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EFFECT OF DIFFERENT PHYSICAL ACTIVITIES ON PHYSICAL PERFORMANCE AND SOME PSYCHOPHYSIOLOGICAL CHARACTERISTICS OF YOUNGSTERS AGED 11 – 14 YEARS

UČINEK RAZLIČNIH TELESNIH AKTIVNOSTI NA ZMOGLJIVOST IN NEKATERE PSIHOFIZIJOLOŠKE ZNAČILNOSTI 11 DO 14 LETNIH UČENCEV IN UČENK

ABSTRACT

The purpose of this study was to verify the effectiveness of physical activities of various levels of intensity, realized within the range of compulsory, non-compulsory and other interest physical activities of pupils aged 11 – 14 years. A sample of 240 observed pupils was divided into two groups. One group (25 boys, 25 girls) with a high and the second one (25 boys, 25 girls) with low intensity physical activities. The intensity of physical activity was diagnosed by means of questionnaires and quantified in output of energy given as a percentage of their basic metabolism. The results in other methods, such as the physiological tests (oxygen consumption; Ruffier's test), psychological tests (need for achievement, EPI) and several motor abilities tests; confirm that children with intensive physical activity attain significantly: – better performances in most of the motor abilities tests, – higher values in oxygen consumption; nonsignificantly: - favourable indices in the achievement motivation test (net motivation). The final analysis recommends that teachers of physical education encourage positive attitudes towards physical activity in children for improvement of their regular physical activity (health and education benefits). Furthermore, they should support and develop the spontaneous physical activity of children together with the parents.

Key words: physical activity, physical performance, effectiveness of physical activity, achievement motivation.

IZVLEČEK

Namen raziskave je bil preverjanje učinkovitosti obveznih in neobveznih telesnih aktivnosti različne intenzivnosti in drugih interesnih dejavnosti 11 do 14 letne šolske mladine. Vzorec 240 učencev in učenk smo razdelili v dve skupini. Ena skupina (25 dečkov in 25 deklic) se je ukvarjala s telesno vadbo zelo intenzivno, druga (25 dečkov in 25 deklic) pa manj intenzivno. Diagnozo intenzivnosti smo postavili s pomočjo vprašalnika, zmogljivost pa izmerili s procentom bazičnega metabolizma. Rezultati drugih metod kot fiziološki testi (poraba kisika, Ruffierjev test), psihološki testi (želja po uspehu, EPI) in več testov za ugotavljanje motoričnih sposobnosti potrjujejo, da so učenci z intenzivno telesno vadbo signifikantno napredovali: dosegli so boljše rezultate pri večini motoričnih testov, višje vrednosti pri porabi kisika. Nesignifikantno: ugodni kazalci pri testu za ugotavljanje motiviranosti za uspeh. Končna analiza pa priporoča učiteljem športne vzgoje, da spodbujajo pri svojih učencih pozitivni odnos do telesnih aktivnosti za izboljšanje svoje redne športne vzgoje (zdravstvene in vzgojne koristi). Nadalje naj bi podpirali in razvijali spontano telesno aktivnost skupaj s starši.

Ključne besede: telesna aktivnost, uspeh, učinkovitost telesne aktivnosti, motivacija

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Introduction

As a consequence of the technical and technological progress the physical activity of young people is less intensive than before. This is detrimental because the function of movement for children, compared with the adult population, is more important. The optimal amount of physical activity for children is not only a means to improve health, physical efficiency and performance, but also an important factor in stimulating and coordinating their development. We should not forget this important educational function. The development of individuals depend also on themselves. The subject selects from the environment the stimuli which are attractive to him. This activity increases during the ontogenetic development. The analysis of physical efficiency and performance of young people in Czechoslovakia indicates (PÁVEK 1972, KOSTKA at al 1987; RYCHTECKÝ 1989) that the usual physical activities (locomotion, school programme, spontaneous games) and physical education in schools are not sufficient for their optimal development. Other forms of physical activities (school, sport clubs, spontaneous activity etc.) are also very important. These activities influence not only the physical development of young people, but they contribute to the formation of attitudes towards physical education and also other personality traits. The purpose of the present study was to verify the effectiveness of various physical activities of different intensity. The above-mentioned physical activities cover the range of compulsory, non-compulsory and other physical activities of interest in the development of the average pupil of 11 – 14 years of age. It was hypothesized that youngsters - boys and girls in the followed age period involved in a more intensive motor regime attain in their development higher norms in physiological (oxygen consumption, Ruffie's index), psychological (achievement motivation) characteristics and higher indices in physical performance (tests of motor abilities).

Methods

The research was conducted with pupils from two primary schools in Prague, which offers favourable conditions for physical education. The following methods were used:

I. Somatometry:

- *body height* /cm/
- *body weight* /kg/
- *body fat*, measured of skinfold in musc. triceps brachii and estimate of the percentage of body fat, by approach, verified by PAŘÍZKOVA (1977) /%/

II. Tests of motor abilities

- *standing broad jump* /cm/
- *flexed arms hang* /s/
- *sit-ups* (120 s)/number/
- *50 m dash* /s/
- *12-minutes-run* /m/

III. Physiology

- *everyday physical activities programme*, registered by questionnaires, during a week. Output of energy in percentage of basic metabolism /% BM/ (SELINGER 1974)
- *efficiency of cardiovascular system* – Ruffier's index. In this test we follow the changes in pulse rate (PR): 1) at rest; 2) after a standard workload (30 complete knee-bends in 45 seconds); 3) one minute after workload. From the sum of the three PR we than calculate the index according to the

$$\text{formula: } \frac{PR_1 + PR_2 + PR_3 - 200}{10}$$

/index/, (STUBBLER 1966)

- *multi-stage 20 m shuttle run test* (VO_2 /ml/kg*min⁻¹) (LEGER & LAMBERT 1982)
- *bicycle-ergometry test* (VO_2 /ml/kg*min⁻¹)

IV. Psychology

- *achievement need questionnaire test*, diagnosing the motivation behind total and net achievement /points/ (HOŠEK, MAN & KLÍMA 1979)
- *personality traits*, EPI – junior form /points/ EYSENCK (1960).

In our study, in which 240 pupils took part, we used a questionnaire derived by SELINGER (1974), in order to estimate a complex of physical activities both organized and spontaneous, during a period of one week. The advantage of that method is evidently in the possibility to measure a long period of time. Its disadvantage results from great demands on a good collaboration between pupils and researchers and from the necessity to control the obtained data.

The questionnaire, which is used quite frequently in practice, enables the expression of intensity of partial physical exercise and all kinds of physical activity through the *output of energy* (percentage of individual rate of basic metabolism). The relationship between the data on movement activities acquired with the help of questionnaires and, on the other hand, by measuring energy output, i.e., pulse rate, has been verified by STEPHARD (1967). In our research the pupils filled in the forms carefully. They filled in all their physical activities for 24 hours during a whole week. Their written reports were then transferred to a quantitative scale according to the intensity of their physical activity (there are eight

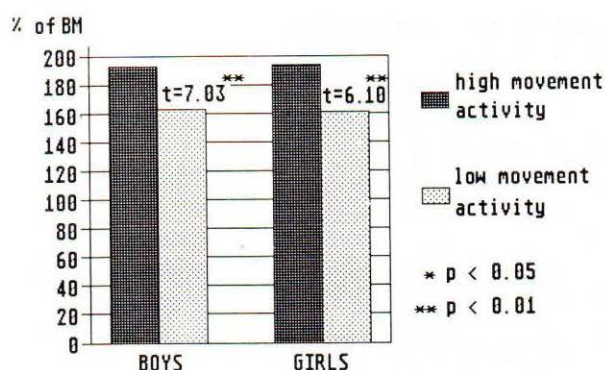


Fig. 1. Results in physical activity (weekly movement activity programme)

stages; from the first – lying down asleep, to the eighth – active movement of considerable intensity) and expressed them as an output of energy (percentage of their basic metabolism).

For our study 25 (boys, girls) with low physical activities in their everyday programme were selected as were and 25 (boys, girls) with high physical activities in accordance with of their percentage of basic metabolism (% BM), measured during a period of one week (see Fig. 1).

The achievement need was diagnosed by the questionnaire MOVYK-II-SK (HOŠEK, MAN KLÍMA 1979). This questionnaire tests two basic tendencies in the achievement need: the expectation to succeed (ES) and the fear of failure (FF). By adding these

tendencies together (ES + FF) we get the total achievement motivation and by subtracting them (ES - FF) we get the net achievement motivation.

Results

The results obtained from the measurement of physical activities of the observed youngsters made it possible to form two groups. One group with a high (output of energy more than 185% of BM) and the second one with a low (output of energy less than 170% of BM) intensity physical activity. The results of other methods are presented in Table 1 (boys) and Table 2 (girls).

The evaluation of somatometric data shows significant ($p < 0.01$) differences in body weight and body fat. The boys and girls with a low intensity of physical activity have higher values of body weight ($t = 3.009$; $t = 3.295$) and body fat ($t = 3.634$; $t = 3.500$). These findings correspond with the physiological results obtained in estimating oxygen consumption in the multi-stage 20 m shuttle run test ($t = 13.363$; $t = 7.765$) and in the bicycle-ergometry test in the laboratory ($t = 3.506$; resp. $t = 2.700$). The pupils (boys and girls) with a weekly regime of high physical activities attained significantly ($p < 0.01$; $p < 0.05$) higher oxygen consumption in both tests. The higher indices of oxygen consumption in the multi-stage 20 m shuttle run test we explain by inter-indi-

TABLE 1
Results in observed indices (boys, N = 25 in each group)

Group with:	High movement activity more than 185 % BM		low movement activity less than 170 % BM		t-test	p
	Mean	SD	Mean	SD		
indices						
Body height (cm)	148.20	6.23	153.50	8.59	1.783	–
Body weight (kg)	47.54	5.87	46.41	8.67	3.009	**
Body fat (%)	14.65	2.46	20.05	4.71	3.634	**
Output of energ. (% BM)	192.90	12.12	163.30	8.34	7.032	**
Ruffier's index (index)	8.65	3.28	17.67	3.47	6.736	**
20 m shutt. run (VO ₂ /ml/kg*min ⁻¹)	54.84	2.09	44.27	1.74	13.363	**
bic. ergom./VO ₂ /ml/kg*min ⁻¹)	47.61	4.28	41.92	3.77	3.506	**
Stand. broad jump (cm)	169.46	14.55	156.77	20.36	1.799	–
50 m dash (s)	8.64	0.62	9.16	0.69	1.992	–
12 min run (m)	2451.25	263.43	2043.33	165.56	4.579	**
Bent-arms hang (s)	51.31	20.60	19.70	12.73	4.573	**
Sit-ups (numb/120 s)	68.46	18.05	50.62	10.83	2.955	**
Total motivation (points)	48.50	7.69	46.00	10.60	0.677	–
Net motivation (points)	33.15	9.63	31.55	7.93	0.452	–
Extroversion (points)	14.92	4.89	16.50	2.53	1.896	–
Neurot. tendenc. (points)	11.70	3.09	11.80	5.54	0.923	–

* $p < 0.05$

** $p < 0.01$

TABLE 2
Results in observed indices (girls, N = 25 in each group)

Group with: indices	High movement activity more than 185 % BM		low movement activity less than 170 % BM		t-test	p
	Mean	SD	Mean	SD		
Body height (cm)	155.20	9.84	159.50	6.42	1.277	—
Body weight (kg)	44.85	8.82	56.26	8.41	3.295	**
Body fat (%)	20.34	2.65	25.54	4.57	3.500	**
Output of energ. (% BM)	193.40	11.07	161.10	6.97	6.105	**
Ruffier's index (index)	9.67	4.82	17.35	4.35	4.150	**
20 m shutt. run (VO ₂ /ml/kg*min ⁻¹)	51.38	2.33	42.96	3.07	7.765	**
bic. ergom./VO ₂ /ml/kg*min ⁻¹)	40.30	6.07	33.00	6.90	2.700	**
Stand. broad jump (cm)	173.50	23.26	145.00	14.12	3.650	—
50 m dash (s)	9.09	0.67	9.76	0.76	7.980	—
12 min run (m)	2214.66	271.99	1741.45	154.44	5.149	**
Bent-arms hang (s)	34.92	15.44	13.07	17.24	3.333	**
Sit-ups (numb/120 s)	59.08	12.35	42.83	10.11	3.560	**
Total motivation (points)	44.30	5.95	34.00	11.27	0.554	—
Net motivation (points)	42.84	7.17	37.07	10.13	0.452	—
Extroversion (points)	16.53	2.43	15.58	3.94	1.256	—
Neurot. tendenc. (points)	13.92	5.32	15.15	4.62	2.212	—

* p < 0.05

** p < 0.01

vidual competition, which arises among the subjects during the testing procedures (see Fig. 2.). The better efficiency of the cardiovascular system of groups with higher physical activity was confirmed also in the Ruffier's index ($t = 6.736$; $t = 4.150$). The positive effect of intensive physical activities is evident from the parameters of physical performance. The results in tables 1 and 2 indicate that higher level of spontaneous physical activities constitutes an important part in the structure of physical

activities of the observed pupils and has also a positive effect on their physical performance. The investigated differences are in most cases (excluding standing broad jump and 50 m dash for boys) statistically significant. For example the differences in the 12-minute-run ($t = 4.579$; $T = 5.149$), reflect not only the amount of persistence (see Fig. 4.), but also the influence of achievement need (see Fig. 3.) of the more active youngsters (RYCHTENCKÝ 1988).

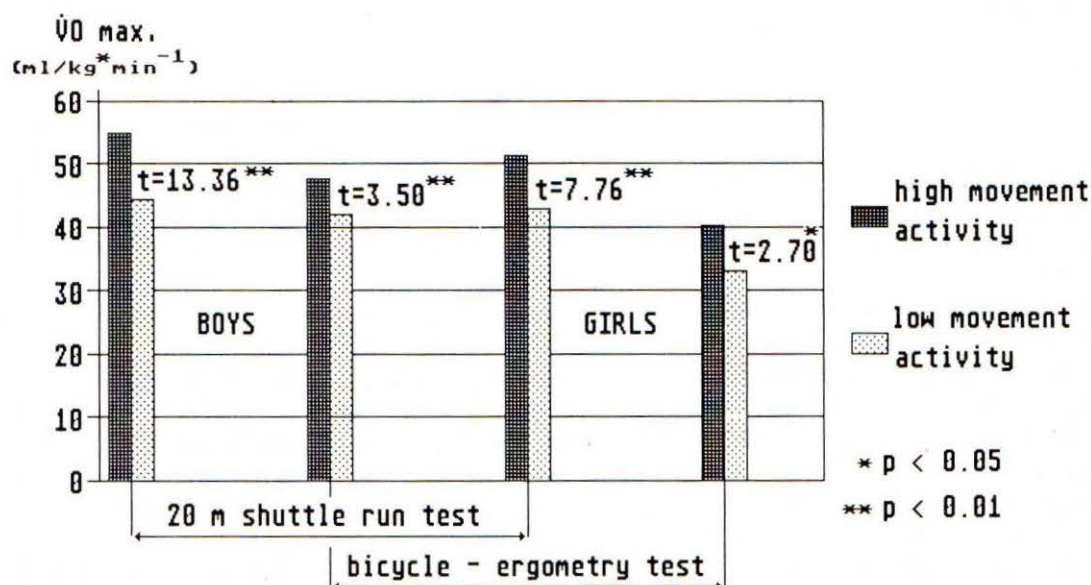


Fig. 2. Results in oxygen consumption

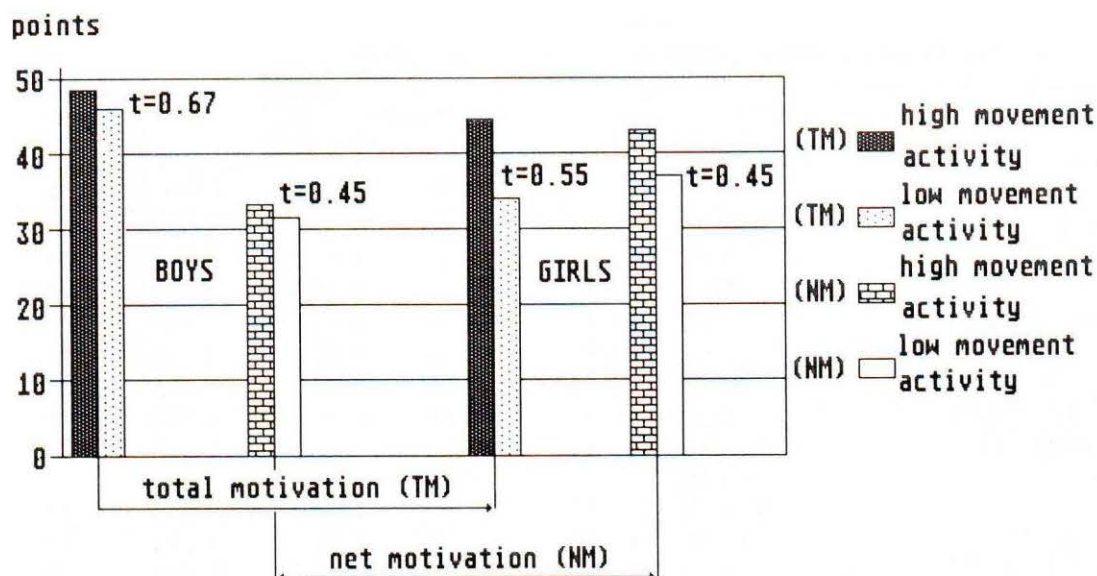


Fig. 3. Results in achievement motivation

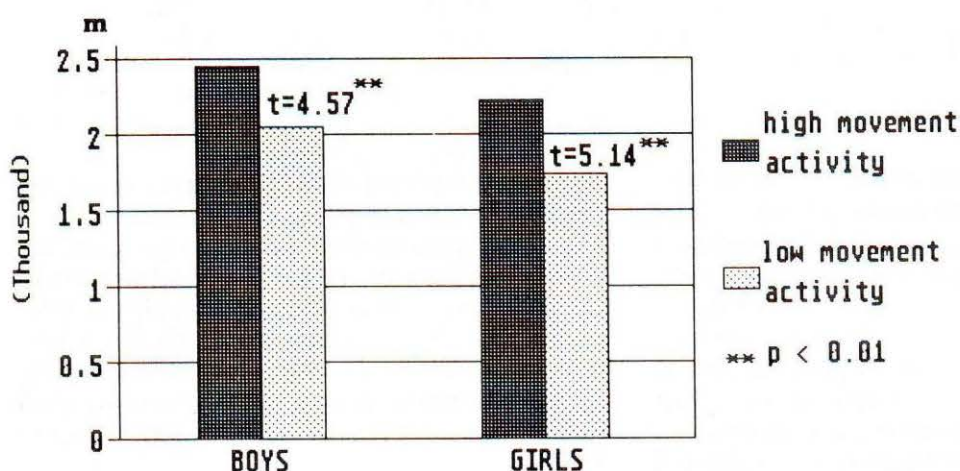


Fig. 4. Results in 12 min. run

Discussion

The analysis of everyday physical activities of the observed youngsters confirms our hypothesis that spontaneous physical activities of children (playing with friends, physical activity, games and activities with their parents etc.) form the most important component of physical activities of their life and bring positive health and educational benefits. Other interesting results show (Table 1 and Table 2) that children with more intensive physical activities and better physical performance are smaller (non-significant), weigh less and especially have less body fat. These pupils (boys and girls) are probably not as advanced in their ontogenetic development, and obviously feel a higher need for physical activity in their everyday programme (they practice it more of-

ten) than children from the second group (with lower movement activity). This result corresponds with the theoretical assumption, that the need for movement decreases with biological age of pubescents (VANEK & al 1984). The pupils who have been more actively taking part in physical activity, have more consistent and coherent structures of their motivation than the less active ones. On the other hand, for subjects with lower physical activity (second groups) it is rather typical to avoid intensive physical activities. These differences in attitude towards physical activity will probably be the cause of significant differences in physical performance (more in girls than boys) between both investigated groups. The differences between the psychological data (achievement need, being extrovert or introvert, neurotic tendencies) in both investigated groups are

not statistically significant, but the obtained data shows more positive personality traits in the groups with high physical activity (see Fig. 3.). They have a favourable structure of achievement motivation (especially boys, where links between self-confidence and physical performance can be supposed). These pupils are moderately less extrovert and they score lower in neurotic tendencies than pupils with low physical activity.

On the basis of these results we recommend the following practices of compulsory physical education:

– Teachers of physical education should devote much more attention to the formation of attitudes towards physical education by means of selected methods, employing the individual approach in evaluating the pupils.

– To support and stimulate spontaneous movement activity of children together with their parents.

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