded that the applied form of treatment has contributed both to the reduction of body mass as well as a majority of the analysed circumferential measurements. A considerable improvement of physical fitness and enhanced adaptation of the circulatory system to physical exercise were noted as well. Regular performance of weight loss exercises contributed to an improved self-evaluation and overall feeling of evaluated patients.

Keywords: overweight, obesity, weight loss exercises.

INTRODUCTION

Obesity is a disease which may contribute to the development of myocardial infarction, coronary artery diseases, neoplasm, diabetes and locomotor system dysfunctions. Costs of treatment of obesity-related diseases are very high (5.5 % of total medical costs in USA). Obesity is one of the most dangerous civilisation-related diseases and statistics shows that 1/5 to 1/3 of the total adult population have excessive reserves of adipose tissue (Grojec, 1978; Krotkiewski, 1994; Zajadacz, Bartnicka, & Juszkiewicz, 1999).

The course and pathogenesis of obesity are complicated and not homogenous. There are two types of obesity. The first, alimentary obesity, is caused by genetical and environmental factors (excessive food intake). The second kind is an essential symptom of an original disease such as some endocrinopathies (hypothyroidism, Cushing's syndrome, growth hormone deficiency) and chromosomal defects, drug-induced obesity, central nervous system disorders (Furmański, 2000; Kowalczyk, Batorska, & Walacik, 1999).

Excessive body weight resulting from excessive development of subcutaneous and per visceral adipose tissues is a typical noticeable feature observed in obese patients. In contrast, excessive body weight, which may be observed in athletes (body weight builders) results from development of muscle tissue. Normally, adipose tissue constitutes 15 % of the total body mass. In obesity, adipose tissue makes up more than 25 % of total body mass in men, and more than 30 % in women. One of the most important functions of adipose tissue is to store unused energy in the form of fat drops in adiposities. Physiologically, there is a constant accumulation of energy reserves and their constant utilisation. The organism is in energy balance when the amount of energy taken in (with food) equals the amount of energy needed for maintenance of homeostasis. However, if the amount of energy taken in is larger than the organism's needs, or when the amount of energy expended becomes smaller (or both of the above), then the energy balance becomes positive. The prolongation of such a situation (of positive energy balance) leads to overweight and finally to obesity (Frömel,1999; Furmański, 2000; Garbala, 1999; Grojec, 1978; Kodejszko, Blaim, & Tatoń, 1965; Kowalczyk, Batorska, & Walacik, 1999; Rożniakowki, 1982; Sanya & Adesina, 1998).

The measure of obesity is the weight of the body, which in adults with normal body mass equals the amount of 100 subtracted from the patient's height and then diminished by 7 % in men and by 10 % in women (Bloc's formula) (Kokot, 1991; Opolski, 2000; Tatoń, 1985).

Precise measurement of adipose tissue in the body is not an easy matter. It requires expensive and specialised equipment (computer tomography, magnetic resonance). The refore most often the amount of excessive body weight is calculated with the use of Quetelet's index (Body Mass Index BMI). It equals the quotient of present body mass expressed in kilograms and the square of body height expressed in meters. Body Mass Index is easy to calculate and as such is comparable with indexes accepted by the World

Health Organisation (BMI between 20 and 24.9 – normal body weight, between 24.9 and 29.9 – overweight, between 30 and 39.9 – obesity and more than 40 – extreme obesity) (Baranowska, Białkowska, Wasilewska-Dziubińska, & Pachocki, 1994; Frömel, 1999; Furmański, 2000; Rożniakowki, 1982).

The localisation of excessive adipose tissue in the area of the stomach, thorax and neck are the most dangerous due to possible obesity-related disorders. It is so-called android or visceral obesity, and can be calculated with the use of WHR (waist to hip ratio). In case of visceral obesity in women WHR is >0.8 and in men WHR is >1 (Baranowska, Białkowska, Wasilewska-Dziubińska, & Pachocki, 1994; Krch & Rathner, 1998; Rożniakowki, 1982).

Treatment of obesity is mainly symptomatic, and very rarely causal. The objective of the treatment is to mobilise the organism to use its own energy reserves stored in adipose tissue and as such to obtain negative energy balance. It can be obtained either by reduction of energy intake supplied with food or by increase of basal metabolic rate and increase of energy expenditure associated with physical exercise and the organism's growth. The above objectives could be obtained by the use of:
- appropriate diet
- pharmacological treatment (hormone therapy, inhibition of lipogenesis, intensification of lipolysis, inhibition of fat absorption in the digestive tract)
- intensification of energy expenditure (muscular work)
- psychotherapeutic treatment or
- surgical treatment

Obese individuals have to keep in mind that their bodies have a constant tendency towards the accumulation of excessive amounts of fat tissue and that this tendency is everlasting and it is present even after successful weight loss treatment. Such a situation is due to the presence of an increased amount of adipocytes (hyper plastic obesity) or due to a lower than normal rate of metabolism. Limitation of overfeeding in childhood may prevent children from development of adipocytes and it is the only successful method of prevention of obesity development in adults. Generally the treatment of obesity, which is initiated in adults, is a never-ending process and requires continuation throughout the individual's entire life (Brohl & Brzozowski, 1984; Enzi, Crepaldi, Pozza, & Renold, 1981; Fricker, 1994; Frömel, 1999; Greenwood, 1983; Grojec, 1978; Kodejszko, Blaim, & Tatoń, 1965; Kokot, 1991).

The objective of this study was to assess the influence of physical exercise on the general health state of obese women. The authors of this study attempted to find answers to the following questions:
- Does physical exercise have an influence on body mass reduction?
- Do regular physical exercises have an influence on physical fitness in overweight and obese women?
- Does regular physical exercise affect the capacity of cardiovascular system in women with BMI >25?
- To what extent does physical exercise influence the self-evaluation and general feeling of overweight and obese patients?

The following hypotheses were made prior to the study:
- Physical exercise has an influence on body weight. Physical exercise performed on a regular basis may reduce body mass.
- Physical exercise performed on a regular basis improves the patient's general physical fitness. Improved flexibility, endurance and coordination may be observed in people who exercise regularly.
- Regular physical training improves the functioning of the cardiovascular system.
- People who exercise regularly are said to have an improved general feeling and higher self-esteem.

MATERIAL AND METHODS

The study group consisted of 20 women aged from 18 to 53, who participated in a weight loss exercise programme. Classes were held twice a week and each session lasted 90 minutes (45 minutes of aerobic exercises and 45 minutes of water aerobics in a swimming pool).

The study group was divided into the three following groups:
- 6 women with BMI within the range of 25 to 30 (overweight), with a mean age of 33,
- 10 women with BMI >30 (obesity), with a mean age of 36,
- 4 women with normal BMI, with a mean age of 25, who were classified as a control group.

The study focused on how the organism of overweight and obese women responds to physical exercise.

1. The assessment of general physical fitness was performed with the use of tests which describe:
   - strength of shoulder girdle (backward hang on wall-bars),
   - endurance (run along sideline of basketball field till fatigued (number of laps)),
   - balance (timing of right and left leg standstill),
   - spine flexibility (bending over while standing on footstool, measurement of distance from 3rd/middle finger to footstool in centimetres).

2. The following measurements were performed to assess the loss of fat tissue:
   a) circumferential measurements:
      - waist level; measured at navel line, perpendicularly to longitudinal axis of the body,
      - hip level; measurement of the largest circumference, perpendicularly to longitudinal axis of the body,
      - thigh; measured in standing, perpendicularly to longitudinal axis of the body; the largest

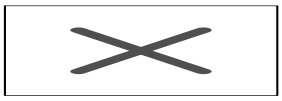
circumference of the thigh was recorded (usually close to the groin area) and its location in relation to anterior superior iliac spine was noted,
- above the knee; localisation of the largest circumference over the knee, usually between 6–10 cm from the base of the patella, its precise localisation in relation to the base of the patella was noted,
- arm; elbow flexion with contraction of elbow flexors allowed for localisation of the largest arm circumference, then elbow flexors were relaxed, the elbow joint was extended and the measurement was performed perpendicularly to the longitudinal axis of the upper extremity, the distance of the level of measurement from the olecranon was recorded.

Circumferential measurements in extremities were performed symmetrically, both in the left and right extremity. The measuring tape used for measurements was inextensible. Measurements were performed according to general guidelines of evaluation procedures (Zembaty, 1987).

b) body weight measurement with the use of a type WL 150 weight scale.

For each individual who participated in the study BMI was calculated prior to commencement of the exercise program and after its completion according to the following formula:

3. To assess functioning of the cardiovascular system:
   - pulse monitoring by palpation,



   - blood pressure monitoring with the use of a type Sunbeam, type 7655 blood pressure monitor.

4. Patients' general feeling was recorded during subjective examination first performed at the beginning of the study (part 1) and then after its completion (part 2). The first part of the survey included questions concerning patients' social and economic situation, health condition, general feeling and forms of recreation in which patients and their families have participated. The second part contained questions regarding changes noted in health condition, general feeling and self-esteem.

All initial and final tests were conducted before the exercises, but after a short warm-up. Circumferential measurements were taken at the swimming-pool before water aerobics. Heart rate and blood pressure readings were taken several times before aerobic exercises and before and after water aerobics.

All women who participated in the study were attending the weight loss exercise programme for 6 months. Each exercise session lasted 1.5 hour (45 minutes of aerobic exercises and 45 minutes of water aerobics). The first 10 minutes of the 45 minutes of aerobic exercises was dedicated to warm-up exercises (general conditioning exercises), that period was followed by stretching and flexibility exercises, strengthening exercises, coordination and balance exercises as well as corrective exercises if needed. The last 5 minutes of each exercise session consisted of cool down exercises including breathing exercises and relaxation techniques.

The warm-up period of water aerobics contained a variety of simple water exercises followed by water aerobics, water games and exercises with flotation devices used in aquatic therapy. The cool down period contained both breathing exercises and relaxation techniques. The majority of women participated in 46 sessions, each of lasted 1.5 hour.

All overweight and obese women who participated in the study declared they would limit quantitatively food intake during the time period of the weight loss programme (5 meals a day, 3 larger and 2 smaller ones). In addition, the amount of food consumed was monitored only by the women themselves and was not the subject of objective assessment.

Collected data were subjected to statistical analysis. Mean values, standard deviation and maximum and minimum values were calculated.

Multiple regression equation was used to assess the influence of BMI on circumferential measurements, parameters describing physical fitness and cardiovascular parameters. The statistical relevancy of differences between the initial and final examinations was assessed with the use of Wilcoxon's test.

RESULTS

The multiple regression equation calculated at the time of the initial examination showed a substantial influence of BMI on measured circumferences and on cardiovascular parameters selected for further analysis. The multiple regression index of 0.88 calculated for measured circumferences indicates that BMI value influences the value of measured circumferences in 88 % of cases, whereas the value of this index calculated for cardiovascular parameters of 0.70 indicates that BMI value influences considerably the function of circulatory system in 70 % of all cases.

The decreasing tendency of mean values of all parameters in all three groups of women can be noted after comparison of data obtained at the time of initial and final examination.

It should be noted that body mass and BMI decline in groups of overweight and obese women were statistically significant ($p < 0.05$) (TABLE 1). Reduction of mean values of circumferential measurements in the group of overweight and obese women measured at the level of hips and right and left thighs appeared to

be statistically significant too ($p < 0.01$ to 0.05). Reduction of the left circumferential measurement taken above the knee showed statistical relevancy in the group of overweight women ($p < 0.05$). Significant statistical relevancy in reduction of right and left arm circumference values was found in the group of obese women ($p < 0.01$), (TABLE 2, 3).

The 6-month weight loss programme contributed to some improvement of the general physical fitness of women who were subjected to this study (TABLE 4). Improvement of flexibility was not statistically relevant in the group of obese women and a decrease in flexibility was noted in the group of overweight women, though no statistical relevancy of that decrease was noted either. Only improvement of endurance and balance (right leg standstill) in the group of obese women appeared to be statistically relevant ($p < 0.05$) (TABLE 4).

When comparing mean values of cardiovascular parameters obtained in initial examination with the final one, it appears that blood pressure, both systolic and diastolic, recorded in the group of overweight women, decreased both before and after exercises. Some decline of heart rate value recorded before and after exercises was noted in that group as well, though the above differences did not appear to be statistically relevant. Only the heart rate value recorded after exercises decreased significantly ($p < 0.05$).

Reduction of mean values of systolic blood pressure recorded after exercises and heart rate values recorded before and after exercises was noted in the group of obese women. Systolic blood pressure recorded before exercises did not change, though diastolic blood pressure recorded before exercises and diastolic blood pressure recorded after exercises increased. However, that increase did not appear to be statistically relevant.

In the control group the increase of blood pressure both before and after exercises and an inconsiderable decline of heart rate value were noted, though only the increase of systolic blood pressure value recorded after exercises appeared to be statistically significant ($p < 0.01$) (TABLE 5).

TABLE 1
Mean values (X), standard deviations (SD), minimum (min) and maximum (max) values of BMI and body mass recorded at the time of initial and final examination and level of statistical relevancy between initial and final examination

Group	Examination		Body Mass [kg]	BMI
Overweight	Initial	X	75.4	28.0
		SD	6.2	1.7
		min	65.0	25.4
		max	81.0	29.9
	Final	X	73.0	27.2
		SD	7.0	2.1
		min	61.0	23.8
		max	80.0	29.3
	level of statistical relevancy		<0.05	NS
Obese	Initial	X	85.4	31.9
		SD	11.6	3.3
		min	73.5	26.0
		max	107.5	39.0
	Final	X	81.5	30.5
		SD	9.1	3.1
		min	70.0	26.8
		max	100.0	36.7
	level of statistical relevancy		<0.05	<0.05
Control	Initial	X	62.7	22.8
		SD	6.1	2.0
		min	57.0	21.0
		max	70.2	24.8
	Final	X	62.6	22.8
		SD	7.0	2.5
		min	56.3	20.7
		max	70.0	25.5
	level of statistical relevancy		NS	NS

NS – not statistically relevant

TABLE 2
Mean values (X), standard deviations (SD), minimum (min) and maximum (max) values of recorded circumferential measurements performed at the hip and waist level at the time of initial and final examination and level of statistical relevancy between initial and final examination

Group	Examination		Waist circumference	Hip circumference
Overweight	Initial	X	85.0	108
		SD	7.5	6.7
		min	79.0	98.0
		max	100.0	116.0
	Final	X	87.2	103.8
		SD	9.6	6.3
		min	76.0	96.0
		max	98.0	113.0
	level of statistical relevancy		NS	<0.05
Obese	Initial	X	98.0	113.0
		SD	9.7	6.5
		min	80.5	103.0
		max	113.0	122.0
	Final	X	95.2	108.8
		SD	10.1	6.7
		min	78.0	98.0
		max	110.0	117.0
	level of statistical relevancy		NS	<0.05
Control	Initial	X	81.3	100.5
		SD	13.0	5.7
		min	70.0	96.0
		max	98.0	108.0
	Final	X	80.0	99.3
		SD	12.6	5.3
		min	69.0	95.0
		max	96.0	106.0
	level of statistical relevancy		<0.05	<0.05

NS – not statistically relevant

TABLE 3
Mean values (X), standard deviations (SD), minimum (min) and maximum (max) values of circumferential measurements of lower and upper extremity recorded at the time of initial and final examination and level of statistical relevancy between initial and final examination

Group	Examination		Circumferences					
			Thigh		Above the knee		Arm	
			right	left	right	left	right	left
Overweight	Initial	X	63.8	63.8	47.8	48.0	33.2	33.2
		SD	5.2	5.6	4.4	5.1	2.6	2.6
		min	55.0	55.0	40.0	40.0	28.0	28.0
		max	70.0	71.0	53.0	53.0	35.0	35.0
	Final	X	62.0	62.0	46.7	47.2	33.2	33.2
		SD	5.0	5.4	4.0	4.6	3.4	3.3
		min	54.0	54.0	39.5	39.5	27.0	27.0
		max	70.0	71.0	50.0	52.5	37.0	37.0
	level of statistical relevancy		<0.05	<0.05	NS	<0.05	NS	NS
Obese	Initial	X	64.5	64.3	49.7	50.0	35.2	35.1
		SD	4.4	4.7	4.9	4.9	2.6	2.7
		min	60.0	55.0	40.0	40.0	28.0	28.0
		max	73.0	73.0	60.0	60.0	39.0	39.0
	Final	X	62.2	61.1	48.6	48.7	33.4	33.3
		SD	4.9	4.9	4.4	4.3	2.7	2.7
		min	57.0	54.0	39.5	39.5	27.0	27.0
		max	70.0	71.0	56.0	56.0	37.0	37.0
	level of statistical relevancy		<0.05	<0.01	NS	NS	<0.01	<0.01
Control	Initial	X	60.5	60.1	47.5	47.5	30.3	30.3
		SD	6.5	6.8	10.5	10.5	2.5	2.5
		min	55.0	54.0	38.0	38.0	27.0	27.0
		max	69.0	69.0	58.0	58.0	32.5	32.5
	Final	X	60.0	59.1	46.9	46.9	29.8	29.8
		SD	6.7	7.0	10.6	10.6	2.2	2.2
		min	54.0	54.0	37.0	37.0	27.0	27.0
		max	69.0	69.0	57.0	57.0	32.0	32.0
	level of statistical relevancy		NS	NS	NS	NS	NS	NS

NS – not statistically relevant

TABLE 4
Mean values (X), standard deviations (SD), minimum (min) and maximum (max) values of data concerning general physical fitness (spine bending, run, backward hang, one leg standstill) recorded at the time of initial and final examination and level of statistical relevancy between initial and final examination

Group	Examination		Spine bending [cm]	Run (number of laps)	Backward [s]	One leg standstill[s]	
						Right leg	Left leg
Overweight	Initial	X	–4.6	9.7	24.3	107.2	89.3
		SD	7.0	6.8	4.8	67.4	68.4
		min	–17.0	5.0	20.0	40.0	30.0
		max	4.5	23.0	30.0	220.0	220.0
	Final	X	–9.2	9.7	30.0	103.3	88.3
		SD	4.8	3.3	5.4	74.1	73.4
		min	–6.0	5.0	25.0	35.0	25.0
		max	5.0	15.0	40.0	220.0	220.0
	level of statistical relevancy		NS	NS	<0,05	NS	NS
Obese	Initial	X	–1,4	8.8	27.7	89.9	100.3
		SD	10.7	5.9	10.4	43.1	58.1
		min	–15.0	4.0	20.0	30.0	28.0
		max	13.5	23.0	45.0	153.0	220.0
	Final	X	–1,3	11.4	31.5	112.0	118.0
		SD	11.4	6.2	10.8	37.3	49.2
		min	–13	6.0	15.0	40.0	30.0
		max	15.0	22.0	55.0	180.0	220.0
	level of statistical relevancy		NS	<0,01	NS	<0,05	NS
Control	Initial	X	–3,0	12.3	60.0	122.5	110.0
		SD	7.4	6.4	43.2	79.3	80.4
		min	–13.0	6.0	20.0	30.0	20.0
		max	5.0	20.0	120.0	220.0	210.0
	Final	X	0.0	12.8	58.0	117.0	112.0
		SD	7.1	6.1	41.4	76.6	80.6
		min	–10.0	6.0	35.0	38.0	30.0
		max	5.0	20.0	120.0	220.0	220.0
	level of statistical relevancy		NS	NS	NS	NS	NS

NS – not statistically relevant

TABLE 5
Mean values (X), standard deviations (SD), minimum (min) and maximum (max) values of cardiovascular parameters (systolic and diastolic blood pressure, heart rate values before and after exercises) recorded at the time of initial and final examination and level of statistical relevancy between initial and final examination

Group	Examination		Blood pressure				HR	
			Before exercises		After exercises		Before exercises	After exercises
			Systolic	Diastolic	Systolic	Diastolic		
Nadwaga	Initial	X	139.0	97.2	153.2	107.2	79.8	99.9
		SD	15.0	12.2	34.7	34.2	11.6	23.0
		min	112.0	83.0	90.0	63.0	64.0	55.0
		max	160.0	124.0	208.0	178.0	96.0	130.0
	Final	X	132.0	90.4	138.7	97.2	79.5	88.8
		SD	7.1	11.5	11.5	24.0	14.8	18.8
		min	122.0	72.0	122.0	60.0	47.0	50.0
		max	7.0	110.0	157.0	141.0	50.0	120.0
	level of statistical relevancy		NS	NS	NS	NS	NS	<0,05
Otyłość	Initial	X	133.3	90.3	138.8	98.5	87.3	101.2
		SD	17.3	10.0	20.5	18.1	5.6	19.7
		min	118.0	80.0	100.0	75.0	80.0	82.0
		max	162.0	101.0	160.0	120.0	96.0	130.0
	Final	X	133.2	102.5	131.3	102.8	85.3	87.2
		SD	17.0	52.6	22.7	18.2	8.3	18.6
		min	118.0	80.0	90.0	73.0	72.0	53.0
		max	161.0	147.0	158.0	124.0	95.0	100.0
	level of statistical relevancy		NS	NS	NS	NS	NS	NS
Control	Initial	X	122.5	82.0	133.8	90.5	74.5	93.8
		SD	9.6	4.0	13.8	7.4	12.2	19.8
		min	110.0	80.0	120.0	82.0	60.0	65.0
		max	130.0	88.0	150.0	100.0	88.0	110.0
	Final	X	124.3	88.0	145.3	95.8	70.5	84.5
		SD	14.1	5.4	12.8	5.1	20.7	13.2
		min	107.0	80.0	130.0	90.0	42.0	70.0
		max	140.0	92.0	160.0	100.0	90.0	100.0
	level of statistical relevancy		NS	NS	<0.01	NS	NS	NS

NS – not statistically relevant

The 6 months weigh loss programme resulted in considerable alternation of BMI range distribution in overweight and obese subjects. The dominant has moved considerably towards the left in the group of overweight women, which caused a reduction in the number of subjects with BMI of 28–30. A decline of BMI was also noted in the group of obese women, where the dominant moved to the left as well and 8 % of subjects from this group presented us with BMI values of 26–28 (BMI values lower than 30 indicate overweight, which can be observed in both of the above cases). At the time of final examination none of the women from the obese group was classified as being in the range of maximum BMI (38–40) (Fig. 1, 2).

Fig. 1
Distribution of overweight women according to BMI at the time of initial and final examination

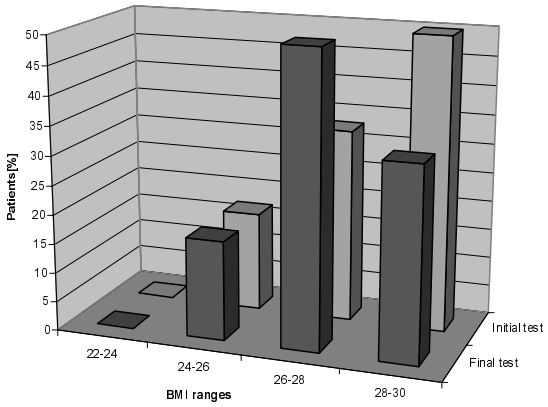
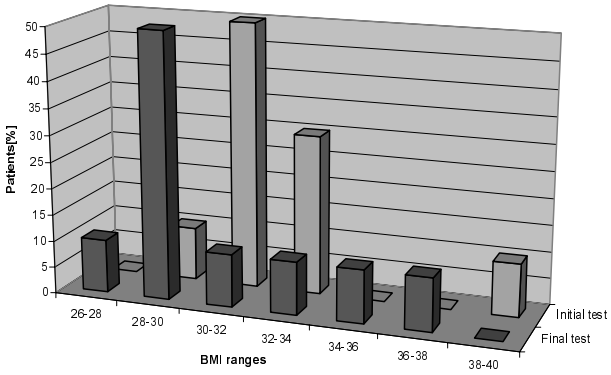


Fig. 2
Distribution of obese women according to BMI at the time of initial and final examination



On the basis of initial subjective examination performed in the group of overweight and obese women it was stated that overweight women were shown to have more psychological discomfort, which had been caused by an excessive mount of body weight. Almost all women declared that they wanted to lose weight, but in the case of those who were overweight it was due to aesthetic reasons, whereas in the case of the obese that declaration was due to health related problems. All overweight and obese women were dissatisfied with their initial body mass. They stated it had been the reason of their general discomfort and low self-esteem. After completion of a 6-month weight loss programme women from both groups noted improved both general physical (weight loss, improved general physical fitness) and psychological feeling (higher self-esteem and health awareness, motivation to have an active lifestyle).

Considering the above results it should be stated that significant improvement was noted in almost all analysed obesity-related parameters. The most significant improvement was seen in body mass and in BMI value. The largest body mass reduction in the group of obese women amounted to 8 kg, which made up 10.3 % of initial body mass (78 kg). There was also one case of weight gain in the group of obese women. That woman's weight had been 75.4 kg and she gained 2.6 kg, which was 3.4 % of her initial weight. In the group of overweight women the largest body mass reduction amounted to 8 kg (10 % of initial body mass). Also in that group there was one case of weight gain: 2.2 kg (3 % of initial body mass). In the group of women with regular body weight the biggest weight reduction amounted to 1.2 kg (2.1 % of initial body weight of 57 kg). Similarly in that group there was one case of weight gain of 2 kg (1.3 % of her initial body weight of 65 kg).

Obviously improvement of parameters concerning general physical fitness resulted from body mass reduction. Results of cardiovascular parameters showed some adaptive changes to physical effort, especially in the group of overweight women (an inconsiderable reduction of blood pressure was recorded before and after exercises). Whereas there was a substantial reduction of heart rate recorded after exercises in both groups, of overweight and of obese women. The above changes noted in the function of the circulatory system may indicate an increase in exercise tolerance, improvement of conditions needed for proper heart function and improvement of general physical condition.

DISCUSSION

The role of physical therapy, in particular kinesiotherapy, was first emphasised in the 16th century by Wojciech Oczko, the author of the aphorism: "movement may substitute for any medicine, but no medicine may substitute for movement" (Zembaty, 1987). It is obvious that physical effort influences body mass reduction and usually people who remain physically active are rarely obese. Lack of physical exercise may result in positive energy balance and in reduction of general physical capacity by 12–22% (Tatoń, 1985). Studies conducted by Rose and Mayer showed that obese children are considerably less active than children with regular body weight. On a daily basis obese adults walk much less than lean individuals. Yet

the usefulness of physical exercise in the treatment and prevention of obesity is often questioned. Some state that energy expenditure during those physical exercises which can be performed by obese individuals is low and therefore the role of physical activity in treatment of obesity is inconsiderable. Others claim that a high level of physical activity stimulates appetite and thereby limits the benefits of slightly increased energy expenditure. Even though the first mentioned above statement is false, it is often quoted. The daily calorie requirement in the population of various countries oscillates between 2400 and 4500, depending on the character of work performed. In the case of coalminers and athletes this energy cost may reach even 6000 calories. It is well known that prevention of obesity does not rely on a single expenditure of a large amount of energy during heavy work, but on daily losses of smaller amounts of energy. A healthy adult individual does not need to exercise heavily to obtain an energy expenditure of 500–600 calories within 1–2 hours (Kozłowski, 1986; Krotkiewski, 1994). The second above-mentioned statement regarding increased appetite which is caused by physical exercise is misleading as well.

The initial weight gain often associated with physical training is another source of misinterpretation and discouragement among overweight and obese patients. Such weight gain, which may be observed mainly with people who lead a sedentary lifestyle, is a result of increased muscle mass (glycogen and water content) which often exceeds fat tissue reduction, (which is also associated with physical activity). Yet this increased amount of muscle mass is considered as a beneficial change, since it improves the adaptive abilities of the organism and causes basal metabolism to increase (Fricker, 1994; Kozłowski, 1986). According to Bjorntrop, a Swedish researcher specialising in physiological aspects of obesity, significant body mass reduction or considerable changes in its composition may be observed only 2–3 months after the initiation of regular physical training (Greenwood, 1983; Kozłowski, 1986). The results of studies show that trained muscle is much more valuable then inactive muscle. The regular performance of physical exercises increases energy expenditure and at the same time allows for the burning of larger amounts of calories during rest. There are two reasons for this increased energy expenditure. The first one is that the metabolism of muscle tissue requires more energy then fat tissue (at rest muscles use more energy) and the second: modification of metabolism in lean body mass (muscles and viscera). In athletes 1 kilogram of lean body mass uses more energy at rest than in an individual leading a sedentary lifestyle (that change may even reach 10 % – which makes 100–200 calories a day) (Fricker, 1994). Results of studies conducted in Sweden showed that the weight gain in males leading an active lifestyle was inconsiderable between the age of 20 and 53. The mean body weight in 20 year old males was 68 kilograms. In 53 year old males leading an active life style, their mean body weight was 68 kilograms too. Whereas those who weighed 68 kilograms when they were 20, and who led sedentary lifestyle for 30 years, weighed 76 kilograms, thus exceeding by 8 kilograms the weight of their active male counterparts of the same age. It was proven that the difference of body weight in these two above-mentioned groups resulted from a different amount of fat tissue. The above facts were verified in many research attempts (Krch & Rathner, 1998). Other studies focused on the effects of physical training performed regularly 3 times a week for half an hour for 3.5 years by patients who had suffered from myocardial infarction in the past. Those patients did not limit the amount of calories they were receiving from food. In the majority of those patients physical training caused weight reduction and then its stabilisation to lower than the original level (Kozłowski & Nazar, 1984). In another research study, subjects were divided into 3 groups, according to different types of the weight loss treatment programme used; in the first group the intake of calories was reduced by 500 calories a day, in the second group patients performed additional exercises causing an energy expenditure of about 500 calories, and patients from the third group reduced their food intake by 250 calories and performed exercises causing an energy expenditure of about 250 calories. The results showed that in the second and in the third group the loss of body weight was equal, and it was a result of fat tissue loss, while the loss of body weight recorded in the first group was a result of both fat and muscle tissue losses (Grojec, 1978). Studies performed on Harvard soccer players showed a high correlation between the increase of metabolism rate and physical exercise. There was a 25 % increase of metabolism rate in players within 15 hours after a game (Greenwood, 1983). Other studies performed by Tremblay et al. showed that physical training increases basal metabolism by 8 % in obese patients when compared with their metabolism level recorded before training. In association with a low-calorie diet, (which used alone causes a decrease of basal metabolism), physical exercise allows for maintenance of a higher basal metabolic rate, or its further increase, according to intensity and time of applied exercise (Kowalczyk, Batorska, & Walacik, 1999).

Besides its essential role in maintenance of normal body weight, physical exercise is also an important factor in treatment and prevention of diseases which are often associated with obesity such as: ischaemic heart disease, hypertension and insulin-independent diabetes (Kowalczyk, Batorska, & Walacik, 1999; Zajadacz, Bartnicka, & Juszkiewicz, 1999).

Therefore movement may be considered to be a therapeutic means in two aspects: reduction of body mass (i. e. fat tissue) and improvement of function of cardiovascular system (Tatoń, 1985).

Reduction of body mass improves function and the haemodynamics of heart muscle, leads to regression of left ventricle hypertrophy, limits the symptoms of hypertension and finally slows down the development

of atherosclerosis by improvement of lipid and carbohydrate metabolism. Multiple studies have also shown that reduction of body mass in overweight patients with mild hypertension results in a decrease of systolic and diastolic blood pressure (Opolski, 2000).

Researchers from Pritkin Centre in Florida performed a 26-day study on heart haemodynamic changes during short-lasting, intensive exercises in patients with high blood pressure, among which some had ischaemic heat disease. Those patients also obeyed a tailor-made diet. The efficacy of that programme was evaluated with the use of a non-invasive technique measuring thoracic electrical bioimpedance. The collected data was compared with results obtained in the control group. It was observed that in obese patients with hypertension who participated in the 26-day study, mean diastolic blood pressure decreased from the value of 100 ± 8.5 to 94.8 ± 7.9 mm Hg. Those results made Mattar et al. suggest implementation of their program in rehabilitation of obese patients with hypertension (Mattar, Salas, Bernstein, Lehr, & Bauer, 1990).

Researchers from Nigeria (Sanya & Adesina, 1998) investigated the correlation between an excess of fat tissue and the functioning of the respiratory system. Patients with BMI over 30, who had no respiratory nor any neurological disorders, were subjected to physical therapy treatment. Their BMI, lungs' vital capacity and time of involuntary apnoea were measured. Significant differences were noted in the percentage values of respiratory parameters (vital capacity and time of involuntary apnoea) between women with normal BMI and obese patients. A high inverse correlation was found between measured fat tissue mass and the following parameters: lungs vital capacity and time of involuntary apnoea in patients with BMI over 30. A high correlation was observed between predicted vital capacity and time of involuntary apnoea in patients with BMI over 30. It was concluded that excessive amount of fat tissue localised in thoracic and in abdominal areas restricts respiratory movements and that patients with BMI over 30 should be enrolled in weight loss exercise programmes (Sanya & Adesina, 1998).

An excessive amount of body weight, both in overweight and obesity, also unfavourably affects patients' mental state and self-esteem. There was a research project done in the Czech Republic where adult residents of Prague and its vicinity were subjected to the study which was supposed to show any correlation between obesity and mental problems. A survey conducted on obese men and women showed some differences between those two groups as far as their self-esteem and behaviour were concerned. Overweight men demonstrated low self-control in the sphere of food consumption, smoking and alcohol drinking. Whereas overweight women, when compared with men, showed an increased awareness of their food consumption and fewer alcohol-related problems. Men who participated in that study complained of general discomfort, depression and other nonspecified symptoms. Women reported anxiety and other social dysfunctions resulting from being overweight (Krch & Rathner, 1998). It also should be noted that they are the ones who attend health clubs, swimming pools and who are willing to do a lot to get in shape and to improve their self-esteem. However obesity is not only an aesthetic problem. Reduction of excessive kilograms of body mass may also bring other advantages such as: lowering of blood pressure, lowering of blood sugar level and increasing of insulin sensitivity (which is very important for patients with a lowered tolerance to glucose and in patients with diabetes), lowering cholesterol level (lowering of total cholesterol and LDL fraction, increasing of HDL fraction level), the possibility of the reduction of drug dosages used in treatment of hypertension and diabetes, lowering the risk of development of ischaemic heart disease, improvement of self-esteem and general feeling (Furmański, 2000; Tatoń, 1985).

Unfortunately, as studies show, 50 % of all patients who originally enroll in weight loss exercise programmes, give up within the first 6 months. A similar situation was observed in our study group. Therefore we should repeat after Tatoń, that weight loss exercise programmes should focus also on behavioural methods, which aim at the development of permanent changes of eating habits and development of an active lifestyle based mainly on low intensity physical exercises (Tatoń, 1985).

CONCLUSIONS

1. There is a correlation between performance of regular physical exercise and reduction of body mass.
2. The general fitness of overweight and obese women, who participate in weight loss exercise programmes tends to improve. Flexibility, endurance and coordination improve in those who exercise regularly.
3. Regular physical exercise influences the functioning of the cardiovascular system.
4. Regular physical exercise allows for the improvement of self-esteem and a general feeling of well-being.

REFERENCES

Baranowska, B., Białkowska, M., Wasilewska-Dziubińska, E., & Pachocki, R. (1994). *Otyłość – choroba cywilizacji.* Warszawa: Bel. Corp. Scientific Publication Co.

Brohl, W., & Brzozowski, R. (1984). *Vademecum lekarza ogólnego.* Warszawa: PZWL.

Enzi, G., Crepaldi, G., Pozza, G., & Renold, A. E. (1981). *Obesity: pathogenesis and treatment.* London: Academic Press Inc., London LTD.

Fricker, J. (1994). *Jak schudnąć nie szkodząc zdrowiu.* Warszawa: WAB.

Frömel, K. (1999). School youth physical activity. Movement and health. In *Acta Univ. Palacki. Olomuc., Gymn., 29(1)*, 29–33.
Furmański, J. (2000.). *Problemy współczesnej medycyny – otyłość.* http://www.zdrowie med.pl.
Garbala, A. (1999). Problem największej wagi. *Beauty Forum, 12*, 48–49.
Greenwood, M. R. C. (1983). *Obesity.* New York: Churchill Livingstone.
Grojec, M. (1978). *Otyłość bez tajemnic.* Warszawa: PZWN.
Kodejszko, E., Blaim, A., & Tatoń, J. (1965). *Otyłość i jej leczenie.* Warszawa: PZWL.
Kokot, F. (1991). *Choroby wewnętrzne.* Warszawa: PZWL.
Kowalczyk, B., Batorska, A., & Walacik, E. (1999). *Otyłość.* http://www.webmedia.pl/medic/otyłość.htm
Kozłowski, S., & Nazar, K. (1984). *Wprowadzenie do fizjologii klinicznej.* Warszawa: PZWL.
Kozłowski, S. (1986). *Granice przystosowania.* Warszawa: WP.
Krch, F. D., & Rathner, G. (1998) The relationship between overweight and psychological problems in the adult Czech population. *Sb. Lek, 99(3)*, 303–309.
Krotkiewski, M. (1994). *Jak schudnąć, wszystko o odchudzaniu.* Warszawa.
Mattar, J. A., Salas, C. E., Bernstein, D. P., Lehr, D., & Bauer, R. (1990). Hemodynamic changes after an intensive short-term exercise and nutrition program in hypertensive and obese patients with and without coronary artery disease. *Arquivos Brasileiros de Cardiologia, 54(5)*, 307–312.
Opolski, G. (2000). Układ krążenia w otyłości. In *Medycyna po dyplomie (wyd. specj.)*, (pp. 101–104).
Rożniakowki, T. (1982). *Mała encyklopedia medycyny. Tom I.* Warszawa: PWN.
Rożniakowki, T. (1982). *Mała encyklopedia medycyny. Tom II.* Warszawa: PWN.
Rudnicki, S., & Smolis, R. (1999). *Poradnik antyzawałowy.* http://www.lodzptkardio.pl
Sanya, A. O., & Adesina, A. T. (1998). Relationship between estimated body fat and some respiratory function indices. *Central African Journal of Medicine, 44(10)*, 254–258.
Tatoń, J. (1985). *Otyłość – patofizjologia, diagnostyka, leczenie.* Warszawa: PZWL.
Zajadacz, B., Bartnicka, K., & Juszkiewicz, A. (1999). *Otyłość – czynnik ryzyka chorób metabolicznych.* http://www.fundacja.pl
Zembaty, A. (1987). *Fizjoterapia.* Warszawa: PZWL.

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ÚČINNOST CVIČENÍ PRO ZTRÁTU VÁHY PŘI LÉČBĚ NADVÁHY A EXOGENNÍ OBEZITY

(Souhrn anglického textu)

Cílem této studie bylo odhadnout vliv šestiměsíčního cyklu tzv. cvičení pro ztrátu váhy na celkový zdravotní a psychický stav obézních žen. Pacientky byly rozděleny do tří skupin: 6 žen s nadváhou, 10 žen s obezitou a 4 ženy s normální tělesnou hmotností. Hodnotily se tyto parametry: Body Mass Index (BMI), obvodové míry, vybrané elementy tělesné kondice, Heart Rate (HR), hodnoty diastolického a systolického krevního tlaku. Navíc se sledovalo sebehodnocení pacientů a jejich subjektivní pocity. Podobné hodnocení bylo provedeno po šesti měsících léčby. Bylo usouzeno, že použitá forma léčení přispěla jak k úbytku tělesné hmoty, tak i většiny obvodových měr. Pozorováno bylo i značné zlepšení fyzické kondice a zvýšená adaptace oběhového systému na fyzická cvičení. Pravidelné provádění cvičení pro ztrátu hmotnosti přispělo ke zlepšení sebehodnocení a celkových pocitů hodnocených osob.

Klíčová slova: nadváha, obezita, cvičení na ztrátu váhy.

THE INFLUENCE OF SOCIAL-ECONOMICAL FACTORS ON THE MORPHOFUNCTIONAL GROWTH OF CHILDREN CONSIDERING THE URBANISATION FACTOR ASPECT

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We tried to prove that living conditions have a significant influence on somatic and functional development of children in Poland. We examined 331 11-year-old children (boys and girls) from the small town of Polkowice and villages in south-west Poland. Basic somatic traits were examined: body height, body weight and body fat. Functional traits were examined through motor trials from Eurofit test: hand grip, standing jump, ball throw, shuttle run and a tapping test of the upper arm. Additionally, psychomotor trials were performed: reaction time and eye-movement coordination. Children from the town and villages were divided into two groups on the basis of a social-economic factors – "the number of children in the family". Four groups of children (boys and girls separately) were compared: urban children from families with 1–2 children, urban children from families with 3 or more children, rural children from families with 1–2 children and rural children from families with 3 or more children. We tried to estimate a hierarchy and directions of this environmental factor's influence on body dimensions, conditional abilities and coordinational abilities. We used cluster analysis as a statistical method towards fulfilling this aim. The results showed that both factors analysed in elaboration are significant modifiers of somatic and functional traits. Boys seem to be, as a sex, more ecosensitive than girls.

Keywords: social-economical factors, environmental conditions for growth, children's development, morphofunctional traits.

INTRODUCTION

People's life conditions are strongly connected with the degree of urbanisation of their living area. So, a lot of research has shown differences in the speed of the biological growth of children among children from big cities, towns and villages and inform us of differences in the quality of life of those populations. Providing such research is socially justified because we can show in which kinds of areas the national program of "social differences reduction" should be implemented. It concerns education as well as the biological development of young people.

In our work we checked to see if there was any distance between rural and urban children in morphofunctional development. Additionally we took into consideration the number of children in each family. It's a social-economical factor diversificating parameters of somatic and functional growth of children in Poland (Hulanicka et al., 1990; Ignasiak et all, 1996; Sławińska, 2000). Our examinations were provided in industrial areas in the south-west part of Poland in the Copper Mine District. The industry factor had impact on the regional economical situation and on what could modulate differences in the examined groups.

MATERIAL AND METHODS

The material used were the measured data of children received during complex research provided by the Department of Human Anatomy, University School of Physical Education in Wroclaw. It was done in September 1998 in six villages: Kotla, Kromolin, Rosochata, Rzeszotaryn, Brzeg Glogowski and Nielubia situated in the Copper Mine District and in September 1999 in the town of Polkowice – also situated in the Copper Mine District. All areas had a lot of air pollution, but they had, on the other hand, a high economic level. It was because of the copper industry, which not only caused environmental pollution, but it was the reason for changes in the social-economic environment as well. It changed the structure of employment in the region, which was transformed from a typical rural area into a high industry region. So the source of the livelihood of families were both work in the copper industry as well as in agriculture. This kind of situation created a special system of common relations of environmental factors of development. The hierarchy, directions and strength of the effects on the human organism is other than what is usually observed.

In our work we chose 11-year-old children. We qualified the children between 10.50 and 11.49 years old children for inclusion in this group. We examined 177 boys and 154 girls.

The body height, body weight and sum of three skin-folds (on the triceps, on the scapula and on the abdomen) were measured.

To diagnose the level of motor development we chose some trials from Eurofit test (1989). They were:
- handgrip (static strength of hand),
- standing jump (explosive strength of legs),
- 1 kg ball throw (explosive strength of arms),
- shuttle run 10 × 5 m (agility),

which measure conditional abilities, and also the following:
- tapping test (speed of movement of the arm),
- reaction speed,

and
- eye-movement coordination,

which measure coordinational abilities.

Additionally, inquiries concerning the socio-economic situation of families were received. Information received from inquiries let us put the families into two groups on the basis of the "number of children in family" factor:
- 1–2 children in family: a family with comparatively few children,
- 3 and more children in family: a family with comparatively more children.

To estimate differences in morphofunctional growth between children from all groups we used cluster analysis. The unweighted pair-group average method of agglomeration was used (UPGMA – Sneath & Sokal, 1973). The distance between clusters was computed as a mean distance between all pairs of objects in two different clusters. Euclid's distance was measured. It's a geometrical distance in multidimensional space.

ANALYSIS

Multidimensional research on conditions of children's development is provided in many European centres (Bláha & Vignerová, 2002; Eiben et al., 1991; Hulanicka et al., 1990; Ignasiak et al., 1996; Lindgren, 1976). In our work we focused on estimating the influence of two kinds of socioeconomical factors: the degree of urbanisation of living area and number of children in family on biological development of children. The number of children in family factor was treated as a marker of the economic possibilities of the family. The degree of urbanisation of the living area determines better education, medical care and more diversified food. These factors, through biological incentives, affect the human organism and can positively stimulate as well as negatively influence growth. Most frequently, they didn't have an effect singly, but connected with each other, creating interactions. So to estimate the influence of both already-described socioeconomic factors on the growth of children, our analysis was provided based on four groups of children of both sexes. Both urban and rural children were divided into groups living in families with a smaller number of children and those with a greater number of children. The same legend exists on all figures: MP1–2 – urban boys from families with 1–2 children, MP ≥ 3 – urban boys from families with 3 and more children, MW1–2 – rural boys from families with 1–2 children, MW ≥ 3 – rural boys with 3 and more children, KP1–2 – urban girls with 1–2 children in family, KP ≥ 3 – urban girls with 3 and more children, KW1–2 – rural girls from families with 1–2 children, KW ≥ 3 – rural girls from families with 3 and more children.

The analysis of single somatic and functional traits gives a lot of information about the human organism, but it's not a mirror of structure and the functional complexity of the human organism. But the human body isn't only a simple sum of single parameters, but is made up of complex components making complicated connections and interactions.

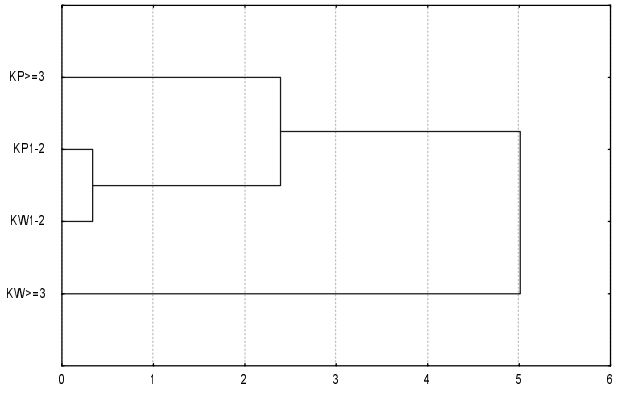
Comparing the created clusters of boys to girls we observed little sexual dimorphism in connections and linkages of environmental groups.

Clusters on the basis of somatic traits (body height and weight and sum of 3 skin-folds)

Boys

The social-economic situation, defined by the number of children in a family, was a relatively stronger factor diversifying the basic somatic traits of boys than the degree of urbanisation of the living area (Fig. 1). This scheme was similar to girls but more strongly marked. Two clearly created clusters proved it. One of them was made up of groups of rural and urban boys from children families with a smaller number of children and the second one was made up of groups of rural and urban boys from families with a greater number of children.

Fig. 1
The clusters of rural and urban boys from families with a smaller or larger number of children per family on the basis of somatic traits



We thought that such a scheme and hierarchy of factors indicating domination of the number of children in family factor could be explained by social-economic specifics of the region, which had a generally high level of economic well-being tied up with the copper industry where people both from villages and towns work. It reduced inter-environmental differences so, in such a situation, the factor of the number of children in a family became more important. It was associated with the economic possibilities of a family, independent, at this moment, of the area of living of that family. A clearer character connection could be seen between boys as opposed to girls in that we could see the result that boys are more eco-sensitive of boys. Perhaps environmental incentives affect the male organism more strongly, increasing diversification.

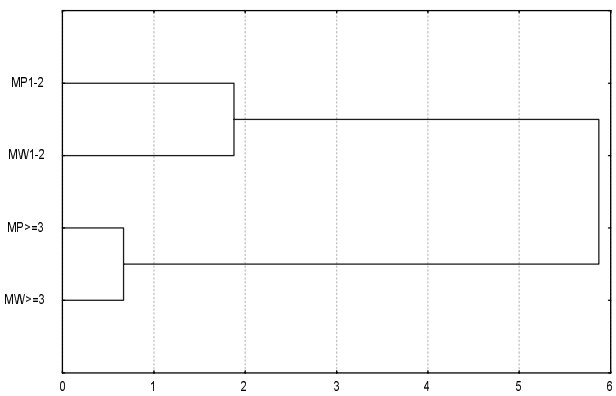
Analysis of linkages of distances in both clusters suggested that the urbanisation of living area factor generally had less of an effect compared to the family having a lot of children. The result is more similarity of the body dimensions of boys from town and villages in the cluster of children from families with a greater number of children in the family.

Girls

There were changes associated with sexual maturity in girls between 10.5–11.5 years old. Individual differences in their hormonal systems caused some of the girls to start growing up faster. Earlier research had shown that the sexual maturity rate depends on, among other factors, the degree of urbanisation of the living area and the social-economic status of the family. The most sensitive indicators of the social-economic situation of each family were body height and menarche (Bielicki, 1986; Bielicki et al., 1986).

Comparing basic growing parameters of the somatic development of rural and urban girls, divided into two groups according to the number of children per family aspect, it was shown that the number of children per family factor strongly modified girls' development rate. Girls from families with a smaller number of children were similar to each other independent of living area (Fig. 2).

Fig. 2
The clusters of rural and urban girls from families with a smaller or larger number of children per family on the basis of somatic traits



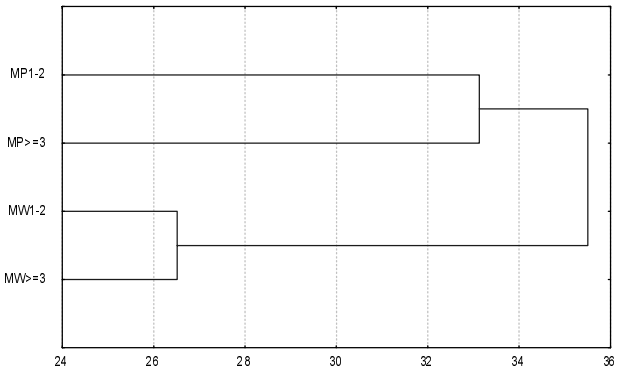
This factor didn't affect boys so clearly, so there wasn't a single second cluster, and the rest of the girls' groups were connected to clusters of the girls from families with a smaller number of children independently. From among both remaining groups, urban girls were most similar to girls from families with fewer children. So, from among all four groups, more similar to each other were rural girls. Knowing the results of other authors who proved special gradients of body height (the best parameters were had by children from big cities, next – towns, and the least – villages) we suggest that dissimilarity was associated with the lowest level of somatic development tied up with the fact that the worst conditions for girls' growth are created in rural families with relatively more children (Hulanicka et al., 1990; Ignasiak & Janusz, 1992; Jedlińska, 1985).

Clusters on the basis of conditional abilities (handgrip, standing jump, ball throw, shuttle run)

Boys

Functional traits, being the basis of conditional abilities, reacted differently than somatic traits. The primary factor affecting conditional abilities was the degree of urbanisation of the living area. In this case, the scheme was similar between boys and girls but more strongly marked. The effect was created by two clusters. One of them was a group of boys from towns living in families with more or fewer children per family, the second one was a group of rural boys living in families with fewer or relatively more children (Fig. 3).

Fig. 3
The clusters of rural and urban boys from families with a smaller or larger number of children per family on the basis of conditional abilities



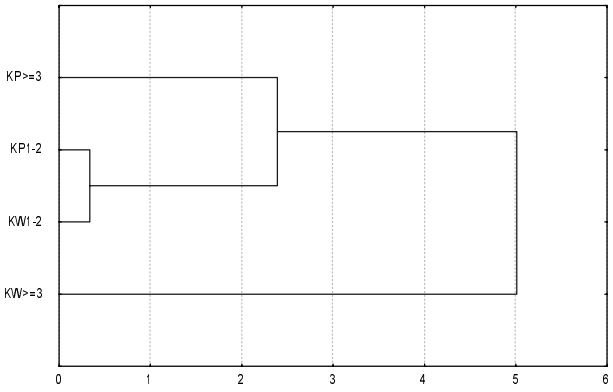
The fact that different directions of environmental factors affect functional traits towards somatic traits was generally known and we confirmed it too in our work. The urbanisation factor dominated the number of children in family factor. The sexual dimorphism related to a clearer scheme in boys' groups. Analysing the dissimilarity degree in the level of conditional

abilities development in every cluster – which means that in every kind of locality we observed more similarity among rural boys. It suggested that living in a rural environment made more uniform conditional abilities development and the number of children per family had no importance. The reverse was true in an urban environment.

Girls

The influence of the factors described on the motor development of girls wasn't so strong as on somatic traits. The "meaning" of factors was changed too. Urban girls were most similar to each other (here were the closest linkages in cluster) (Fig. 4). Both groups of urban girls created a single cluster and the rest of the groups connected independently.

Fig. 4
The clusters of rural and urban girls from families with a smaller or larger number of children per family on the basis of conditional abilities



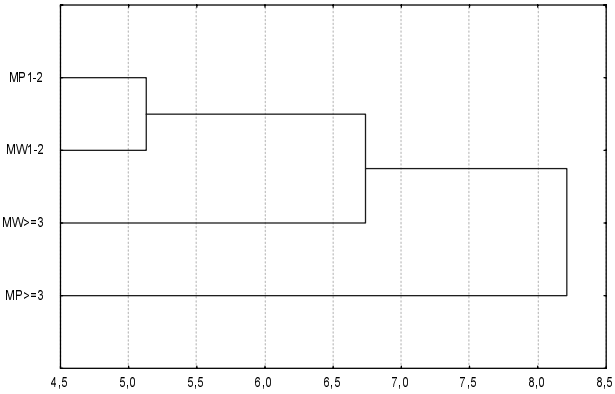
It seemed that the number of children per family factor had less weight in urban environment than the urbanisation factor. In a rural environment, the reverse is true. The girls from families with a smaller number of children had a higher level of conditional abilities than girls from families with a larger number of children. The last one, similar to somatic traits, was closer to the other groups. The social-economic factor diversified motor abilities, and there were gradients similar to somatic traits. Our observations were the same as observations by other authors. The social--economic factor diversified children independent of their area of living, and the children from families with a lot of children had a lower level of conditional abilities. That factor had a less serious effect in urban locations (Osiński, 1988; Przewęda, 1985; Szopa & Sakowicz, 1987).

Clusters on the basis of coordinational abilities (tapping test, speed of reaction, eye-movement co-ordination)

Boys

Analysis linkages of boys on the basis of their coordinational abilities suggested no clear effects of both described factors. There was one cluster of boys from families with a smaller number of children as well as from villages and a town as a result of that (Fig. 5).

Fig. 5
The clusters of rural and urban boys from families with a smaller or a larger number of children per family on the basis of coordinational abilities

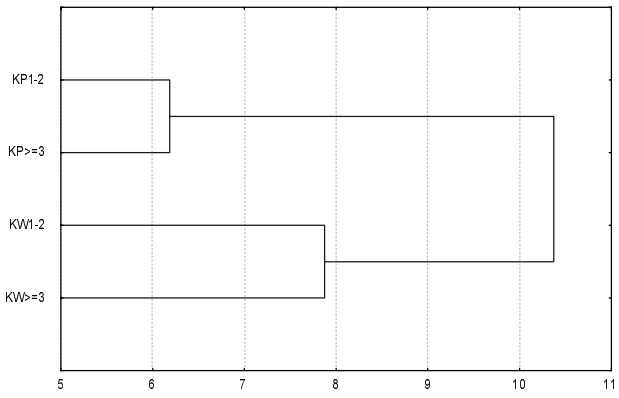


It suggested a stronger effect of the factor of the number of children per family than the urbanisation factor. The remainder of the two groups connected independently to the cluster. Rural boys from families with more children per family were more similar to groups in the cluster. Urban boys were the most dissimilar. The sexual dimorphism was very clear. The degree of urbanisation of living area factor had a stronger effect than the number of children per family factor in girls' groups.

Girls

Both described factors affected girls. But primary was degree of urbanisation of living area factor. It was the reason that two clear clusters were created. There were girls from the town Polkowice (independent of the number of children per family) in one of them, and there were rural girls in the second one. Urban girls were different than rural girls (Fig. 6).

Fig. 6
The clusters of rural and urban girls from families with a smaller or a larger number of chidren per family on the basis of coordinational abilities



It was worth it to demonstrate that girls from town were more similar. Other authors suggested that there might be more stimulation of the nervous system in a city or town than in a village. We supposed that rural girls had a lower level of coordination ability than rural girls from families with more children.

RESULTS

1. There was sexual dimorphism in the structure of linkages of factors: urbanisation degree of living area and the number of children per family. The influence of both factors is stronger and more noticeable in boys' groups than in girls'. Coordination abilities had the parameters where differences were biggest.
2. The number of children per family factor affected somatic traits more strongly than the urbanisation factor. Urban and rural children from families with a smaller number of children were similar each other; the second cluster consisted of urban and rural children from families with a larger number of children. More similarity concerned boys from families with a larger number of children, and vice-versa among girls.
3. The urbanisation factor affected conditional abilities more strongly. Children from families with a smaller or larger number of children per family living in the town Polkowice were similar each other; children from families with a smaller or a larger number of children per family living in villages were similar to each other too. More similar among boys were rural children; urban children – among girls.
4. The number of children per family factor affected coordination abilities stronger than the urbanisation degree factor affected the coordination abilities of boys. Boys from families with a smaller number of children were more similar to each other. The rest of the groups didn't create a separate cluster. The urbanisation degree factor affected coordination abilities of the girls more strongly. Urban girls from families with fewer or relatively more children were similar to each other, as well as rural girls from families with a larger or smaller number of children. But more similar were urban girls.

REFERENCES

Bielicki, T. (1986). Physical growth as a measure of the economic well-being of populations. In F. Falkner & J. M. Tanner (Eds.), *Human Growth, Vol. 3* (pp. 283–305). N. York: Plenum Press.

Bielicki, T., Waliszko, A., Hulanicka, B., & Kotlarz, K. (1986). Social-class gradients in menarcheal age in Poland. *Annals Human Biology, 13*, 1–11.

Bláha, P., & Vignerová (Eds.) (2002). *Investigation of the growth of Czech children and adolescents.* Praha.

Eiben, O. G., Barabas, A., & Panto, E. (1991). The Hungarian national growth study. *Humanbiologia Budapestientis, 21*.

Hulanicka, B., Brajczewski, C., Jedlińska, W., Sławińska, T., & Waliszko, A. (1990). City – Town – Village. Growth of children in Poland in 1988. *Monographies of the Institute of Anthropology Polish Academy of Sciences, 7*.

Ignasiak, Z., Fugiel, J., Sławińska, T., & Żurek, G. (1996). Stan rozwoju dzieci wiejskich z Zagłębia Miedziowego na tle innych populacji wiejskich w Polsce. *Pediatria Polska, Suplement – Zdrowie dziecka w środowisku skażonym ołowiem, 4*, 121–126.

Ignasiak, Z., & Janusz, A. (1992). Ocena różnic rozwojowych 7-letnich dzieci miejskich i wiejskich. In *Materiały Konferencyjne "Zdrowie i sprawność dziecka".* Gdańsk: AWF.

Jedlińska,W. (1985). Wpływ niektórych czynników środowiska społecznego na wysokość ciała dzieci szkolnych w Polsce. *Przegląd Antropologiczny*, 1–2.

Lindgren, G. (1976). Height, weight and menarche in Swedish urban school children in relation to socio--economic and regional factors. *Annals of Human Biology, 3*, 6.

Osiński, W. (1988). Wielokierunkowe związki zdolności motorycznych i parametrów morfologicznych. Badania dzieci i młodzieży wielkomiejskiej z uwzględnieniem poziomu stratyfikacji społecznej. *Seria: Monografie, 261*. Poznań: AWF.

Przewęda, R. (1985). Uwarunkowania poziomu sprawności fizycznej polskiej młodzieży szkolnej. *Z Warsztatów Badawczych.* Warszawa: AWF.

Sławińska, T. (2000). Uwarunkowania środowiskowe w rozwoju motoryczności dzieci wiejskich. *Studia i Monografie AWF we Wrocławiu.* Wrocław: AWF.

Szopa, J., & Sakowicz, B. (1987). Zróżnicowanie relatywnego poziomu sprawności fizycznej krakowskich dziewcząt i chłopców w wieku 8–18 lat

w zależności od wybranych wskaźników społeczno-rodzinnych. *Wychowanie Fizyczne i Sport, 1*.

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VLIV SPOLEČENSKO-EKONOMICKÝCH ČINITELŮ RODINY NA ÚROVEŇ MORFOFUNKČNÍHO ROZVOJE DĚTÍ V KONTEXTU STUPNĚ URBANIZACE MÍSTA BYDLIŠTĚ

(Souhrn anglického textu)

V práci jsme se zaměřili na hodnocení vybraných společensko-ekonomických ukazatelů (počet dětí v rodině a velikost místa bydliště) v kontextu dosažené úrovně rozvoje somatických a funkčních ukazatelů 11letých dětí. Zkoumali jsme 311 chlapců a dívek, bydlících na vesnici a ve městě Polkowice v jihozápadním Polsku. Měřena byla výška a hmotnost těla a dále tloušťka podkožní řasy. K hodnocení úrovně tělesné zdatnosti v oblasti kondičních a koordinačních schopností byly použity vybrané testy z baterie Eurofit: síla stisku ruky, skok do dálky z místa, hod plným míčem, člunkový běh, tapping horní končetiny, čas jednoduché reakce a test zrakově-pohybové koordinace. Všechny probandy z města i z vesnice jsme rozdělili na dvě skupiny podle počtu dětí v rodině, a to na rodiny s 1–2 dětmi a rodiny s 3 a více dětmi. Celkem tak vznikly čtyři soubory probandů. Na základě analýzy můžeme konstatovat významnější vliv činitele počtu dětí v rodině na somatické ukazatele a významnější vliv místa bydliště na kondiční schopnosti. Tato skutečnost je výraznější u chlapců. U koordinačních schopností působí činitel počtu dětí v rodině silněji u chlapců a velikost místa bydliště u dívek.

Klíčová slova: společensko-ekonomické činitele, rozvoj dětí a mládeže, oblast morfologická a funkční, podmíněnost rozvoje bydlištěm.

COMPONENTS/INDICATORS OF ATTITUDES TOWARD INCLUSION OF STUDENTS WITH PHYSICAL DISABILITIES IN PE IN THE ATIPDPE INSTRUMENT/SCALE FOR PROSPECTIVE CZECH PHYSICAL EDUCATORS

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Submitted in October, 2002

The purpose of the study was to examine the structure of the attitudinal scale of the ATIPDPE, an instrument based on the theory of planned behavior (TPB) of Ajzen (2000). Participants were 145 prospective physical educators (70 females & 75 males), of an average age of 21.19 years, enrolled in three physical education teacher preparation programs in the Czech Republic. Based on analysis, the attitudinal scale of ATIPDPE measures III psychological properties (components). Three components, drawn from principal component analysis, explain more than 65 % of the variance. These three components are: a) positive outcomes/results for students, b) negative outcomes for teachers, and c) negative outcomes for students.

Keywords: inclusion, physical disabilities, attitude, adapted physical education.

This study was realized with the support of GAČR (Grant Agency of Czech Republic, grant number 406/02/P123).

INTRODUCTION

Inclusion of students with disabilities in general education represents a relatively new phenomenon in Czech education (Michalík, 2000; Válková, 1998). Until the year 1991, most students with disabilities were educated in segregated special schools. It is important that future physical education (PE) teachers be prepared to include individuals with disabilities in general physical education (GPE) settings. According to planned behavior theory (Ajzen, 1991), behavior (e. g., including students with disabilities) is predicted by intention. The theory of planned behavior (TPB) (Ajzen, 1991) posits that behavioral beliefs, normative beliefs, and control beliefs are predictors of one's intention to perform specific behavior. Attitude Toward Inclusion of Individuals with Physical Disabilities in Physical Education (ATIPDPE) was developed (Kudláček, Válková, Sherrill, Myers, & French, 2002) in order to assess intentions and belief systems and to use the results to personalize teacher preparation so that university students develop positive attitudes and strengthen their intentions of practicing inclusiveness. The results showed that 23 % of variance in intentions can be explained by three belief components based on TPB. It is now necessary to examine the factor structure of these belief components in order to further explain beliefs about inclusion.

The most frequently studied component of both theories are behavioral beliefs, because this component is used to infer attitudes toward the intention to perform a specific behavior. Attitudes are often cited as extremely important in order to successfully work with students with disabilities (Downs & Williams, 1994; Folsom-Meek, Nearing, Groteluschen, & Krampf, 1999; Hodge & Jansma, 1999; Rizzo, 1985; Rizzo & Kirkendall, 1995). Rizzo (1984) is credited with initiating theoretically-based research on attitudes towards the teaching of individuals with disabilities in GPE. Rizzo developed an instrument, now entitled the Physical Educators' Attitudes toward Teaching Individuals with Disabilities (PEATID), which is based on the theory of reasoned action (Ajzen & Fishbein, 1980). PEATID uses a 5-point Likert-type scale to measure 12 behavioral beliefs about the outcomes of teaching children with disabilities in GPE. Without a doubt, the PEATID has become the most commonly used attitude instrument in adapted physical education (e. g., DePauw & Karp, 1990; Downs & Williams, 1994; Folsom-Meek et al., 1999; Hodge & Jansma, 1999; Kowalski & Rizzo, 1996; Rizzo & Kirkendall, 1995; Schmidt-Gotz, Doll-Tepper, & Lienert, 1994).

In each of the studies using PEATID or its earlier form, PEATH, an attitude score was inferred by averaging the Likert-type ratings of 12 belief statements. Factor analysis of PETID was examined (Folsom-Meek & Rizzo, 2002) with three factors resulting: (a) Outcomes of the teaching of students with disabilities in regular classes (b) Effect on student teaching (c) Need for more academic preparation to teach students with disabilities. The purpose of this study was to discover the structure of the attitudinal scale of ATIPDPE by

finding components of this scale using principal component analysis and to compare these to the components of Folsom-Meek & Rizzo (2002).

METHOD

Participants

Participants were 145 prospective physical educators (70 females & 75 males) of an average age of 21.19 years enrolled in three physical education teacher preparation programs in the Czech Republic. The sampling goal was to obtain as many participants as possible. The sampling design was purposive, meaning all students were surveyed who met the criteria of (a) enrollment in PE teacher preparation programs, and (b) willingness of the course instructor to allow class time for the survey.

Instrument

We have used the attitudinal scale from Kudláček et al. (2002) ATIPDPE instrument. This scale is measuring behavioral beliefs about the outcomes of inclusion of students with physical disabilities in physical education. The attitude scale was selected from three scales to compare the results of attitudes toward inclusion among Czech perspective educators with results from similar studies in the USA (Folsom-Meek & Rizzo, 2002; Folsom-Meek et al., 1999; Rizzo, 1984; Rizzo, 1985; Rizzo & Kirkendall, 1995).

Each ATIPDPE item is accompanied by a 7-point scale, as recommended by Ajzen (2000). The scoring system required use of two 7-point scales: a) 1 to 7 for the likelihood construct, and b) –3 to +3 scale for the evaluation construct. Scores for each statement were then multiplied to create item belief scores as shown in TABLE 1. The results of multiplication were summed up and thereafter referred to as the Summative Belief Index (Attitudinal Score).

Much research has been conducted outside of adapted physical education that uses this or a similar scoring system as well as this terminology (e. g. Baker, Morrison, Carter, & Verdon, 1996; Yordy & Lent, 1993). The scoring systems and logic of those studies applying the recommendations of Ajzen (2000) were followed.

Data Analysis

Data were analyzed using SPSS PC 10.0. First it was necessary to determine if there were significant differences in the TPB components between females and males and among students in different years of study. A one-way ANOVA revealed that there were no significant differences between the groups. This finding provided the justification for combining data for gender and year of study in the subsequent data analysis. Principal component analysis was used because this procedure analyzes all variance in shared variables and was used in a comparable study of attitudes by Folsom-Meek and Rizzo (2002). The Kaiser measure for sampling adequacy for this study was .77 which was above the recommended minimum .60 (Tabachnik & Fidell, 2000). Components were required to have eigenvalues above 1.0 to be included.

RESULTS

Based on analysis, the attitudinal scale of ATIPDPE measures III psychological properties (components). Detailed information on means and standard deviations of each item can be found in TABLE 2. Three components drawn from principal component analysis explain more than 65 % of the variance. The three components are: a) positive outcomes for students, b) negative outcomes for teachers, and c) negative outcomes for students.

TABLE 3 depicts component loadings of the 10 items, each of which was loaded higher then the .40 cut off point. Most items showed excellent loadings (Above .73), with one item loading on .64 (item 6) and one item loading on .56 (item 8).

TABLE 1
Sample Item from the Attitudinal Scale

Behavioral Belief (Outcome Belief)
Likelihood
Including students with physical disabilities in my PE class will help students without disabilities to learn to interact with persons with physical disabilities.
Extremely Unlikely Outcome : ___1 : ___2 : ___3 : ___4 : ___5 : ___6 : ___7 : Extremely Likely Outcome
Evaluation
Students without disabilities learning to interact with persons with physical disabilities is an:
Extremely Bad Outcome : ___1 : ___2 : ___3 : ___4 : ___5 : ___6 : ___7 : Extremely Good Outcome

TABLE 2
Description of the 10 Items on the Attitudinal Scale of ATIPDPE with Means and Standard Deviations

Component/ item #	Description	M	SD
Positive outcomes for students			
1.	Including students with physical disabilities in my PE class will help students without disabilities to learn to interact with persons with physical disabilities.	15.60	5.64
3.	Including students with physical disabilities in my PE class will encourage students to learn to help others.	16.87	4.52
5.	Including students with physical disabilities in my PE class will teach students greater tolerance.	15.58	4.84
6.	Inclusion will have a positive effect on the development of the personalities of students with physical disabilities (e. g. self esteem, feeling of belonging, etc.).	16.08	4.99
9.	Inclusion will cause my students to have better knowledge about persons with disabilities.	16.91	5.30
10.	Including students with physical disabilities in my PE class will teach students cooperation.	16.39	4.68
Negative outcome for teachers			
2.	Including students with physical disabilities in my PE class will make teaching physical education more difficult.	5.31	8.16
4.	Including students with physical disabilities in my PE class will make lesson planning and preparation much more difficult.	4.81	8.71
Negative outcome for students			
7.	Students with physical disabilities will experience discrimination in my regular physical education classes.	–8.71	4.66
8.	Students with physical disabilities will slow down instruction and progress in my PE class.	–4.87	6.37

Note: Scores of all items are based on multiplication of the evaluation and likelihood of beliefs about the outcomes of the inclusion of students with PD in general PE class. The possible range of scores for each item is from –21 (–3 on evaluation and 7 on likelihood) to +21 (+3 on evaluation and 7 on likelihood)

TABLE 3
Component Loadings, Eigenvalues and Percentages of Variance Using Principal Components Extraction With Varimax Rotation for Total Composite Scores

Item #	Varimax Components		
	1	2	3
Positive outcomes for students			
1.	.73		
3.	.83		
5.	.78		
6.	.64		
9.	.78		
10.	.81		
Negative outcomes for teachers			
2.		.90	
4.		.91	
Negative outcomes for students			
7.			.86
8.			.56
Eigenvalue	3.58	1.86	1.07
Percent variance	35.31	17.85	11.92

DISCUSSION

The purpose of this study was to discover the structure of the attitudinal scale of ATIPDPE by finding components of this scale using principal component analysis and to compare these to the components of Folsom-Meek & Rizzo (2002). Prospective PE teachers seem to be evaluating the possible outcomes of inclusion (Ajzen, 2000) as both positive and negative. Negative outcomes are divided into outcomes affecting teachers (teaching and preparation being more difficult) and outcomes affecting students (students with PD and students without disabilities). It is interesting to notice that the results of negative outcomes for teachers were not rated as bad outcomes (minus scores) rather they were evaluated as not so good outcomes, suggesting that respondents were likely to respond in a socially desirable way.

We must acknowledge that the study by Folsom--Meek & Rizzo (2002) used a different instrument, PEATID-III in a different cultural environment then we did. Therefore it is not possible to compare each and every item or component. However we must highlight some similarities of both studies. Folsom-Meek & Rizzo (2002) has 6 items in the first component (Outcomes of teaching students with disabilities in regular classes). All outcomes are negative, apart from the item, which, based on Ajzen (2000), should not be included "Students labeled _____ should be taught with nondisabled students in my PE classes whenever possible". Component two (negative outcome for teachers) and three (negative outcome for students) from our study are comparable to Folsom-Meek & Rizzo's (2002) first component. Folsom-Meek & Rizzo's (2002) second component (Effects on students' learning) include four positive items, which are comparable to six items from our first component (positive outcomes on students).

If we consider the fact that two instruments (PEATID and ATIPDPE) were developed by two separate pilot studies, where researchers have asked respondents to list possible outcomes of the inclusion of students with PD in general physical education classes, in two different countries with different states of inclusion, the similarities of the results are surprising (For differences in scoring of these instruments, see Kudláček et al. 2002). In relation to ATIPDPE, we suggest reevaluating instruments and considering the inclusion of more items representing the negative outcomes of inclusion. The inclusion of more negative outcomes might help us to better understand the phenomena of inclusion in physical education.

REFERENCES

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*, 179–211.

Ajzen, I. (2000). *The construction of a standard questionnaire for the theory of planned behavior.* An unpublished manual for the construction of questionnaires.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting behavior.* Engelwood Cliffs, NJ: Prentice-Hall.

Baker, S. A., Morrison, D. M., Carter, W. B., & Verdon, M. S. (1996). Using the theory of reasoned action (TRA) to understand the decision to use condoms in an STD clinic population. *Health Education Quarterly, 23(4)*, 528–542.

DePauw, K. P., & Goc Karp, G. (1990). Attitudes of selected college students toward including disabled individuals in integrated settings. In G. Doll-Tepper, C. Dahms. B. Doll, & H. von Selzman (Eds.). *Adapted Physical Activity* (pp. 149–158). Berlin: Springer Verlag.

Downs, P., & Williams, T. (1994). Student attitudes toward integration of people with disabilities in activity settings: A European comparison. *Adapted Physical Activity Quarterly, 11*, 32–43.

Folsom-Meek, S. L., Nearing, J. R., Groteluschen, W., & Krampf, H. (1999). Effects of academic major, gender, and hands-on experience on the attitudes of preservice professionals. *Adapted Physical Activity Quarterly, 16*, 389–402.

Folsom-Meek, S. L., & Rizzo, T. L. (2002). Validating the physical educators' attitude toward teaching individuals with disabilities-III (PEATID-III) for future teachers. *Adapted Physical Activity Quarterly, 19*, 141–154.

Hodge, S. R., & Jansma, P. (1999). Effects of contact time and location of practicum experiences on the attitudes of physical education majors. *Adapted Physical Activity Quarterly, 16*, 48–63.

Kowalski, E. M., & Rizzo, T. L. (1996). Factors influencing preservice studentattitudes toward individuals with disabilities. *Adapted Physical Activity Quarterly, 13*, 180–196.

Kudláček, M. (2001). *An attitude toward an inclusion instrument based on the theory of planned behavior for prospective Czech physical educators.* Doctoral dissertation, Texas Women's University, Denton, USA.

Kudláček, M., Válková, H., Sherrill, C., Myers, B., & French, R. (2002). An inclusion instrument based on planned behavior theory for prospective Czech physical educators, *Adapted Physical Activity Quarterly, 19*, 280–299.

Michalík, J. (2000). *Školská integrace dětí s postižením.* Olomouc: Vydavatelství University Palackého.

Rizzo, T. L. (1983). Attitudes of physical educators toward teaching handicapped pupils. Doctoral disser-

tation, University of Illinois at Urbana, Champaign, USA. *University Microfilms International*, 8324631.
Rizzo, T. L. (1984). Attitudes of physical educators toward teaching handicapped pupils. *Adapted Physical Activity Quarterly, 1*, 267–274.
Rizzo, T. L. (1985). Attributes related to teachers' attitudes. *Perceptual and Motor Skills, 60*, 739–742.
Rizzo, T. L., & Kirkendall, D. R. (1995). Teaching students with mild disabilities: What affects the attitudes of future physical educators? *Adapted Physical Activity Quarterly, 12*, 205–216
Schmidt-Gotz, E., Doll-Tepper, G., & Lienert, C. (1994). Attitudes of university students and teachers toward integrating students with disabilities in regular physical education classes. *Physical Education Review, 17(1)*, 45–57.
Tabachnick, B. G. & Fidell, L. S. (2000). *Using multivariate statistics* (4th ed.). New York: Harper & Row.
Theodorakis, Y., Bagiatis, K., & Goudas, M. (1995). Attitudes toward teaching individuals with disabilities: Application of planned behavior theory. *Adapted Physical Activity Quarterly, 12*, 151–160.
Válková, H. (1998). Education of adapted physical activity professionals in the Czech Republic. *Studies in Physical Culture and Tourism, 15*, 51–55.
Yordy, G. A., & Lent, R. W. (1993). Predicting aerobic exercise participation: Social, cognitive, reasoned action, and planned behavior models. *Journal of Sport and Exercise Psychology, 15*, 363–374.

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STRUKTURA POSTOJŮ K INTEGRACI ŽÁKŮ S TĚLESNÝM POSTIŽENÍM V TV V DOTAZNÍKU ATIPDPE U BUDOUCÍCH UČITELŮ TV V ČESKÉ REPUBLICE

(Souhrn anglického textu)

Cílem této studie bylo prozkoumat strukturu postojové škály dotazníku ATIPDPE, který je založen na Ajzenově (2000) teorii plánovaného jednání (Theory of Planned Behavior), a porovnat ji se strukturou dotazníku PEATID (Folsom-Meek & Rizzo, 2002). Této studie se účastnilo 145 budoucích učitelů tělesné výchovy (70 žen a 75 mužů) průměrného věku 21,19 let. Analýza postojové škály ATIPDPE poukázala na tři psychologické ukazatele (komponenty). Zmíněné tři komponenty, které vzešly z analýzy základních komponentů (principal komponent analysis), objasňují více než 65 % variace. Tři komponenty jsou: a) pozitivní důsledky pro studenty, b) negativní důsledky pro učitele, a c) negativní důsledky pro studenty.

Klíčová slova: integrace, tělesné postižení, postoje, aplikovaná tělesná výchova.

TO THE ISSUE OF THE PHENOMENON CALLED FREE TIME

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There is no doubt about the term "free time". The problem which is expressed by this term can be met in kinanthropology studies as well as in concrete projects which are carried out. It is also a philosophical, sociological, psychological and pedagogical problem. Each of the mentioned disciplines often understands "free" time rather differently and even, oftentimes, there are certain discrepancies within one discipline. Knowing this reality, a Czech-Slovak-Polish symposium was organised at the Faculty of Physical Culture in Olomouc and it aimed to discuss these problems and the result was an impeachment of this term. This article is based on a personal approach presented at the symposium and then completed by adding some of the thoughts of other discussion participants.

Keywords: time, free time, liberty, freedom, phenomenology, lifestyle.

When studying the literature concerning free time, we find two concurrent directions going side-by-side. First, the same, similar or even a different understanding of "free time" has existed for many years and, on the other hand, preferably in recent years, there has been a certain impeachment of this term. At the beginning I must admit that I belong among those people who endorse this impeachment even if some of the definitions I undertook some years ago belong to the first category.

From some characteristics it seems that "free time" was followed by itself without knowledge of any relations existing whatever, as it was entirely purposefully abstracted and, on behalf of "liberty", given as contrary to "submission". It is evident that we cannot speculate about free time without realising at least, particularly, the problem of time itself. The point is not to deal with different philosophical theories of time and their comparison, but to compare some thoughts about "time generally" as opposed to "free" time.

Time belongs among the fundamental problems that philosophy has studied from time immemorial because it is a problem that is connected with our lives essentially. In his speculations about time in connection with free time Jirásek (2002, in press) thinks over three basic dimensions of "time":

– *Past time* according to him is emphasised preferably by mythic views to a "golden age" when everything was perfect. In this context he cites Hésioda (1976, 13): "… not otherwise did they live than Gods and they did not have worries in their hearts They were without work, without adversity and woes; not even shabby old age did they know; forevermore having the same hands and feet, they enjoyed the richness of everything, evil did not touch them". He sees the same emphasis on past time in Confucianism in that it impersonates a view to traditions. In philosophical speculations, according to him, past time does not play such a strong role as other time periods. It is maybe because that time does not exist anymore and that's why we do not empower it. From transpersonal psychology of Jung or existential analysis of Heidegger result so simply that past time cannot be written off. Past time is always somehow involved, grounded, displayed in present time (but also in the future).
– *Present time* is, according to him, accented in a prephilosophical intellectual tradition but to the greatest extent in Buddhist idea circles. Not only experience but even fully conscious experience is the assumption of Buddhist meditation. It is a condition of personal development according to Buddha's concept. It does not regard only spiritual spheres – full concentration and full awareness concern whatever activity we do. The Buddhist full possession of any random phase of experience is, for present western civilisation, characterised by speed and continuous accentuation of the future. They are very distant and in conflict. Despite this fact, also in the philosophical tradition, the moment of present time is emphasized – in Husserl's thinking – standing as a point from which our experience streams out.
– *Future*, a respective perception of the future is, according to him, the most evident in Christianity, at its clearest in the concept of salvation. The Future and its evaluation can be devoted to other time levels. The Present time is only a preparation for the future, only this is vital. Everything which is going on "now" is a narrow-minded exam for what a Christian will be awarded in eternity. Next to this

he mentions Heidegger according to whom the future is an open possibility we can plan. It is a challenge and chance for anyone – to plan the field of possibilities we command in order not to limit our experience only for the obtaining and accumulation of material property, but in order for our existence to be authentic.

From this brief description it is evident that these "time levels" themselves, their concept, their mutual diffusion, bring us many problems which are to be solved on different levels. The problem of "time flow", the way in which each time level gradates into the other, is also connected with these "time levels". It is not possible to reflect all these problems in understanding of "free time" and not to incorporate them with its expression.

History of philosophy brings us a wide range of authors for whom "time" became a problem they tried to solve. In connection with this it is possible to name many names that are adherent to the problem from the deep past up to the present time. To interpret their opinions and to compare them is not an aim of this article. I suppose that at least for comparison it is suitable to present several opinions, historically very distant. Aristotle, considered as the most systematic thinker of the ancient world, perceives *time as objectively existing, not dependent on us. Time withal always coheres with motion and space. He speaks about the continuity of motion as well as the continuity of time. He supposes that time is calculated motion with regard to "before" and "after"*. Plotinos also presents time in connection with motion, shifting it into a more abstract level and comprehending it as the *"life of the soul in motion"*. St. Augustine has a totally different opinion and he refuses to recognize a relationship between time, motion, and space. He regards time as being absolutely independent but also connected with inner human experience. He works with past and present time as well as the future. He concludes that *time can't be anything other than "range" but he doesn't know the range of what, maybe of the soul itself*.

Even if it is interesting for us to follow the development of these old thoughts, after all, regarding our time, it is more expedient to follow the development of contemporary opinions. With regard to the possible range of this article it is not possible to study the philosophy of time in detail but it may be useful to at least encapsulate some fundamental thoughts. Time vanishes in them as "space" that is filled with something. It is "experienced". It is an interesting opinion of Bergson, according to Jirásek (Hodaň, in press), that he operates with *temporality*, rejects the prevailing quantification and emphasises the qualitative characteristics of temporality. *"Time does not demand to be pictured but to be lived."* (Bergson, 1947, 150). He concludes that the only possibility as to how to avoid identification of time with space is to give up splitting time into particular sections and adopt experienced temporality during its lasting. Husserl in his speculations does not speak about time because he doesn't know any arguments for vindication of time and he doesn't see any possibility for verifying the existence of "objective time". There is no reason to speak about "time" but about time consciousness or experience. And this fact complicates the situation because "time experience" is continuous, fluently converting from "past" to "future" without any strict demarcation. So in "present time", that is practically the only moment or point, we have in mind regarding the past (retention) as well as the future (protention). The one, at the same time, converts fluently into the other and is perceived as presence in the sense of just now, at the moment. Heidegger reassumes these thoughts and relates them to the temporality of our being. He perceives it as the categorical determination of humankind, that means that *temporality is a possibility of how humans can exist. "Temporality is neither existence (…) it produces possible ways of itself. These then enable a diversity of modes of being preferably the basic possibility of authentic and non-authentic existence."* (Heidegger, 1996, 360). From the mutual bounds of the past and future he then deduces that humans are directed into the future (but the future is determined by the past). The future is fully open for whatever possibility of expression of our relationship toward our own existence, our own being.

Time is something that is lived, experienced. And experience of time cannot be other than very diversified, amply structured because it is determined by many subjective and objective determinants. In agreement with what is mentioned above, Patočka understands time *as the unified function of "expectation, remark and withholding of existence"*.

In all mentioned cases "time" vanishes, becomes something abstract, ungraspable and is basically replaced by terms such as sense or experience (of something), life, being, existence. In all cases everything realised, lived, experienced is very relative and concededly connected with biological, psychological, societal, cultural and other factors – also sense of something, experience of something etc. is for everybody differently intensive, anew important, differently interesting, which very much influences the perceiving of the "length" of this lived process. Even with different approaches of the several authors stated, it is evident that they have something in common. The term time (that is basically ungraspable) limits some abstract, inwardly considering "flow" (thus no space), without some other specification (it is possible only with the use of established "time units"). It evidently concerns "flow" that is fully and individually perceived, experienced, and lived. It is something that was, is and will be, from the point of view of our individual life, more likely what was and will be, thus something that constantly flows and we cannot hold it back and thus generally do not "possess" it.

Most of us see "time" quite practically. Apart from above-mentioned speculations, time is for us a sort of concrete, in established time units, expressed space

"from-until" that we have got (sensationally we often do not have) at our disposal so that we could achieve something particular.

Eigen in this connection talks about time as about something that *we miss when many things happen*. We perceive thus time as abstract "space" for doing some activity that is full of it or "space" that indeed exists but has stayed, thanks to our inactivity underflow (or "filled" with inactivity). The relativity of the size of this space, followed by the "length" of percieved time, is dependent on this difference. In this concept time becomes wrongly space or even only a certain possibility related to a certain particular activity (or inactivity). From the relation between time and the practical activity of human beings follows, in addition to the basic philosophical concept of time, a sociological concept as well.

The well-ordered design of the history of the sociological comprehension of time is presented by Čihovský (Hodaň, in press). One current study dealing with the sociological concept of time is Šubrt's study (1993). In its introductory part he says that *"by influence of education that we received, most of us understand time as something that is purely quantitative, without features, evenly and regularly and constantly – second by second – flowing, curtly as some sterile form, or one of the abstract co-ordinates that measure our life and connected phenomena. It is a vision arising from Newton's view of the world…."* This opinion, starting from a wrong understanding of time as "space for activity", is not as simple as it seems to be on first sight, but develops into several dimensions. Time is a term that expresses infinity and indefiniteness. "Time" was, is and will be regardless of us. "Time" is also a term that we introduced in order to somehow structure our activity. And in such interpreted time there exist radical differences. Natural people, even farmers, understood and, up until now, understand time preferably in connection to changes of seasonal periods, change of day and night, etc. These "time periods" fluently converting from one to the other, have determined the rhythm of his activity as well as his life. From the point of view of the "rationalisation" of human activity, this objective rhytmisation was insufficient, so we derived, from this, "precise" time measurement. We are able to measure its flow relating to our activity not only "second by second" but even more precisely. It happened that time as infiniteness changed into something finite, into something that has got a beginning and an end and thus, also of different length. And just the "length" of time determined by us appears to be the space we have at our disposal and that we fill with some activity. And an impression, an image or the following experience of this length can serve as necessary orientation points. But the "length" of time is individually different. It cannot be, naturally, the length that is objectively measured, but the "length" subjectively perceived. This one of course does not result only from our subjective perception determined by the strength of experience connected with activities by which given time space is filled up. Objectively it is also significantly connected with a change of speed, the deceleration of physiological processes dependent on age (the older we are, the more quickly time "passes"). On one hand time expresses infiniteness, on the other hand, in relation to a particular individual, it expresses finiteness. This one is basically given by birth and death. That is the particular, limited "space" that an individual has got at their disposal even if he without information about its size. Flow of time within these limits and thus the speed of its flowing and also the reducing of dispensable space is various and relative regarding particular events. Regular interruption of the continuity of time flow ("respect Sunday"), interruption by meaningful days, vacancies, etc. is connected with this. The speed of "time running" directly corresponds to the perceived reduction of dispensable space, generated from a feeling of its accelerated "tossing" (feeling of a lack of time, the reduction of space in relation to the number of missing targets in relation to age, etc.).

We can continue in these and similar speculations of course, but it is not the aim of this article. It results from them that as to the term of time and regarding what it expresses we hardly can add any adjectives and distinguish thus one "time" from the other "time". Šubrt in the above mentioned study on the basis of studying the works of several authors assigns to time a different function – he speaks thusly about *time as an expression of the rhythm of collaborate life, as a formal condition for nationalisation, about the relation of time's constitution and human conduct, about the social meaning of time and its structure and level, about time's function in system theory as well as social theory*.

It seems to me that similar approaches are more acceptable than attempts to "distinguish" time into different types.

From this more general speculation let's shift to the problem of "free time". Why are added to this term "time" some adjectives causing this time to somehow be set apart from time itself? I suppose that it is preferably connected with the organisation of human society, respectively its prevailing parts. If of course its structure and linked organisation were for long decades or even centuries very little variable or even constant for a long period, this cannot be said about the present time.

The term free time is not, understandably, a new term, even if it may seem, in our hectic present day, to be an ever-increasing problem. We can find the first mentions of free time in ancient society, connected with the content of the known term "scholé" that is described by Čihovský (Hodaň, in press). A characteristic feature of society and thus also of Aristotle's conception was, according to him, an *"…enhancement of intellectual activity (philosophical discussion) over handmade work. For Aristotle the peak of the highest human felicity is meditative activity of a hedonistic kind that satisfies. Meditation leads one towards wisdom, and self-reliance and is a delight just for its inner value that*

does not aim at any practical target. This meditation is done within one's free time (scholé). Old Greeks regarded free time as the extent of human happiness. Aristotle in his "Ethic Nikomach" attributes meditation with having the highest value and as a sainted activity and refuses not only physical work, amusement and play, but even political activity. Free time he understands as time for philosophising, reading poems, meeting friends, listening to music. It is time for science and philosophy and for serious things. It doesn't have anything in common with dolce far niente, lounging and boredom. Scholé was music, philosophical speculations and profound discussions. There were the dramas of Aischylos, Euripidus and Sofokles as well as the mystery of geometry. It was time for developing a talent for enjoyment. There was no plan for material profit and the only purpose was to resemble the gods. Freedom meant that one did not have to work and went in for leisure time". Aristotle's conception of free time (filled with leisure activities) is very interesting (and from the present point of view very inspiring). Freely interpreted, Aristotle appeals to freemen that *they have free time in order to use it for their improvement, for reaching higher and higher levels and, for this reason, they have the right to vote and citizens as voters have the right to vote for the best people among them*. Thus free time is understood as a space for self-improvement which means an individual improvement for the good of a village. The political aspect expressed is also interesting. Probably just thanks to this "function" of free time the term "scholé" did not penetrate into European civilisation as an expression of free time but became, on the contrary, the *"…etymological root of all contemporary expressions for school – as a place and obligation to learn"* (Hodaň, in press). Even if this concept is interesting and inspiring, it is not our task to deal with the historical development of opinions. For us our present time is more interesting and important because it is so different from history.

We can say that most contemporary opinions and "definitions" come from Dumazedier's formulation. As is known he *conceived free time as a complex of activities beyond working, familiar and social engagements. Individuals deal with their own free will in order to relax, enjoy or freely improve their own creative capacity*. (i. e. the possibility to fill free time with leisure activities.) It's interesting that he gets out of whatever expression of "time", a certain "space", but immediately he fills this supposed (anticipated) space with a "complex of activities". Those activities have got the character of non-commitment, free decision, without being linked to some duty. The directivity of these activities is towards regeneration, amusement and personal development. This basic characteristic from which many others start, entirely corresponds with the character of the era during which it is set and so, preferably, the level of technological development everything starts from. This era corresponds, for most people, with determining precise limits of working hours, without the possibility of making a shift, or the "plasticity" of these limits. There is an evident fundamental discrepancy between work and non-work, as well as between work and relaxation or work and experience (enjoyment), etc. The character of corresponding social roles is understandably connected with this. Regarding these (and many other) facts it is understandable that in the prevailing group of people, precisely limited time sequences originated as spaces for activities of a totally different kind. Apart from these objective conditions to which the definition reacts, it seems to me that certain discrepancies are hidden there. "Working engagements" can be regarded as strong, in a given era mainly strictly time limited, moreover bringing economic profit so that one is de facto economically obliged to fulfil these engagements. "Familiar engagements" have got, on the other hand, a totally different character. Even if the vast majority of people accepts them, they are based on the free decision to start a family and fulfil these engagements. But their fulfilment has got a different character than fulfilment of working engagements and they are not limited by any economic effect. Also "societal engagements" are not connected with economic effects but mainly, only in a smaller part of the population, they are more or less directly connected with social role. For the vast majority of the population, these engagements are accepted absolutely optionally, on the basis of free decision. The author presents his own free time in contradiction to all these "engagements", activities carried out within it he regards as wholly "free", aimed at relaxation, amusement, respectively the improvement of one's own capacity. Here a question arises – to what extent "free" is the decision to relax if it is almost a physiological necessity? And further – is an individual decision "to develop one's own creative capacity" truly free or is it, as related to social role represented, a basic individual societal (thus "human") necessity? At the present time, tens of definitions or characteristics of "free time" exist. Mostly they come from the cited definition by Dumazedier. For illustration I would like to introduce some of them.

Spousta (1996) understands free time as quantity for which a *mark of freedom is characteristic* whereas its value obtains only *as a rate of working or out-of-working activity*. Basically it is the same as what has already been said. Slepičková (2000) regards free time as an *era or time sequence in which an individual does not have any duties and which, on the basis of his own decision, he devotes only to chosen activities that he enjoys, which make him feel happy and satisfied, although sometimes he may be worried or frightened*. To a certain degree she leaves Dumazedier, arises from basic segmentation into "compulsory" and "optional" activities, reasons about independent decision and, typically, she presents, which is interesting, only activities that have got a character of positive experience. A further definition that Spousta (1996) presents understands *free time as a residual* (in agreement with Dumazedier) that remains after fulfilment of all duties – working, academic, familiar and even after satisfaction of all physiological needs. Filipcová (1966) regards *free time*

as the world of activity by choice when one "may but doesn't have to". Maeranová according to Šípek (2001) perceives *free time as some gap in time, as moments for situations that are freely voted for*. The *factor of freedom* stays here as basic without other specification. Spousta (1996) further states that free time is for most of the authors defined by fundamental functions as *relaxation, amusement, and personal development*. These authors thus quite evidently arise from Dumazedier not only in the mentioned functions (for the leisure activities) but also in the concept of a "residuum" of free time. In a rather old publication Spousta (1994) concludes that, into free time, only *mimetic activities* (visiting cinema, sports events etc.) should be counted, those which offer *"alternative" excitement as compensation for the monotony and non-excitement of our present life*. With this opinion of monotony and non-excitement we can, of course, argue. Free time is yet interestingly interpreted as breaking away, liberation from "normal" life, as entrance into space that is absolutely out of perceived reality. Even if I find this concept to be sympathetic, *it expresses free time as non-intentional fulfilment of emptiness* to which, after all, we may have certain objection. Does this concept not have the character of satisfaction of one of the important psycho-physiological needs? I suppose that it has. And also in this case there is necessity as well as directivity, but unconsciously. Characteristics mentioned elsewhere under the same title (Spousta, 1994) have got completely opposite features, according to which *free time is considered as an immense value resulting from the unlimited possibility of each human being to return to his full authentic life, think about values, realise their threat and go in for their liberation*. This is an absolutely inverse concept regarding the previous one and controverts it. It shifts free time into the sphere of "spirit" or even "intellectual", it skips the individual as such and orients free time to the societal field. It seems to me as a return to Aristotle's concept even though, on one hand, reduced, but, on the other hand, enhanced in its directivity. Meisner according to Spousta (1994) *doesn't regard free time as either idleness connected with boredom nor recreation*. From this negative limitation obviously results the directivity to development of an individual for several of the time frames mentioned above and that's why refusing recreation is surprising (maybe its sense is not fully understood). A further mentioned characteristic (Spousta, 1994) defines free time as *space for all activities that should be oriented to development of one's health*. Partially, there is agreement with some previous opinions, the problem may be the concept of health that is not defined here. The mentioned directivity can be very distinctly changed according to one's understanding of health. Directivity to a person emphasises also other Spousta's (1994) mentioned characteristics according to which free time is understood as *optimal social space for self-development of a person also in the creativity field*. Šípek (2001) in other text states that *free time is a psychological space in which one gets closer to oneself and where one can freely produce, create, modify, clearly imagine who one is, what one wants and what will be, where to go, etc.* Free time here again occurs in the "intellectual" field and we award it together with certain arbitrament with a quite fundamental life task – searching for the sense of life. It is also in radical conflict with most other characteristics. Piepper (1992) presents an interesting characteristic when he regards free time as an *inner state of the soul*. Free time at the same time he labels as a *"vacuum" ("nothingness")*. This definition seems at first sight to be extensively vague but preciously gives a true picture of the large diversity and individuality of its understanding. Šípek (2001) states to the given topic that *terminologically it is not sufficiently clear what the difference is among free time, relaxation time, vacancy and recreation*. According to Teplý (1971) *free time is the time that an individual has got at his or her own disposal quite freely, it remains after fulfilment of all engagements and each individual brings it into being through his or her own hobbies, interests and needs*. It is also about residual time (Dumazedier), the empire of freedom and directivity to each individual. During critical comparison I cannot dismiss my own approaches to free time that gradually developed into an opinion that *free time, from the point of view of an individual, provides a space for relaxation, amusement and development of each human being, from the point of view of society then, space for regeneration and development of the work force as well as forthe universality of the individual*. *Freedom of decision and total economic independence* are regarded as characteristic features. *Individual, societal as well as political aspects of leisure time are mentioned and developing, regenerative and experience functions are specified* (Hodaň, 1997). Even if the problem of free time is described multilaterally with different bounds, after all it is evident that Dumazedier's conception cannot be denied – time as *residual, freedom of decision, personal development*. On the basis of the phenomenological analysis of time, freedom and liberty Hlavinka (Hodaň, in press) states that *"… in so called 'free time' interpreted just as this residuum after subtracting work, sleep and necessary relaxation, one often gets into tuning of anxiety or boredom. This setting, according to Heidegger, opens the personal nothingness of staying for his living in the world. They reveal to him, for one thing, his mortality in the tuning of anxiety and for another thing, the absurdity of failing existence in the tuning of boredom. This tuning then, 'psychologically' said, leads to feelings of emptiness that result in the need of dispersal or fulfilment of that residual – free time. Commonly one takes free time if one's regenerating forces let him as a space for searching for experience that should be pleasant. The so-called degree of living standard in modern countries is given by the degree of liberation from the load of necessary work and maximal satisfaction through pleasant experience. (…) Everything that is led by optics on how to live or the most beautiful 'killing' of time results in their collections. (…) Into the blind street of self-immolation, obtaining*

leads also to the use of free time only for regeneration and relaxation because of reinforcing the new workforce for other necessary work. These ways of spending free time are Nietzsche's said willpower, meant for us as will for strong or comparative experience. (…) Thus it is possible to trace how be it only model hierarchical structures of the human soul, it is also possible to observe, sometimes more markedly, societal stratification from the point of possibility to have available one's own time, it means one's own life (…) human society is temperamentally structured just by the possibility of living in the truth of one's own destiny. (…) From the facts so far, it should be clear that liberation, staying within 'free time' par excellence, is, only at this certain present time, thus out of time (…), it is in this way always when the mind calms down and we meditate. To understand this will happen if the inert mind passively gets lost in a given task in the present here and now".

From the thus-far-mentioned brief comparison, it follows that we may distinguish two trends in the development of the understanding of free time. The first, which I would say is fundamental, continues in the line of Dumazedier, which it copies or more or less develops (free time is filed with leisure activities – leisure time). The second direction seems to be less frequent. It delimits from this line and, to some extent, non-systematically apart from Dumazedier, brings us some new possibilities. New opinions appear and they deconstruct the previous ones. In my opinion, it is positive and necessary.

From what does this necessity of deconstruction follow and on what basis do new opinions appear? It is necessary to fundamentally philosophically and sociologically analyse the whole problem. There are also basic changes that happen during the development of society. Human life and its structure and content always react to changes of environment, to the changes of social roles as well as their contents. If we compare particular societies (pre-industrial, industrial, post-industrial, informative etc.), gaps are evident that touch the very foundation of life. (Also in the present development stage there exist, on the one hand, societies that speculate, for example, about the issue of free time, while, on the other hand, there are societies that are forced to speculate about the fundamental problem of surviving.) Technological advancement and related work concepts are, for sure, connected with these differences (related to the discussed problem of "free time"). Then different structures of working activity are connected to this – while before there was an absolute majority of working activities timely and spatially linked, activity half-free as well as free occur more often. These are limited by each particular task but fulfilment is dependent on individual decision when and what will be carried out. Thanks to all these changes, work is not necessary and unpleasant duties which result in obtaining means for satisfaction of necessary needs of humans but, more and more, is connected with experience, enjoyment, can, in many cases, be considered to equal a hobby, and so sometimes there exists the problem of "workaholics". In the definitions used so far as we showed before, experience (enjoyment) is connected preferably with, perhaps even exclusively, free time. But not only changes regarding possible experience (enjoyment) of working activity induce doubts about free time as thus far interpreted. This is so far perceived as the only possible space for personal development (on the basis of the thesis that all activities in other times are directed from outside of the dealing person while activities practised in free time are oriented to the dealing person – thus each of us takes care of ourselves). A new concept of work, especially creative work, or work as a hobby, provides at least the same space for individual development, the result of work and personal development are in mutual relationship and dependent on each other. From this point of view the discrepancy between work and non-work starts to vanish.

Education is based on personal development and it is not only the problem of free time. In case of work and personal development relations it is necessary to count on large differences, ranging from monotonous work of a mechanical character (eg. manufacturing) up to totally free creative work. From technology development it is evident that this monotonous mechanically and physically demanding work is less and less.

Free time is connected with independent decision (but this one is connected with free, creative working activities). But also here a problem appears. Whatever independent decision for activity in free time may consequently bring and mostly brings is duty. This duty is connected with performance of what an individual has independently decided and is the bigger the more regular is the activity, and linked with other people with whom it is jointly carried out.

In many definitions, especially those that regard free time as residual time, it appears that it is time liberated from satisfying all needs, including biological ones. But this is reduced only to those needs for which satisfaction is obtained by means of working activity. Of course, a large number of biological, mental as well as social needs are satisfied just by these "leisure-time" activities which are performed in "free time". And especially biological needs penetrate throughout our lives and they cannot be referred into just one field.

On the basis of this deconstruction, in which it would be possible to continue, it is also possible to formulate several other discrepancies and questions as well.

– Theses conditioned by definition – *"free time is liberated from all duties", "free time is the only space for personal development"* (which was doubted above). If I start from the basic thesis that human life (given to each of us) is the highest value from which other values are derived and then continue based on this, I have to also say that our basic "human" duty is to take care of this value (thus maintain and enhance it) not only for our own benefit, but also for society's. It is possible to say

that *personal development is a fundamental "human" duty and it is not dependent on independent decision*.

- Thesis conditioned by definitions – *"activities in free time are economically independent"*. Higher working performance, quality of work, lower valetudinarianism, etc. is the result of personal development and without doubt it can bring an increase of economic effect. The already mentioned independence doesn't entirely count. Further – two entrepreneurs during a golf match agreed on a business deal involving millions. What is it? Free time or working time? It means that so called *"free time" brings as its consequence an economic effect, sometimes arranged*.
- Thesis conditioned by definitions – *"free time is oriented to relaxation, regeneration…"*. During the time-limited working process, it is interrupted by rest breaks, a social break for coffee, exercising in the company's fitness centre, etc. Lately psychologists recommend even a doze. All of this happens during working hours for the purpose of working performance enhancement. Are these activities realised only on the basis of "independent decision" or on the basis of feeling that "I already need it"? And are these activities regarded as leisure-time activities (in one's free time) even if they are done within working hours? *The discrepancy between work and relaxation vanishes.*
- Thesis conditioned by definitions – *"free time is the time that remains after fulfilment of all the duties of working and off-duty time"*. The structure of these "times" is understandably different in working, retired or unemployed people. *Does free time (and leisure activity) concern only working, or also retired and unemployed people?*

One more note to this thesis. In the carried out research (Hodaň, 1988) that dealt with the problem of free time and leisure activities, it was found that *free time is not a result of simple subtracting from working and off-duty time*. The largest share in leisure activities, thus also the largest space of so called free time, was found in employed women aged 25–35 years. Thus in the period when they are objectively the most burdened by working, household duties and care of children, etc. *"Free time" thus is not an objective category (originated by simple subtracting) but a subjective category dependent on individual needs, preferred values etc.* A confirmation of this is the fact that free time is generally relatively dependent on sex, age, education, occupation, residence etc.

From the above mentioned facts, it is evident that the discrepancies mentioned, as well as the questions that arise from them, will be different according to social class, professional role, age, health, education, value orientation of interests, etc. The range of criteria appears to be crucial. From all the mentioned and non-featured definitions it follows that free time is contrasted with and determined in relation to other times – working as well as off-duty. Even some discrepancy may arise, since there is an effort towards a certain degree of generalising that results in a new polarity – necessary time versus free time. What characterises this necessity? It will surely be individually very differentiated and if we want to define a common space of "necessity" for all members of the human race, we might come to the several most fundamental biological needs. And it would be for the purpose of understanding of free time surely very little. The terms "disposable" and "non-disposable" time are built on a similar polarity. From the point of practical specification of "time" and perceiving of time, we may say that all time in its entirety is disposable. Thus its disposable character or its inversion are again dependent on some accepted criteria that return us to discrepancies and problems about which we have already spoken.

It seems to me for all these reasons that *free time is something that cannot be practicably expressed, that it is not applicable as a term because it cannot be precisely defined*. Surely we would find many other reasons deconstructing this term than are stated in this article. If I consider all the links that are connected with free time, if I consider its fundamental and absolutely individual determination, then I think that the most suitable is the above mentioned definition of Piepper who said that it is *"… preferably the inner state of the soul"*. Even if this definition is sympathetic for me and I identify with it because it gets into the deep core of the problem, it has, after all is said and done, one disadvantage. This definition can be used in many other cases because the "inner state of the soul" is connected with many other fields of human life. Thus it must be presented within the relation to a given sphere.

I would connect this "inner state of the soul" with the following. If I return to the beginning, thus to time generally, it is evident that time is lived, experienced and related to our existence, our being. In spite of this, it seems that everybody is inconsistent with it, as is mentioned above. Practically everybody perceives his own life as positioned into a certain "time space" that has got its start and end. This "time space" seems to be an individual space thus "my". This space can stay empty or is somehow filled. Activities that filled it have got their start and end, boarders separate one from the other or one penetrates into the other (by time as well as content). Through whatever influences and action of environment, through whatever relationships individual – society relationships, only "I" finally fill "my" space, regardless of the fact, whether the effect of this filling of time space thus affects the carried out activity, individual or societal. Because it is "my" space and "my" filling, the final effect is dependent on the individual, thus "my" approach to individual ("my") as well as societal life, to formulating the sense of my own life and its achievement, to real experience, to real living of my life. All the speculations and all the concrete activities, their shifting and

penetrating correspond to this fact. All of this is surely expressed as *"lifestyle"*.

Similarly, as in the case of free time, also in the case of lifestyle we could find and analyze tens of characteristics and definitions, which is not the aim of this article. In spite of this, for illustration relating to speculations about free time, I propound, as an example, three definitions, which are presented in different places (Hodaň, 2001).

Junger & Kasa (1996) consider as lifestyle a summary of life activities through which people reproduce their existence, satisfy and develop their needs, enter into particular economic and social relationships, aim at certain target values whi le maintaining fundamental norms. Hodaň considers a lifestyle to be an arrangement of polymorphous activities that helps an individual to maintain and renew. Šmídová characterizes lifestyle as the functional system of an individual as well as society, by which one chooses from the repertory of a certain culture and, under certain conditions, particular items according to individually selected criteria (values, aims …) and needs and also how one connects these items, transforms and enriches them and how they approach their own system.

Next to this descriptive approach to defining lifestyle there exists an approach that tries to rationalize, thus it thinks about the relation between lifestyle and something else. For example Blaxterová (Hodaň, 2000), in her speculations about lifestyle and health, understands lifestyle as a selection that people do regarding this value.

Despite different approaches it is evident that lifestyle is:

a) A historically determined form of an individual's life in which the individual reproduces his or her own existence
b) conscious searching and creating of qualitatively higher life forms and values that as completely as possible reflect the objective features of inter-individual relations, which are an expression of ideological, ethic and other approaches in human activity (Hodaň, 2000).

If lifestyle is characterized in this way, we find in general that the level of everything is what determines "free time". Thus this everything that concerns "free time" is a problem of lifestyle – not in the sense of some extracting, but total reciprocity. The problem of "free time" seems to dissolve in it. This view is multiplied by what determines the lifestyle. It is – individual development and its actual state, the level of culture of a certain individual, individual philosophical and value orientation, family traditions, in particular a share in the process of production, membership in a social-professional group and one's role in it, the number and level of realized social roles, living standard obtained, influence of one's environment. None of these conditions exist without being at the same time a condition of "free time" (and leisure activities). If from all of these conditions the lifestyle arises, its backward impact on a man is spontaneous and incidental. If this impact is to be individually useful, intervention is necessary in the sense of its optimizing. And reassessment, change and shift of activities that fill "my" time space are its result. And, as we showed above, the boarders between them are very inaccurate (contrary to strict boarder working time – off-duty time – free time). Totally individually, on the basis of different conditions, the dominance of these or those activities comes up. These then can be, as a part of individual lifestyle, judged from the point of the "inner state of the soul" thus from the point of view of time experience, living time, enjoyment time…

Regarding all of the above mentioned discrepancies as well as regarding the contemporary situation of civilization I seem to see the term "free time" as out of date, in my opinion to a certain degree also useless. If it would be possible for the above mentioned reasons to think about it, it would be in the sense of opinions that are connected with special experience, mimetic activities providing "alternative excitement" and an entrance into space that is out of reality, the inner state of the soul and "emptiness" as well as with a stay in the moment of present time, out of time. It is a kind of "without time" in which an individual gets somehow out of the real world (it is very typical for meditative states). But also, in this case, it is time experience. I feel that the term "free time" in the sense in which it is usually used, does not have any foundation and the term "life style" is sufficient enough as an expression of all the possibilities that time, in which our life goes on, provides us, and how we live it. And it is understandably a problem of values and preferences that are individually very various.

REFERENCES

Bergson, H. (1947). *Čas a svoboda: o bezprostředních datech vědomí.* Praha: Jaroslav Samec.

Filipcová, B. (1966). *Člověk, práce, volný čas.* Praha: Svoboda.

Heidegger, M. (1996). *Bytí a čas.* Praha: OIKÚMENÉ.

Hésiodos (1976). *Železný věk.* Praha: Odeon.

Hodaň, B. (1988). Physical culture and its role in recreating and regenerating the workforce. *Acta Universitatis Palackianae Olomucensis. Gymnica, 28*, 5–22.

Hodaň, B. (2000). *Tělesná kultura – sociokulturní fenomén: východiska a vztahy.* Olomouc: Univerzita Palackého.

Hodaň, B. (in press). *Volný čas a jeho současné problémy.* Olomouc: Hanex.

Junger, J. & Kasa, J. (1996). *Úvod do športovej kinantropologie.* Prešov: Univerzita P. J. Šafárika.

Piepper, J. (1992). *Volný čas, vzdělání, moudrost.* Praha: Křesťanská akademie.

Spousta, V. (1994). *Teoretické základy výchovy ve volném čase.* Brno: Pedagogická fakulta.

Spousta, V. (1996). *Metody a formy výchovy ve volném čase.* Brno: Pedagogická fakulta.

Slepičková, L. (2000). *Sport a volný čas.* Praha: Karolinum.
Šípek, J. (2001). *Úvod do geopsychologie.* Praha: Karolinum.
Šubrt, J. (1993). Kategorie času v sociologii. In Kolektiv, *Sociologické texty I.* (pp. 99–107). Praha: Karolinum.
Teplý, Z. a kol. (1971). Volný čas a pohybová rekreace. *Teor. Praxe Těl. Vých., 11*, 647–654.

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K PROBLÉMU FENOMÉNU VOLNÝ ČAS
(Souhrn anglického textu)

S pojmem „volný čas“ se setkáváme nejen v kinantropologických studiích, ale i v konkrétních projektech, které jsou realizovány. Při studiu literatury týkající se volného času zjišťujeme dva směry, které jdou paralelně vedle sebe – již desítky let stejné nebo podobné chápání „volného času“, resp. zpochybňování tohoto termínu. Tato práce patří k těm, které termín zpochybňují.

Zdá se, že termín volný čas bývá uvažován sám o sobě, bez vědomí jakýchkoliv existujících vztahů. Nelze však o volném času uvažovat, aniž bychom brali v potaz problém času obecně. Je to základní problém, kterým se filozofie od pradávna zabývá.

Autor zde předkládá stručný filozoficko-sociologický exkurz, na němž dokumentuje složitou problematiku času a neoprávněnost snah přidávat k tomuto termínu jakákoliv přídavná jména.

Je zřejmé, že termín a problematika volného času existují od starověku (scholé) po dnešek. Dá se říci, že většina současných názorů a „definicí“ vychází z formulace Dumazedierovy. Jak je známo, ten *volný čas pojal jako komplex aktivit mimo pracovní, rodinné a společenské závazky, jimiž se jedinec zabývá ze své vůle, aby si buď odpočinul, pobavil nebo svobodně zdokonaloval svou tvůrčí kapacitu*. Je zajímavé, že se dostává mimo jakékoliv vyjádření „času“, do určitého „prostoru“, ale ihned ten předpokládaný (tušený) prostor naplňuje „komplexem aktivit“. Ty pro něj ale mají charakter nezávaznosti, svobodného rozhodnutí, bez vazby na jakoukoliv povinnost. Od názorů Dumazedierových, které jsou podle autora zatíženy nejen dobovým chápáním, ale i tehdejší organizací společnosti a práce, jsou většinou odvozovány všechny pozdější definice. S těmi právě autor, srovnáváním s pojetím času obecně, polemizuje. Dochází k názoru, že většina lidí nechápe čas „filozoficky“ ve smyslu jeho prožívání, plynutí, ale ve smyslu jakéhosi prostoru, který se snaží naplňovat konkrétními činnostmi. A z charakteru těchto činností potom uvažuje o charakteru „času“.

V závěru autor odmítá jakékoliv pokusy o dělení času na různé jeho „druhy“. Na základě provedené analýzy dochází k názoru, že termín „volný čas“ je umělý, tedy zcela zbytečný. (Zdá se, že by byl použitelný v případě „aktivit“ vedoucích člověka mimo reálný život – meditace…) Vzhledem k plynutí, vnímání a prožívání času se autor domnívá, že vše, co je v souvislosti s časem ve vztahu k různým aktivitám třeba vyjádřit, může být shrnuto pod pojmem „životní styl“. Tento svůj názor v závěru zdůvodňuje.

Klíčová slova: čas, volný čas, svoboda, fenomenologie, životní styl.

CORRELATION BETWEEN SELECTED MOTOR AND PERSONALITY DIMENSIONS OF GIRLS 7 TO 11 YEARS OF AGE

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The aim of this research was to establish the correlation between selected motor and personality dimensions of children between seven and eleven years of age. The sample consisted of seventy-five school-girls, attending the first five grades of the elementary school Kette-Murn in Ljubljana. Motor abilities were measured with a battery of 20 motor tasks *(flexibility, speed, balance, strength and co-ordination)* and personality with the Big Five Questionnaire *(extraversion, neuroticism, openness, conscientiousness and agreeableness)*. The association between all the dimensions was analysed with correlation analysis.

Personality dimensions have higher correlations with motor dimensions, belonging to the mechanism of movement regulation, only *extraversion* and *conscientiousness* are highly correlated also with some tests of *strength*, too.

Keywords: motor abilities, personality, girls, age 7 to 11 years.

INTRODUCTION

Correlation between motor dimensions and personal traits is very complex. A continuous return connection exists, in which certain personal dimensions determine successful accomplishment of motor tasks, while, on the other hand, they have return impact on the formation and development of certain patterns of behaviour and personal traits, respectively. The objective of our investigation was to find the existing common inner mechanisms that lead to certain ways of motor behaviour. With the term **motor behaviour**, we tried to describe motor abilities in correlation with personal traits. The results of studies from the end of the 19th century had shown that sport activity has a certain influence on the development of human personality and personal traits, respectively.

On the basis of the results of previous investigations, we expected strong correlation between extraversion and numerous motor tests (Eysenck, 1970–71; Hayes, 1996), especially those acquiring quick and extensive energy mobilisation (Šturm & Strojnik, 1994). Those were mostly tests of explosive strength and speed. Some authors had proven the existence of correlation between co-ordination and extraversion (Caprara, Barbaranelli, Borgogni, Bucik, & Boben, 1997) with tests that had required the quickest possible execution of a given activity. Due to their high mental quickness, extroverts should be quicker in accepting, analysing and processing information, and preparing a motor response. On the basis of this quickness in accepting information and reacting to it (Eysenck, 1970–71), we expected to find correlation between extraversion and balance. Some authors had even found correlation between extraversion and endurance (Mrak, 2000).

In the dimension neuroticism, individuals whose characteristics were calmness, self-assurance, concentration, and emotionally controlled behaviour obtained high values. By contrast, so-called neurotics, who are characteristically tense, stiff, irritable, and anxious, obtained low values in this category. Arousal and lability of the autonomous nervous system and subcortex centres represent the neuro-physiological background for this dimension (Eysenck, 1970–71). Sub-cortex centres of individuals who are less emotionally stable are highly stimulated, their performance is labile and unbalanced, while the arousal itself lasts longer. Since the tests of co-ordination and balance require a certain degree of composure, calmness and concentration, correlation with neuroticism could well be expected.

We also expected the dimensions of conscientiousness, agreeableness and openness to be in correlation with motor abilities (Piedmont, Hill, & Blanco, 1999; Salgado, 1998). Conscientiousness represents a sense of precision, which enabled us to correlate it with motor tests, in which particular movements had to be carried out precisely. Another characteristic that can be correlated with conscientiousness is endurance. This characteristic could be shown also in motor tests of repetitive and static strength, in which an activity has to be carried out for a longer period of time. Some authors had considered openness to be a dimension that has more the nature of a problem solving ability than that of a personal trait (Little & Wanner, 1998;

Mc Crae, 1994; Shafer, 1999). Some investigations had found that dimension to be even more closely correlated to cognitive abilities than it is to other personal dimensions (Ferguson & Patterson, 1998). According to these statements, we can expect openness to be correlated with problem solving tasks. Agreeableness, in the negative sense, can be shown as increased aggression (Caprara et al., 1997) and strong need for competition. It can be correlated with tests that require endurance in a motor activity (Mrak, 2000).

The object of our investigation was to establish correlation between motor and personal dimensions of girls, 7 to 11 years of age. **Motor abilities** are those psychosomatic dimensions that determine motor efficiency and performance of motor tasks (Šturm & Strojnik, 1994). Numerous authors (Magill, 1998; Schmidt & Lee, 1999) had investigated the structure of motor abilities. The Kurelič (1975) model of motor abilities has been the most widely used in the investigations on the population of the Slovenian pupils. We also used it in our investigation.

Personal traits are dimensions that determine human reaction and behaviour, respectably, in different situations. They are crucial for understanding and prediction of human behaviour. Numerous modern studies in the field of psychology of personality that had been carried out in Europe and America had shown that the main characteristics of a personality can be almost entirely and with reasonable accuracy described with one model. The model consists of five orthogonal factors, which are extraversion, neuroticism, conscientiousness, agreeableness and openness (Little & Wanner, 1998).

METHODS

The subject sample (TABLE 1) encompassed 75 female pupils, which attended the first to fifth grades of primary school (7 to 11 years of age). They were involved in regular classes of physical education and were without physical injuries and morphological shortcomings. The sample was divided into several groups, each group consisted of pupils of the same grade.

The variable sample used to assess the level of motor abilities (flexibility, speed, balance, strength and co-ordination) consisted of twenty motor tests (a description of the tests is available with the authors). Personality dimensions were measured with the Big Five Questionnaire for Children (extraversion, neuroticism, openness, conscientiousness and agreeableness) (Little & Wanner, 1998).

The measurements of motor abilities and personality dimensions were performed in January and February of 1999. The obtained data was analysed with the SPSS statistical package. In the first phase of the analysis we computed for each grade group the basic statistical parametres. In the second phase, the association between all the measured variables was analysed with correlation analysis and the correlation matrix was formed.

All the girls that took part in our investigation, as well as their parents, were acquainted with the measurement procedure. The parents had to give their written consent to their children taking part in the test. The measurements of motor abilities and personal traits were led by accurately qualified personnel.

TABLE 1
Subject sample by grade

Grade	number	age
1	11	7.54 ± 0.31
2	12	8.42 ± 0.27
3	27	9.34 ± 0.32
4	15	10.42 ± 0.33
5	10	11.29 ± 0.27

RESULTS AND DISCUSSION

The personality trait **neuroticism** is characteristically associated with tests of balance and speed. The results of tests performed by children in the first class of primary school show a characteristic association with the *flamingo balance* test (TABLE 2). The association is positive which means that a higher degree of neuroticism has a higher value and a bad result of the *flamingo balance* test. The individuals who show strongly expressed neuroticism also have highly aroused central nervous systems (Eysenck, 1970–71), which is why they have difficulties with performing motor tasks that require serenity and concentration. Due to their restlessness and general nervousness, those children have difficulties with being precise (Little & Wanner, 1998). In order to keep balance while standing on one foot, quick correction movements have to be made. The activation of exclusively those muscle groups that enable such moves is necessary. Other muscle groups should be relaxed, for their activity can be disturbing. Due to higher arousal of sub-cortical centres, too many impulses are sent to the muscles, which is shown in unnecessary moves and consequently rapid loss of balance.

Girls in third class of primary school (9 years of age) showed typical correlation between neuroticism and the movement frequency tests (TABLE 4). The girls with expressed neuroticism did not achieve very good results when relaxation and concentration were required. The movement frequency tests reflect the activity of the inverse regulation centre, which is responsible for quick interchangeable descent and activation (agonists, antagonists), (Pistotnik, 1999). In order to carry out this change as quickly as possible, muscles have to be relaxed to some extent. Since the *tapping with better arm* motor test requires quick, repeated movement with hands with constant amplitude, precision in the performance of touches is necessary for a good result. However, girls with higher results in dimension neuroticism probably didn't

achieve the needed calmness and relaxation and consequently didn't do very well on the test. Individuals with higher neuroticism have difficulties determining the level of effort that they are willing to put into the performance of a particular task. They tend to consider the task to be more difficult than it really is, which makes them invest more energy than needed (Morgan, 1994). Due to higher sensitivity to the stressful situation, which testing is, the children in third class of primary school have constantly aroused centres. Since a muscle remains partially active all the time, its change from the role of agonist into the role of antagonist is less successful. A higher degree of neuroticism, therefore, conditions poor results in movement frequency tests.

The results of our study show that **extroversion** is associated mostly with the tests of strength and flexibility. The results of tests performed by children in the first class of primary school show characteristic association of extroversion with variables *bend and touch on a bench and throwing a heavy ball* (TABLE 2). The association in both cases is negative, which is not consistent with Eysenck's theory. Extroverted individuals are capable of quick accumulation of energy and rapid response. In order to be successful in the test of explosive strength of arms, one has to be able to regulate energy. A great amount of muscle power needs to be developed in a short period of time. The level of cortical arousal in the case of extroverted individuals is low, and consequently needs a higher level of stimulation. Those individuals are better in carrying out tasks that require intensity (Morgan, 1994), such as tests of explosive strength. Those conclusions would lead us to expect a positive association of the mentioned variables. We didn't find any studies that would support our findings. The negative association of extroversion with a flexibility test can be the consequence of the ability to quickly accumulate energy. It is probable that girls invest too much energy into the performance of the flexibility test and consequently the muscles that should be relaxed are activated. That results in a too high muscle tonus, which has a negative impact on the ability to achieve large movement amplitudes. Generally, extroversion is in a negative correlation with the majority of motor tests, which show that the results are the consequence of the particularities of the sample group.

The results of tests performed by children of the second grade of primary school show a characteristic association of extroversion with a variable *tapping with left leg* (TABLE 3). According to Eysenck's theory, high mental speed and consequently quick information processing are characteristic of extroverted individuals. It would be reasonable to expect a positive association between the mentioned variables. In our sample group, the girls show poor results in movement frequency tests, which is not so easy to explain. The test task is unusual, for quick movements have to be performed with a non-dominating limb. Effective performance of the functional synergy and muscle tonus regulation mechanism, which is responsible for the regulation of strain in the muscles, is necessary. Optimal performance of the muscle tonus is necessary for quick change from the role of agonists into the role of antagonists. The processes of excitation and inhibition need to be in balance. Regarding the accumulation of great amounts of energy that the extroverted girls are capable of, this can be disturbing for the proper execution of the *tapping with left leg* test. It is possible that some muscle groups are activated which don't contribute to successful movement, moreover, they can even retard it.

Extroversion of girls in the fourth class of primary school is characteristically associated with variables that measure strength (TABLE 5). Since the accumulation of great amounts of energy and a rapid motor response are characteristic of extroverted individuals, positive association with the tests of explosive strength would be expected. However, the association with the *standing broad jump* test is in our case negative. In order to achieve a good result in an explosive strength test, a high frequency of nervous impulses is needed for the activation of a larger amount of motor units during a shorter period of time. The intensity of excitation is regulated by a mechanism located on a subcortical level. The performance of functional synergy and tonus regulation mechanism, which enables optimal balance between the processes of excitation and inhibition, can also be important. Extroverted individuals quickly develop reactive inhibition (Eysenck, 1970–71; Maxeiner, 1983), which has an impact on their motor behaviour. It is possible that the impact of inhibition mechanisms is larger, which is shown in less distinctive expression of explosive strength. Girls in the fourth grade of primary school obviously have difficulties with the determination of optimal level of excitation and the necessary amount of energy for the successful performance of the test. Those difficulties are probably caused by developmental changes during which bodily proportions change. Movement that is automated to some extent (jump) suddenly requires a different degree of intensity. Extroverted girls are normally more successful in the performance of tasks that require higher intensity (Morgan, 1994), but obviously they are unable to find the balance between the processes excitation and inhibition. When excitation is too strong, muscles can get cramped, if it is too weak, inhibitory effects appear.

Extroversion of girls in the fourth grade of primary school is also negatively associated with the repetitive strength test, which can be easily explained. Namely, extroverted individuals wish to quickly retard a repeated action (Maxeiner, 1983). That inhibition is of a long lasting character, which is why such individuals show a low level of tolerance for the tasks that are long lasting and repeated. It is possible that a low persistence in repeated actions is what is shown in the case of the fourth class pupils. They had to perform the activity for one minute, which is probably enough for their interest in the test activity to drop.

The results of tests performed by girls in the fifth grade of primary school show the association between the variables of extroversion and *bend and touch on a bench*. The coefficient has a negative sign, which means that strongly extroverted girls achieve lower values in the motor test. This sort of association has already been mentioned in the case of the girls in the first grade of primary school. An overview of all such associations in single classes of primary school shows similar results. The reason probably lies in the functional mechanisms of the central nervous system. Quick and strong action, which can have a negative impact on the flexibility tests, is characteristic of the extroverted individuals. Large movement amplitudes require relaxed muscles, while quick accumulation of energy causes the activation of muscle groups and consequently higher tension in them. Higher muscle tonus has a negative impact on the results of the flexibility tests (Pistotnik, 1999). The extroverted individuals show a higher arousal threshold (due to a lower level of arousal they require tasks of higher intensity). This is why it is possible that this type of child is not interested in such activity, and that, consequently, they do not make any effort upon the performance of the test.

The personality trait **openness** is characteristically associated with tests in which the information component prevails. The association with the coordination tests is positive. The majority of scientists describe openness as the ability to resolve problematic situations (Ferguson & Patterson, 1994; Little & Wanner, 1998; McCrae, 1994; Shafer, 1999). Hence, the association can be expected, for they have a common basis in the ability of the central nervous system to effectively process information. The coordination tests require a movement problem to be solved quickly and accurately. Motor tasks are complex, which means that they also have a cognitive activity component. Openness represents complexity and quality of the mental and experiential world of an individual (Little & Wanner, 1998), so it should enable as much information as possible to be stored in the movement memory. The majority of tasks that are coordinationally challenging require the use of movement memory when known information is to be used for finding a solution of a new problem task.

Characteristic association of the results of test performed by girls in the second class of primary school with the variables of openness and *climbing and descending* was found (TABLE 3). With this motor test the abilities for wholesome space problem solving within the frame of coordination are measured. Girls climb up a bench which is fixed to wall bars as fast as they can and then descend down the wall bars. Not only speed but also precision is important for this task, for each bar of the wall bars has to be stepped on. Since the task is of a cognitive nature, cognitive activity is probably present. A movement program has to be generated on the basis of available information. Knowledge and experiences with similar movement tasks, stored in the memory of an individual, are here of great importance. Openness should represent the complexity and quality of the mental and experiential world of an individual, in other words, intellect (Little & Wanner, 1998). According to some previous studies, openness is closely related to cognitive abilities (Ferguson & Patterson, 1998), so that it can be supposed that it reflects some level of cognitive functioning (ability to quickly use stored information).

Openness of the girls in the third class of primary school has the highest association with variables that reflect the abilities that are under the supervision of the mechanism for structuring movement (TABLE 4). A positive association with the variable *bend and touch on a bench* was found, which can be explained from the point of view of muscle tonus. It is under the impact of the central nervous system, which sends impulses to the alpha-motoneuron. The activity of a motoneuron is dependent on the tonus in muscles. Lower muscle tonus enables muscles to be relaxed and, consequently, to execute larger amplitudes of moves. With willful mental relaxation one can achieve a lower degree of the arousal of the mechanism that is responsible for the muscle tonus (Pistotnik, 1999). Openness represents susceptibility to novelty and a desire for learning more about it. It marks the quality of the mental and experiential world of a child, which is shown as a wide base of knowledge and experience (Caprara et al., 1997). The association of openness with the *bend and touch on a bench* test can be explained by the supposition that girls in the third class of primary school already had experiences with relaxation. They had probably been executing similar tasks already and have at their disposal knowledge for their successful solution.

Some authors assume that openness is more strongly associated with cognitive abilities than it is with other personality variables (Ferguson & Patterson, 1998), and that it shows effective operation of the central nervous system during solving problem situations (e. g. using information stored in memory). Stronger cognitive activity is probably present during the *figure of eight with bending* test. During this test, movement needs to be perceived as a whole and be executed as fast as possible. The movement problem is therefore of a complex nature. Openness shows the ability for effective use of gained knowledge and experience in solving problems of a complex nature, a knowledge base and memory. This can explain the association with the mentioned variables since cognitive processes are engaged (rapidity of information processing and analysis) during the retrieval of knowledge from memory. The most probable explanation is that previously gained motor knowledge produced good results in the coordination test. Due to their susceptibility to novelty, girls that are more open have at their disposal more of this type of knowledge and they use it to their benefit.

The results of tests performed by girls in the third class of primary school are characteristically associated

with the variable *pull and push on a bench*. The results of that test depend on the mechanism for supporting excitation, as well as the mechanism for synergy and muscle tonus regulation. For a good result, adjustment of muscle activity, so called inter-muscular coordination, is needed. Since effort is not maximised, economy of movement is expressed. Girls that have experience with similar movement are able to use their strength economically and get tired later than those that lack such experience.

The results of tests performed by girls in the fifth class of primary school show a characteristic association of openness with the *flamingo balance* (TABLE 6). It would be reasonable to expect the correlation coefficient to be negative. Girls with a wider base of knowledge and experience (openness) could better use this source during the motor test. The results show, however, that experience even hinder the achievement of a good result in the balance test. The nervous system of motorically more highly developed individuals operates on a higher level, which is shown also in better stabilisation of movement. Their mechanism for movement regulation is very effective; therefore, less uncontrolled movement appears during the balance test. Girls in the fifth class of primary school form a group in which negative impacts of bodily development (adolescence) begin to show. Changes in bodily proportions lead to changes in movement control. It is possible that motorically better girls have more troubles with movement regulation, for old movement patterns begin to collapse (in comparison with the motorically less successful, who didn't automate their movement). They try to solve a motor task in the same way as before, but they are less successful due to difficulties in adjustment of coordinated moves (correction moves are not adequate).

The personality trait **conscientiousness** is highly associated with repetitive strength in the lower classes, and with coordination in the higher classes of primary school. In the first class of primary school, a characteristic association of conscientiousness with the test of repetitive strength of legs can be observed (TABLE 2). Since that dimension is a measure for diligence and assiduity, we find this association logical and expected. A test of *jumping over an elastic band* is carried out for one minute, which can be an endurance problem in this age group. Tests of repetitive strength need to be carried out with a certain degree of motivation. Conscientious girls are more persistent and better motivated, which has been confirmed by other scientists (Caprara et al., 1997; De Raad & Schouwenburg, 1996). It is possible that they are more motivated through their desire for a perfect execution of a given task. This could support their persistence in executing jumps up to the end of given time.

Girls in the third class of primary school show a characteristic association of conscientiousness with the test of repetitive strength of arms (TABLE 4). Conscientiousness is defined in a personality questionnaire with a sub-dimension persistence, with which a motivation of an individual for persistence in a given activity is evaluated (motor test lasts for one minute). It is possible that more persistent girls are more motivated for the activities that last longer, with which they can show their persistence. Some authors describe conscientiousness as a source of motivation for effective solution of a given task (De Raad & Schouwenburg, 1996). It is likely that girls are more successful in motor tests due to their higher motivation for the achievement of a good result.

For the fourth class of primary school, a negative association of conscientiousness with movement frequency is characteristic (TABLE 5). Conscientiousness can also be described as proneness to diligence, persistence and precision. Because a high degree of precision and a certain amount of persistence are needed in the tests of movement frequency, it would be reasonable to expect positive associations of those variables with conscientiousness. Similar conclusions could be drawn for the *arm drumming* test, which also requires a certain amount of attention, collection and persistence in a repeated activity. From the point of view of persistence, a sub-dimension of conscientiousness, we can conclude that the mentioned tasks are of shorter duration. Persistence can not yet be fully expressed. It is not certain that girls have enough motivation for this type of activity. Namely, conscientiousness means a desire for good performance of a given task (De Raad & Schouwenburg, 1996), which the girls in the fourth class of primary school are lacking in the case of motor tests. This lack of interest could be the consequence of negative impacts of developmental changes (destruction of steady movement patterns due to rapid growth and development). Girls that don't control their bodies can lack the motivation for the execution of a given task. Motorically successful individuals have a positive image of themselves and are therefore more persistent in the execution of movement tasks.

The association of the personality trait **agreeableness** with motor abilities is weak. We didn't find any characteristic association. Since the associations are predominantly negative, we can conclude that a certain amount of aggression is needed for a good result.

CONCLUSIONS

Girls between seven and eleven years of age show statistically significant correlation between motor and personal variables. The correlation is the most emphasised in the lower age groups, while at the age of eleven it is the least distinguished. The correlation is in agreement with the results of previous investigations that are stated in the Introduction. In general, we can conclude that personal traits highly correlate with motor abilities, which are under the regulation of the central movement regulation mechanism.

TABLE 2
Correlation between motor and personality dimensions at age 7

	NEURO	EXTRA	OPEN	CONSC	AGREE
Arm-twist with a stick*	–0.40	0.22	0.33	0.42	0.39
Bend and touch on a bench	0.29	–0.67	–0.08	0.22	–0.04
Leg flexibility from lying on the back	0.35	–0.24	0.25	0.23	0.33
Sprint 10 m with running start*	0.16	0.42	–0.35	–0.44	–0.30
Tapping with better arm	0.45	–0.47	–0.28	0.02	–0.11
Tapping with right leg	0.30	–0.47	0.05	0.37	0.02
Tapping with left leg	0.45	–0.32	0.09	0.41	0.19
Stand on a T bench	0.31	–0.44	–0.31	–0.21	–0.31
Flamingo balance*	0.64	–0.40	–0.31	–0.31	–0.41
Throwing a heavy ball	0.23	–0.75	–0.51	–0.12	–0.52
Standing broad jump	–0.50	–0.11	–0.12	0.05	–0.05
Pull, push on a bench	–0.47	–0.20	–0.26	–0.04	–0.19
Sit-ups	–0.12	0.14	–0.12	0.28	0.14
Jumping over an elastic	–0.09	0.03	0.24	0.63	0.42
Bent-arm hang	–0.26	0.21	0.05	0.18	0.19
Polygon backwards*	–0.22	0.23	0.24	–0.32	0.06
Climbing and descenting*	–0.16	–0.06	–0.01	–0.56	–0.31
Jumping over and crawling under*	–0.21	0.12	–0.30	–0.58	–0.23
Figure of eight with bending*	–0.53	–0.33	0.12	–0.29	–0.20
Arm drumming	–0.16	0.21	–0.02	0.12	0.25

(* a lower value is better)

TABLE 3
Correlation between motor and personality dimensions at age 8

	NEURO	EXTRA	OPEN	CONSC	AGREE
Arm-twist with a stick*	–0.19	0.46	–0.35	–0.46	–0.48
Bend and touch on a bench	0.07	–0.33	–0.22	–0.22	–0.05
Leg flexibility from lying on the back	0.08	–0.52	0.16	0.10	0.22
Sprint 10 m with running start*	–0.17	0.04	–0.25	–0.14	–0.16
Tapping with better arm	–0.43	0.55	0.50	–0.09	–0.10
Tapping with right leg	0.33	0.27	0.32	0.34	0.27
Tapping with left leg	–0.10	–0.64	0.27	0.19	0.38
Stand on a T bench	0.42	0.40	0.20	–0.05	0.08
Flamingo balance*	0.17	–0.38	–0.35	0.38	0.02
Throwing a heavy ball	0.03	0.19	0.33	0.15	0.03
Standing broad jump	0.46	0.32	0.28	0.03	0.16
Pull. push on a bench	0.35	0.22	0.43	–0.03	0.39
Sit-ups	0.54	0.50	0.29	0.09	0.22
Jumping over an elastic	–0.17	0.06	0.21	–0.17	0.01
Bent-arm hang	–0.27	0.06	0.39	0.11	0.08
Polygon backwards*	0.04	–0.04	–0.43	–0.14	–0.31
Climbing and descenting*	–0.27	–0.32	–0.67	–0.14	–0.56
Jumping over and crawling under*	–0.26	–0.11	–0.53	–0.15	–0.39
Figure of eight with bending*	–0.29	–0.24	–0.35	–0.28	–0.17
Arm drumming	–0.09	0.30	0.14	–0.41	0.04

TABLE 4
Correlation between motor and personality dimensions at age 9

	NEURO	EXTRA	OPEN	CONSC	AGREE
Arm-twist with a stick*	0.17	–0.04	–0.16	–0.13	–0.22
Bend and touch on a bench	0.16	0.00	0.40	0.24	0.28
Leg flexibility from lying on the back	0.21	–0.04	0.02	–0.33	–0.13
Sprint 10 m with running start*	0.13	0.02	–0.13	–0.04	–0.05
Tapping with better arm	–0.42	–0.07	–0.30	–0.38	–0.35
Tapping with right leg	–0.14	–0.05	–0.16	–0.23	–0.08
Tapping with left leg	0.06	0.01	0.21	0.17	0.32
Stand on a T bench	0.05	–0.14	–0.19	–0.25	–0.10
Flamingo balance*	0.27	–0.05	–0.31	–0.12	–0.17
Throwing a heavy ball	0.05	–0.19	–0.15	0.01	0.05
Standing broad jump	–0.06	0.11	0.26	0.09	0.18
Pull. push on a bench	0.05	0.27	0.43	0.50	0.23
Sit-ups	–0.19	–0.02	–0.09	0.06	–0.01
Jumping over an elastic	–0.22	–0.01	0.18	–0.03	0.05
Bent-arm hang	–0.25	–0.04	0.17	0.13	0.01
Polygon backwards*	0.09	–0.10	–0.02	0.00	0.09
Climbing and descenting*	–0.13	–0.05	–0.07	–0.14	0.01
Jumping over and crawling under*	–0.07	–0.07	–0.15	–0.14	–0.02
Figure of eight with bending*	–0.16	–0.18	–0.42	–0.16	–0.23
Arm drumming	–0.17	0.15	–0.21	–0.20	–0.18

TABLE 5
Correlation between motor and personality dimensions at age 10

	NEURO	EXTRA	OPEN	CONSC	AGREE
Arm-twist with a stick*	–0.51	–0.28	0.02	0.01	–0.19
Bend and touch on a bench	0.28	–0.24	–0.31	0.24	0.05
Leg flexibility from lying on the back	0.40	–0.40	0.36	0.02	0.06
Sprint 10 m with runing start*	0.11	0.43	0.12	0.01	–0.12
Tapping with better arm	–0.17	–0.11	0.21	–0.28	0.29
Tapping with right leg	0.08	–0.21	–0.51	–0.77	–0.07
Tapping with left leg	0.04	–0.04	–0.40	–0.58	–0.07
Stand on a T bench	0.14	–0.02	0.11	0.06	0.12
Flamingo balance*	–0.04	0.42	0.00	0.21	–0.40
Throwing a heavy ball	0.00	–0.32	–0.32	0.06	0.20
Standing broad jump	–0.02	–0.54	–0.19	–0.10	0.11
Pull. push on a bench	–0.03	–0.09	0.36	–0.20	0.46
Sit-ups	0.11	–0.58	–0.08	–0.10	0.27
Jumping over an elastic	–0.10	–0.04	–0.25	–0.48	–0.07
Bent-arm hang	–0.14	–0.44	–0.31	–0.38	0.21
Polygon backwards*	–0.31	0.39	–0.07	0.35	–0.10
Climbing and descenting*	–0.11	0.44	0.05	0.41	–0.07
Jumping over and crawling under*	–0.47	0.12	–0.31	0.15	–0.32
Figure of eight with bending*	–0.10	0.50	–0.05	0.12	–0.21
Arm drumming	0.17	–0.12	–0.27	–0.64	–0.06

TABLE 6
Correlation between motor and personality dimensions at age 11

	NEURO	EXTRA	OPEN	CONSC	AGREE
Arm-twist with a stick*	0.03	0.22	–0.37	–0.49	–0.16
Bend and touch on a bench	0.09	–0.77	–0.14	0.31	0.27
Leg flexibility from lying on the back	0.40	–0.12	0.01	–0.45	–0.35
Sprint 10 m with running start*	0.25	–0.18	–0.16	0.36	0.19
Tapping with better arm	–0.60	–0.34	–0.06	–0.54	–0.34
Tapping with right leg	–0.07	–0.14	0.49	0.18	0.17
Tapping with left leg	0.08	–0.01	–0.23	–0.39	–0.48
Stand on a T bench	–0.32	–0.19	0.36	0.12	0.08
Flamingo balance*	–0.36	–0.46	0.63	0.04	–0.31
Throwing a heavy ball	–0.41	–0.38	0.55	–0.06	0.02
Standing broad jump	–0.13	–0.04	0.22	–0.25	–0.37
Pull. push on a bench	–0.15	–0.02	–0.37	–0.13	–0.06
Sit-ups	–0.17	0.01	–0.02	–0.26	0.05
Jumping over an elastic	–0.04	0.36	–0.09	0.03	–0.05
Bent-arm hang	–0.56	–0.12	0.07	0.04	–0.02
Polygon backwards*	–0.03	–0.06	–0.23	0.23	0.15
Climbing and descenting*	0.29	–0.14	–0.02	0.21	0.01
Jumping over and crawling under*	0.25	0.09	–0.17	0.29	0.15
Figure of eight with bending*	0.12	0.23	–0.19	0.31	0.08
Arm drumming	0.05	–0.19	–0.04	0.05	0.47

REFERENCES

Caprara, G. V., Barbaranelli, C., Borgogni, L., Bucik, V., & Boben, D. (1997). *Model velikih pet: pripomočki za merjenje strukture osebnosti – priročnik.* Ljubljana: Produktivnost, Center za psihodiagnostična sredstva.

De Raad, B., & Schouwenburg, H. C. (1996). Personality in learning and education. *European Journal of Personality, 10*, 303–336.

Eysenk, H. J. (1970-71). *Readings in extraversion – introversion, 1, 2, 3.* London: Stamples Press.

Ferguson, A., & Patterson, F. (1998). The five factor model of personality: Openness – a distinct but related construct. *Personality and Individual Differences, 24(6)*, 789–796.

Hayes, T. L. (1996). How do athletic status and disability affect the five-factor model of personality? *Human Performance, 9(2)*, 121–140.

Little, D., & Wanner, B. (1998). *Validity of a big five personality inventory for children (B5P-C).* Poster presented at the International Society for the Study of Behavioral Development Meeting. Switzerland.

Kurelić, N., Momirović, K., Stojanović, M., Šturm, J., Radojević, D., & Vaskić-Štalec, N. (1975). *Struktura i razvoj morfoloških i motoričnih dimenzija omladine.* Beograd: Univerza u Beogradu, Fakultet za fizičko vaspitanje, Institut za naučna istraživanja.

Magill, R. A. (1988). *Motor learning: concepts and applications.* Dobuque: McGraw Hill.

Maxeiner, J. (1983). Reactive inhibition as a determinant of performance in sport with cyclical forms of movements. *International Journal of Sport Psychology, 14(2)*, 98–103.

McCrae, R. R. (1994). Openness to Experience. *European Journal of Personality, 8(4)*, 251–272.

Morgan, W. P. (1994). Psychological components of effort sense. *Medicine and Science in Sports and Exercise, 26(9)*, 1071–1077.

Mrak, A. (2000). *Povezanost morfoloških značilnosti, motoričnih sposobnosti in osebnostnih lastnosti z rezultati teka 600 m in 2400 m pri učencih v obdobju adolescence.* Diplomska naloga, Univerza v Ljubljani, Fakulteta za šport, Ljubljana.

Piedmont, R. L., Hill, D. C., & Blanco, S. (1999). Predicting athletic performance using the five-factor model of personality. *Personality and Individual Differences, 27(4)*, 769–777.

Pistotnik, B. (1999). *Osnove gibanja.* Ljubljana: Fakulteta za šport.

Schmidt, R. A., & Lee, T. D. (1999). *Motor control and learning.* Champaign: Human Kinetics.

Shafer, A. B. (1999). Relation of the Big Five and the Factor V subcomponents to Social Intelligence. *European Journal of Personality, 13(3)*, 225–240.

Šturm, J., & Strojnik, V. (1994). *Uvod v antropološko kineziologijo.* Ljubljana: Fakulteta za šport.

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VZTAH MEZI VYBRANÝMI MOTORICKÝMI A OSOBNOSTNÍMI DIMENZEMI U DÍVEK VE VĚKU 7–11 LET
(Souhrn anglického textu)

Cílem výzkumu bylo určit vztah mezi vybranými motorickými a osobnostními dimenzemi u dětí ve věku mezi 7 a 11 lety. Výzkumný vzorek se skládal ze 75 dívek školního věku, navštěvujících 1.–5. ročník základní školy Kette-Murn v Lublani. Motorické schopnosti byly měřeny pomocí souboru 20 motorických testů (pružnost, rychlost, rovnováha, síla a koordinace), osobnostní charakteristiky byly zjišťovány za pomoci dotazníků pětifaktorového osobnostního inventáře (Big Five) založeného na koncepci pětifaktorového modelu osobnosti (extraverze, neurotismus, otevřenost, svědomitost a přívětivost). Vztahy mezi všemi charakteristikami byly studovány prostřednictvím korelační analýzy. Charakteristiky osobnosti mají těsnější vztah k těm motorickým charakteristikám, které patří k mechanismům regulace pohybu, pouze extraverze a svědomitost mají vysokou korelaci taktéž s některými testy síly.

Klíčová slova: motorické schopnosti, osobnost, dívky, věk 7–11 let.

METHODOLOGICAL ASPECTS OF BODY CONSTITUTION EVALUATION – AN ANALYSIS OF ANTHROPOMETRIC METHODOLOGY

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The concept of body constitution first appeared in Matiegka (1921), who suggested quantification of body components on the basis of body's external dimensions. Since Matiegka, a whole range of other methods for body constitution assessment based on anthropometrical dimensions has been developed. Fat is the main factor of inter--intraindividual variability of the body's constitution during an entire ontogenesis. The estimation of fat content based on calliperation draws on two basic assumptions:

1. Thickness of the hypodermic fat tissue is in constant ratio to the total fat volume.
2. The places chosen for the measurement of dermal thickness represent the average thickness of the hypodermic fat layer.

However, these assumptions were not unequivocally confirmed and that is why it is often stressed that the validity of regression equations for the body constitution estimate is limited to the population based on which the equations were derived. Regarding the reliability interval of the regression equations the estimated application error can be considerable, the error probability increases with extreme values.

For evaluation of body constitution, specialists chose the respective methodology based on their needs and possibilities, in some cases they even compared the resultant data from different methodology. This was the reason for the publication of two reports, in 1995 and in 1996, in the Acta Gymnica, titled "Body fat evaluation using anthropometrical methods and Bodystate 500". The studied subjects, whose data are presented in the publications, were on different levels of ontogenetic development, they had different percentages of fat in their bodies' constitutions and even the harmony of their fat tissue dispersion was different.

The presented study seeks answers to two scientific questions:

1. Why do the outcomes of anthropometrical methodologies for fat percentage estimates in different population groups often differ distinctively (what variables influence the result variability the most)?
2. Why isn't the information on fat volume in different groups the same, if the endomorphological evaluation is the same?

The answers should reflect both morphological and methodological aspects.

Keywords: body composition, analysis of anthropometric methodology, central indices.

RESULTS

Searching for answers to the aforementioned questions involved the use of concrete data on groups representing different ontogenetic development and pneumotoric activity as well as different percentages of body fat distribution. The periods of Early Childhood 2, Juveniles and Adults are represented. Early Childhood 2 was represented by children from Olomouc primary schools with common physical training education. The study lasted from 1986 to 1989. The juvenile phase was represented by a group of the Olomouc apprentice population that, at present and in general, has been shown to be a group at risk and is therefore omitted from primary care. The study was carried out in 2000. The adult group was represented by 1st year students of physical education at The Faculty of Physical Culture, Palacký University, and the study was carried out in 1994–1995. The data was processed using the programmes Anthropo and Statgraphic.

Firstly, an assessment of the basic statistical characteristics.

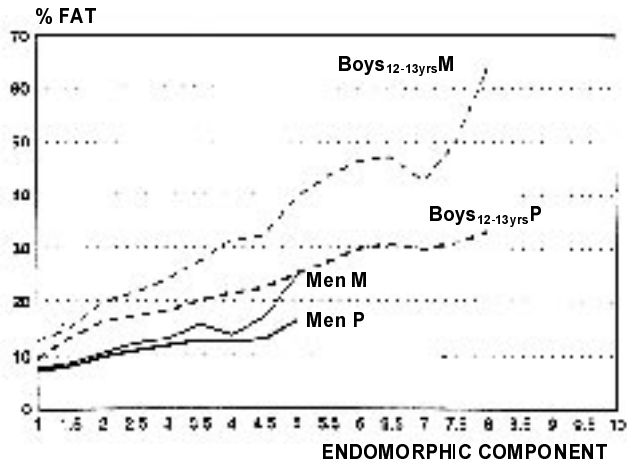
TABLE 1
Males – average percentual values of body fat based on Matiegka methodology with revised values

	Early Childhood II. – boys from classes with common PT education		Juveniles – apprentice population			Adults PE students
Feature	12yrs. n = 32	13yrs. n = 135	16yrs. n = 45	17yrs. n = 43	18yrs. n = 43	19yrs. n = 159
	$\bar{x}$ s	$\bar{x}$ s	$\bar{x}$ s	$\bar{x}$ s	$\bar{x}$ s	$\bar{x}$ s
% K	21.17 2.29	20.21 2.23	17.04 2.13	16.83 1.68	17.06 1.70	17.07 1.50
% S	36.17 4.24	35.94 4.98	42.71 5.03	45.14 3.74	44.80 4.35	48.29 3.00
% T	23.27 9.52	23.84 10.72	16.66 8.24	14.05 5.59	14.31 6.32	11.06 3.17
% R	19.38 4.75	19.99 5.39	25.59 2.71	23.98 2.20	23.83 2.08	24.28 3.50

From the average values, we can observe that the boys from classes with common PT education demonstrate the highest fat volume while the PE students have the lowest. Boys also show a higher percentage of bone mass, the other age group's bone percentage is lower and is at approximately at the same level. Logically, a paradoxical situation is true of the muscle mass and residuals.

The following graph takes into account the percentage of fat in relation to the endomorphic component values.

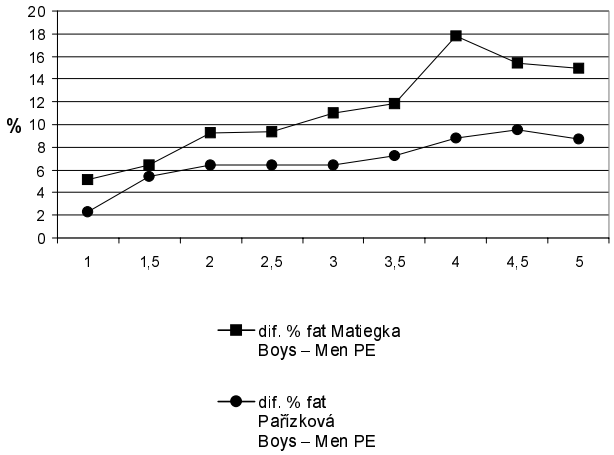
Fig. 1
Average values of fat in relation to endomorphic component values (P = percentage of fat based on Pařízková methodology, M = percentage of fat based on Matiegka methodology)



For male physical education students, the differences in fat estimates based on both Matiegka and Pařízková methodology are very low and, up to the endomorphic evaluation grade of 4.0, relatively stable (difference 0.45 % – 2.85 %). Boys with lower constitutional homogeneity show a higher average value of percentual fat based on both methodologies, the differences increasing from the lowest grades of the endomorphic component to the highest ones, with higher fat mass based on the Matiegka methodology.

Fig. 2, which follows, shows the level of differences in the fat mass estimate in relation to the endomorphic component between the boys and the men's groups, always using the same methodology.

Fig. 2
The differences between the percentual fat mass based on the Matiegka and the Pařízková methodologies as related to the endomorphic component of the somatic type (PE men – boys of 12 and 13 years of age)



The differences are higher in results posted by Matiegka methodology and they increase with the endomorphic level. The fat volume relating to the concrete endomorphic component value differs at the component level 3.0 by more than 10 %. The error in estimating can be conditioned by the reliability interval extent of the regression equations. It is also neces-

sary to take into account that to set the endomorphic level, only 3 skinfolds are needed (the triceps, the subscapular and suprailiacal skinfolds) and the resulting point evaluation is achieved based on the total of the cilium thickness within the closest lower values or the closest higher values. This interval increases together with the endomorphic grade (e. g. 3.9 mm for 2.5 component, 4.2 mm for 3.0 component, 4.8 mm for 4.0 component, 6.4 mm for 5.5 component, 7.9 mm for 7.0 component up to 16 mm for 12.0 component).

The central indices (x2 and x3 – the ration of fat dispersion in the body, possibly including the head and the limbs) for physical education students amount to 1.0 and 0.99 units, representing harmonic fat tissue dispersion. In boys, the average values for 12yr-olds ($\bar{x}$2 0.74, $\bar{x}$3 0.66) and 13yrs ($\bar{x}$2 0.81, $\bar{x}$3 0.73) signal the centripetal character of fat dispersion (lower fat percentage on the limbs than in the rest of the body). This, of course, is in accordance with rules of growth. It is also known that hypokinetic individuals have less muscle mass on their legs as opposed to other parts of the body and the body has, overall, a higher percentage of fat. The absolute values of the skin cilium in the centre of the thigh above the quadriceps are distinctively variable, this variability growing with the increasing corpulence of the individual.

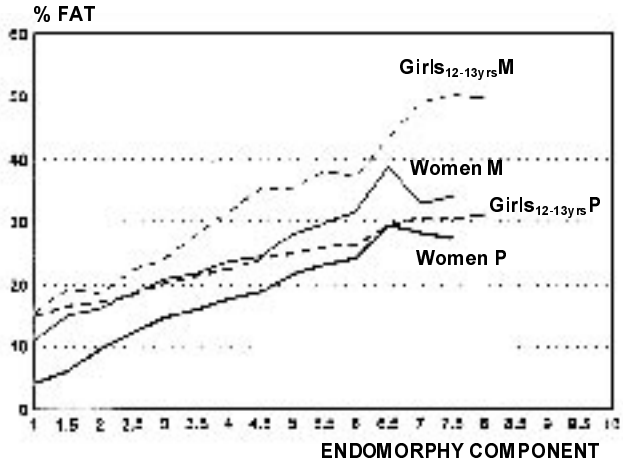
By processing the central indices, we found some interesting as well as alarming results in the apprentice population of the Specialised High School in Olomouc (construction workers). The indices evaluating the ratio of fat in the body and on the limbs (x2, x3) for 16, 17 and 18-year-old apprentices amount from 1.23 to 1.39 units and demonstrate a centrifugal dispersion (higher fat volume in the body). The average value of WHR index of these ranged within 86.6 and 86.9 %, the average value of WHR index for PE students ranged around 83.4 %. Using the Molisson index, the difference between both groups can be regarded as above average (n. i. = 0.99 s).

TABLE 2
Females – average percentual values of body factions based on the Matiegka methodology with revised values

	Early Childhood II. – girls from classes with common PT education		Adults PE students
Feature	12yrs n = 116	13yrs n = 119	19yrs n = 174
	$\bar{x}$ s	$\bar{x}$ s	$\bar{x}$ s
% K	18.98 2.36	17.92 1.91	15.60 1.30
% S	35.93 4.07	33.44 3.66	40.43 3.32
% T	25.12 7.99	24.99 9.25	20.87 4.51
% R	19.96 4.64	20.42 5.62	22.67 3.73

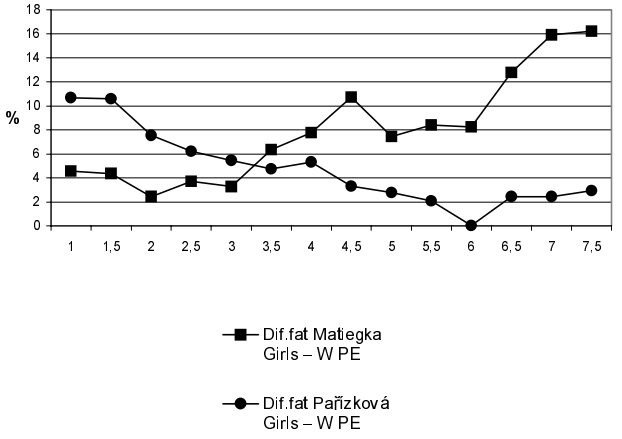
In 12 and 13 year old girls attending primary school, the percentage of bone mass is again higher than in the physical education students, this trend also follows the percentage of fat. Muscle development is significantly lower. This corresponds with ontogenetic and motoric trends, the residuum percentage is within the range of average fluctuations.

Fig. 3
Average values of fat in relation to endomorphic component values (P = percentage of fat based on Pařízková methodology, M = percentage of fat based on Matiegka methodology)



In physical education students, the differences within the endomorphic component values are also quite stable and correspond to the total average difference of 6.34 %. In groups of girls of younger age, a lower intensity and volume of movement activity and constitution homogeneity, and a higher percentage of fat corresponds with this somatic type. The differences are variable and starting at 4.5 component, are very high.

Fig. 4
The differences between the percentual fat faction based on the Matiegka and the Pařízková methodologies in relation to the endomorphic component of somatic type (Girls – PE Women)



The differences up to the 3.5 grade are higher in the estimate using the Pařízková methodology, and in higher endomorphic components using the Matiegka methodology. They do not grow linearly as in males, but from the beginning they demonstrate irregular fluctuation.

The centrality indices (x2, x3) for PE students correspond to 0.96 and 0.99, which shows harmonic dispersion of fat cells. The 12 year old girls ($\bar{x}2$ 0.77, $\bar{x}3$ 0.78) show again a centripetal fat dispersion, whereas in 13 year old girls the percentage of fat revealed by the skinfold test to be in the body and on the limbs levels out, however at higher absolute levels ($\bar{x}2$ 0.78, $\bar{x}3$ 0.94).

In 10 to 13 year old girls from classes with a concentration on sports (longitudinal observation – Vostrejžová, 2001), harmonic fat dispersion was also found in comparison with girls of the same age from classes with common physical training education who exhibit a centripetal character. Similarly, boys of the same age from sports classes are more inclined to harmonic fat dispersion, however boys from classes with common physical training education show a predominance of centripetal tendencies. A similar trend can be found in average values of centrality index determined as x3.

General conditions for the origin of different results:

First of all, it is important to consider the technique of mechanical measuring of skinfolds and differences in used callipers. The differences in skin elasticity and thickness are generally considered to be negligible. On the average, the skin thickness below the shoulder blade is mentioned as the highest, based on sex, age and tissue hydration. A certain role can be played also by skin type (Hajniš, 1989). Following Prader (1976), it is also necessary to consider the skinfold variability. Vacková (1993) talks about skinfold compression, she mentioned significant differences between skinfold above the iliac crest, above the iliospinal point and above the biceps brachii. As the most suitable for hypodermic fat determination as well as for total adiposity, the majority of authors give preference to the subscapular and pre-biceps brachii skinfolds.

Vacková (1993) in her work did not confirm this assumption and also our conclusions do not directly correspond with her statement. The simplified evaluation is not capable of grasping the fat layer development in the abdominal region and it can often be misleading. The correlation relations for the triceps skinfold with the abdominal skinfold in the children's group amount to the high level of tautness (0.80), considering the skinfold below the shoulder blade with only to the mid-tautness level (0.60).

CONCLUSIONS

The conclusions are stated as answers to the questions mentioned in the introduction.

1. The methodology of 10 skinfolds according to Pařízková gives usually lower results in comparison with the Matiegka methodology (6 skinfolds), the differences in evaluation increase with growing thickness of fat layers. The mentioned methodologies are based on different number of skinfolds, that do not always have the same location. The construction of the regression equation is substantial, it also depends on age, sex, constitution and movement activity intensity, and on harmonic fat tissue dispersion conditions. This allows variability for some skinfolds distinctively influencing calculations, to enter the result (skinfold in the middle of thigh above the quadriceps femoris, skinfold above the patella). Greater differences can be found in females and generally in individuals with a higher volume of hypodermic fat. Hypokinetic individuals have atonic muscles in the legs and the body has a higher percentage of fat. This situation is better characterized by the skinfold measurement performed on the middle of the thigh above the quadriceps femoris than by the one above the patella. This choice of skinfold location is also supported by the fact that in females it is considered to be one of the critical points of hypodermic fat cumulation.
2. To determine the endomorphology using only 3 skinfolds, (triceps, subscapular and suprailical), it is necessary that the resulting point evaluation be received by the skinfold total within the closest higher value among closest lower values. The range also increases with the endomorphological grade increase (3.9 mm for 2.5 component, 4.2 mm for 3.0 component, 4.8 mm for 4.0 component, 6.4 mm for 5.5 component, 7.9 mm for 7.0 component up to 26 mm for 12.0 component). That is why the differences in people with higher fat volume increases.

A group of authors state that measuring subcutaneous fat using callipers is more precise than other methods. We agree with this conclusion. When selecting the processing and then, the interpretation method, it is important to consider all variables that could influence results. A direct comparison is then possible only using absolute values of skinfolds measured by the same type of callipers.

REFERENCES

Hajniš, K., Brůžek, J., & Blažek, (1989). *Růst českých a slovenských dětí.* Praha: Academia.

Prader, A., Hernesnieni, I., & Zachmann, M. (1976). Skinfold thickness in infancy and adolescence – a longitudinal study in normal children. In Laron, Karger (Ed.), *The adipose child* (pp. 84–88). Basel.

Riegerová, J. (1995). Confrontation of results of the body fat evaluation using three somatometrical methodologies. *Acta Univ. Palacki. Olomuc., Gymn., 25*, 15–23.

Riegerová, J., & Přidalová, M. (1996). Evaluation of the body from the point of view of anthropometrical methodologies and Bodystat 500. *Acta Univ. Palacki. Olomuc., Gymn., 26*, 31–34.

Vacková, B. (1993). *Podkožní tuk v dospělosti* (přímé měření). Disertační práce, Univerzita Karlova, Přírodovědecká fakulta, Praha.

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METODOLOGICKÉ ASPEKTY HODNOCENÍ TĚLESNÉHO SLOŽENÍ – ROZBOR ANTROPOMETRICKÝCH METODIK

(Souhrn anglického textu)

Souhrn je formulován jako odpovědi na otázky položené v úvodní kapitole.

1. Metodika 10 kožních řas podle Pařízkové dává obvykle nižší výsledky ve srovnání s metodikou Matiegky (6 kožních řas), rozdíly v hodnocení narůstají s rostoucí tloušťkou tukových vrstev. Uvedené metodiky vycházejí z rozdílného počtu řas, které nemají vždy stejnou lokalizaci. Podstatná je konstrukce regresní rovnice, dále záleží na věku, pohlaví, konstitučním typu a intenzitě pohybové aktivity, podmiňující harmonii rozložení tukové tkáně. Tím do výsledku vchází i variabilita některých kožních řas výpočet výrazněji ovliňujících (kožní řasa ve středu stehna nad m. quadriceps femoris, kožní řasa nad patellou). Vyšší diference nacházíme u žen a obecně u jedinců s vyšším množstvím podkožního tuku. U hypokinetických jedinců bývá svalstvo na dolních končetinách ochablé a poměr tělesné hmoty je posunut na stranu tuku. Tuto situaci lépe vystihne řasa ve středu stehna nad m. quadriceps femoris než nad patellou. Výběr řasy podporuje také skutečnost, že u žen je tato lokalizace považována za jedno z kritických míst kumulace podkožního tuku.
2. Ke stanovení endomorfie jsou potřebné pouze 3 kožní řasy (na tricepsu, subskapulární a suprailiakální), výsledné bodové hodnocení je získáno součtem řas v rozmezí hodnot nejblíže vyšších či nejblíže vyšších. Také toto rozmezí se zvyšuje s nárůstem známky za endomorfii (3,9 mm pro komponentu 2,5, 4,2 mm pro komponentu 3,0, 4,8 mm pro komponentu 4,0, 6,4 mm pro komponentu 5,5, 7,9 mm pro komponentu 7,0 až 26 mm pro komponentu 12,0). Proto se diference u osob s vyšším množstvím tuku zvyšují.

Řada autorů uvádí, že měření podkožního tuku pomocí kaliperu je přesnější než měření jinými metodami. K tomuto závěru se plně přikláníme. Při volbě metodiky zpracování a následné interpretaci je třeba zvažovat všechny proměnné, které výsledky ovlivňují. Přímé srovnání je pak možné pouze u absolutních hodnot kožních řas měřených stejným typem kaliperu.

Klíčová slova: tělesná stavba, rozbor antropometrických metodik, indexy centrality.

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INSTRUCTIONS FOR MANUSCRIPT FOR THE ACTA UPO GYMNICA

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

General instructions

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

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

All contributions are reviewed anonymously.

Interface of the contribution

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

Text of the contribution

Names of individual chapters are to be written in capital letter from the left margin. References to quoted authors see a brief from the FTK UP publication manual.

Epilogue of the contribution

A reference summary, (see a brief from the FTK UP publication manual), address of the main author, summary including the key words.

Tables, pictures, graphs, appendices

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

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

We look forward to our further cooperation!

Doc. PhDr. Vlasta Karásková, CSc.
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Obecné pokyny

Text příspěvku v jazyce českém (1×) odevzdejte laskavě výkonnému redaktorovi. Na základě doporučující recenze upraví autor příspěvek k publikaci.

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Tabulky, obrázky, grafy, přílohy

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

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Děkujeme Vám za spolupráci.

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