PHYSICAL DEVELOPMENT, FUNCTIONAL CAPACITY AND MOTOR FITNESS OF ADOLESCENTS LIVING IN PREŠOV REGION

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- body height,
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- Eurofit,
- boys.

Abstract:

The study presents partial findings of the research supported by Slovak Research and Development Agency pursuant to contract no. APVV-0768-11 entitled Physical, functional and motor development of secondary school students in the reflection of their physical activity. The study aimed to determine current level of somatic development, functional capacity and general motor fitness of 15-year-old boys (n = 50) attending different secondary technical schools located in Prešov region. Boys were measured for body height, body weight and skinfold thickness and also performed Ruffier test and Eurofit test battery items to measure their functional capacity and general motor fitness, respectively [3]. Data on physical development and motor fitness were compared with population data collected in 1993 and 1994 through administration of the Eurofit control-information system. In physical development, comparison of results showed that body height plateaued, mean body height, mean sum of skinfolds and thickness of 4 skinfolds except for triceps skinfold increased. The evaluation of general motor fitness showed higher performance when tested by 'flamingo test' and bent-arm hang test. Comparable motor fitness was found for the sprint shuttle run, but for 6 other tests, boys tested within the present study demonstrated lower performance capacity compared to their counterparts tested 20 years ago. Mean value of the Ruffier test was 11.1 points, which indicates low functional capacity. The results have shown lack of physical activity in the lifestyle of examined adolescents.

INTRODUCTION

At present, volume of physical activity performed by both adults and school-aged children is permanently decreasing. Their leisure-time activities are reduced to following mass media or internet media while seated or standing [2]. Furthermore, children demonstrate negative attitude towards physical education and physical activity in general. Despite the fact that active lifestyle significantly affects body composition and physical fitness of school-aged children [5], only small proportion of youth is active athletes with a positive attitude towards sports [6]. Lack of physical activity is a negative lifestyle factor deteriorating health of contemporary people; however, youth are not fully aware of this fact. In addition to high-calorie diet, lack of physical activity leads to undesirable changes in body composition and declining level of physical fitness. Monitoring of physical development and physical fitness of school populations is crucial in terms of following trends in negative effects of an unhealthy lifestyle as early as adolescence and also points to the need to seek effective ways of how

children and youth can adopt a positive attitude towards life-time participation in physical activity [4].

One of the possibilities of determining current levels of physical development and general motor fitness of school-aged population is to administer Eurofit test battery consisting of 9 motor tests and anthropometric parameters - body height, body weight and sum of skinfolds [3].

THE AIM OF THE WORK

The aim of the study was to determine and compare current level of physical development, functional capacity and motor fitness of 15-year-old adolescent students attending selected schools located in Prešov region with the results achieved by their counterparts who performed Eurofit test items in 1993 and 1994.

THE MATERIAL AND THE METHODOLOGY

A sample of 50 boys (age: x = 15.83 $\pm$0.37 years) attending 5 secondary technical schools located in Prešov region participated in testing administered in September and October 2014/2015. This study was supported by Slovak Research and Development Agency pursuant to contract no. APVV-0768-11 entitled Physical, functional and motor development of secondary school students in the reflection of their physical activity. Students were duly informed about the course of testing. Among the basic anthropometric parameters measured were body height, boy weight, BMI (Body mass index) and the sum of 5 skinfolds. Body height was measured using stadiometer Seca to the nearest 0.1 cm and body weight using InBody 230 to the nearest 0.1 kg. BMI was computed according to formula body weight in kilograms divided by body height in meters squared: BW (kg) / BH^2 (m). Skinfold thickness (triceps skinfold, biceps skinfold, subscapular skinfold, supraspinal skinfold and calf skinfold) was measured by caliper Best to the nearest 0.5 mm. Body height, body weight and BMI were evaluated according to national growth standards from 2011 for particular age categories.

To determine levels of functional capacity, students performed Ruffier test consisting of 30 squats in 45 seconds. The time interval to perform squats was accompanied by an audio signal. Carotid pulse rate was measured by palpation. Three pulse rates were inserted into the formula to compute Ruffier index: Index = (PR1 + PR2 + PR3 – 200) / 10 and the index was evaluated according to Ruffier test standards [1] shown in Table 1.

Table 1. Ruffier index standards [1]

Index value	Functional capacity
0 or less	Excellent
1 – 5	Good
5.1 – 10	Average
10.1 – 15	Poor
over 15.1	Very poor

To determine the levels of general motor fitness students performed Eurofit test battery items: balance ‘flamingo’ test (BT), plate tapping (PT), sit-and-reach test (SRT), standing broad jump (JUMP), sit-ups (SU), bent-arm hang – underhand grip (BAH), sprint shuttle run (SSR) and endurance shuttle run (ESR). The results of physical development and general motor fitness measurements were compared with the results of the nationwide survey of school population based on administration of Eurofit test battery in 1993 and 1994, which has enabled to assess trends in physical development and motor fitness of adolescent population over the last two decades.

Descriptive statistics was used to process data and t-test for independent samples was applied to compare mean values of particular physical development and motor fitness parameters.

RESULTS AND DISCUSSION

Physical development

Basic statistical characteristics of anthropometric parameters for the studied sample of 15-year-old boys are presented in Table 2. Compared to reference values of age-matched Slovak population tested in 2011 within 7th Slovak nationwide anthropometric survey of children and youth (NAS 2011) [7], mean values of body height, body weight and BMI of contemporary 15-year-old boys were found to be lower. According to nationwide growth charts, mean BMI value of present boys reached 70th percentile. The intra-individual analysis of BMI values showed that 2 boys (4%) were identified as overweight (90th to 97th percentile) and 2 boys as obese (over 97th percentile), respectively. All 4 students had higher sums of skinfolds, which indicates greater proportion of body fat in their body composition.

Table 2. Basic statistical characteristics of anthropometric parameters for boys (n = 50, mean age = 15.8 years) and comparison with nationwide age-matched population [7]

Anthropometric parameters	Boys (n = 50)				NAS 2011 (n = 838)	
	x	s	min	max	x	s
Body height (cm)	174.0	7.6	155.0	194.6	175.8	7.6
Body weight (kg)	62.3	11.1	41.4	99.3	66.0	12.9
BMI (kg . m $^{-2}$)	20.6	3.0	16.5	30.3	21.3	3.5

Note: x - mean; s - standard deviation; min - minimal value; max - maximal value; n - number; NAS 2011 - national anthropometric survey 2011; BMI - body mass index

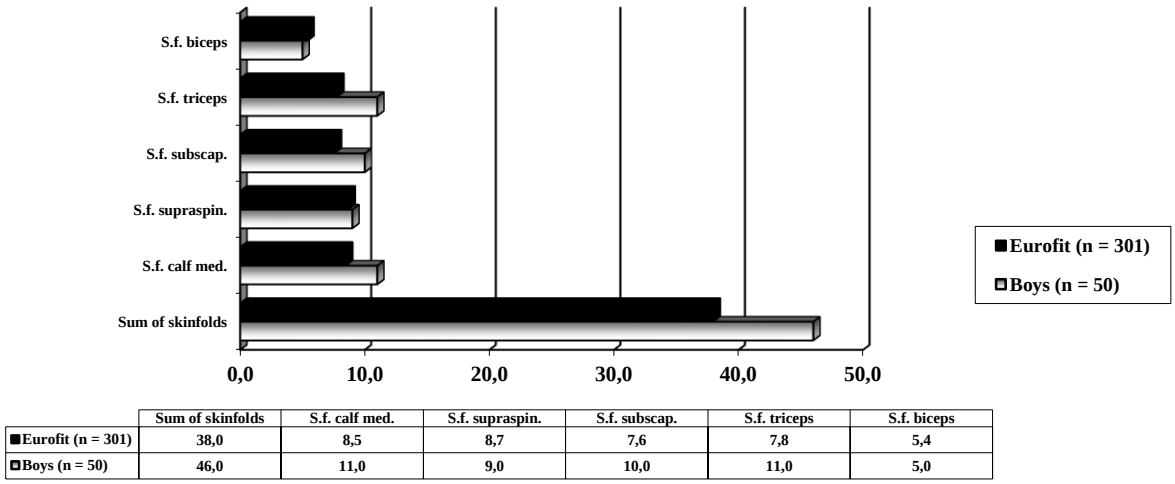
Comparison of data on physical development with age-matched school population tested by Eurofit test battery in 1993 and 1994 are presented in Table 3 and Figure 1. At present, boys were of the same body height, but their body weight was greater by 1 kg and the sum of skinfolds by 8 mm. The analysis of particular skinfolds (see Figure 1) showed higher mean thickness of all skinfolds except the biceps skinfold. Greatest differences were found for triceps skinfold (3.2 mm), calf skinfold (2.5 mm) and subscapular skinfold (2.4 mm). Differences in skinfold thickness were statistically significant for the sum of all 5 skinfolds ($p<.05$) and for the subscapular skinfold and calf skinfold ($p<.01$).

These results also correspond with the results of 7th Slovak nationwide anthropometric survey of children and youth conducted in 2011, which over the last decade from 2001 to 2011 revealed that Slovak adolescents lack acceleration stimuli and secular trend in body height. However, there is an ongoing increase in mean values of body height resulting in greater BMI [7].

Table 3. Comparison of physical development parameters for boys (n = 50, mean age = 15.8 years) and Eurofit sample tested in 1993 and 1994 (n = 301, mean age = 15.5 years) and statistical significance in differences between samples (t – test)

Physical development parameters	**Boys** (n = 50)				**Eurofit sample** (n = 301)		
	x	**s**	**min**	**max**	**x**	**s**	**t**
Body height (cm)	**174.0**	7.6	155.0	194.6	**174.0**	7.3	0.000
Body weight (kg)	**62.3**	11.1	41.4	99.3	**61.3**	9.3	1.808
∑ 5 skinfolds (mm)	**46.0**	24.0	16.0	124.0	**38.0**	13.2	2.277*
Triceps skinfold (mm)	**11.0**	5.0	3.0	27.0	**7.8**	3.3	4.328**
Biceps skinfold (mm)	**5.0**	3.0	2.0	14.0	**5.4**	2.2	0.894
Subscapular skinfold (mm)	**10.0**	7.0	4.0	38.0	**7.6**	2.3	2.379*
Supraspinal skinfold (mm)	**9.0**	6.0	2.0	35.0	**8.7**	4.5	0.334
Calf skinfold (mm)	**11.0**	5.0	2.0	27.0	**8.5**	3.5	3.367**

Note: t - testing criterion; *p<.05; **p<.01



	Sum of skinfolds	S.f. calf med.	S.f. supraspin.	S.f. subscap.	S.f. triceps	S.f. biceps
Eurofit (n = 301)	38,0	8,5	8,7	7,6	7,8	5,4
Boys (n = 50)	46,0	11,0	9,0	10,0	11,0	5,0

Figure 1. Comparison of average skinfold thickness values (mm) for boys (n = 50, mean age = 15.8 years) and sample tested by Eurofit in 1993 and 1994 (n = 301, mean age = 15.5 years)

Functional capacity

Ruffier test is one of the most administered functional capacity tests in practice. The analysis of pulse rates allows for assessment of functioning and adaptation of the cardiovascular system to physical load. When evaluating the test, the lower the index, the higher the functional capacity level.

Basic statistical characteristics of functional capacity parameters tested by Ruffier test are presented in Table 4 and index standards are presented in Table 1. The results showed that mean value of Ruffier index was 11.1 points, which indicates poor level of functional capacity (10.1 - 15.0 points). Ruffier index values ranged from 1.6 points (best) to 24.4 points (worst).

Table 4. Basic statistical characteristics of Ruffier index for boys (n = 50, mean age = 15.8 years)

Ruffier test	**Boys** (n = 50)			
	x	**s**	**min**	**max**
Index	**11.1**	5.1	1.6	24.4

Note: x - mean; s - standard deviation; min - minimal value; max - maximal value; n - number

Figure 2 shows percentage of boys in particular categories according to values of Ruffier index. None of the boys achieved excellent Ruffier index score (0 and less) and 3 boys (6.0%) achieved good Ruffier index score (1 to 5 points). Almost half of the boys (48%) had an average functional capacity (5.1 to 10 points) and one third of the boys (30%) had a poor level of functional capacity (10.1 to 15 points). Very poor level of functional capacity (over 15.1 points) was found in 16.0% of boys. The results of Ruffier test highlight high school students' highly unfavorable levels of functional capacity.

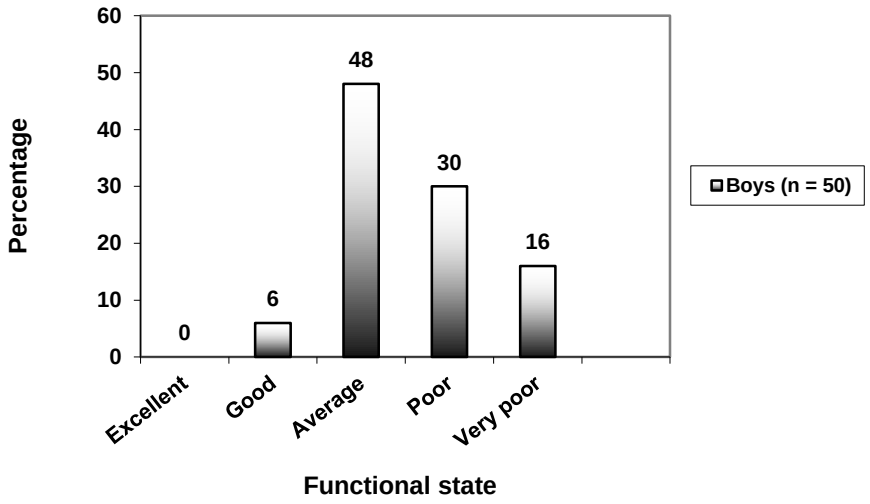


Figure 2. Percentage of boys in categories according to Ruffier index

Motor fitness

Basic statistical characteristics of general motor fitness parameters for boys and comparison with results achieved by their age-matched counterparts tested by Eurofit test battery in 1993 and 1994 are presented in Table 5. Great range between the minimal and the maximal values and standard deviations in particular tests show significant differences between samples of boys in all motor abilities. Compared to their counterparts tested 20 years ago, boys tested within this study achieved higher mean scores in only two tests, i.e. balance 'flamingo' test and bent-arm hang with significant differences between samples in both tests ($p<.01$ and $p<.05$), respectively. Mean scores were comparable only in the sprint shuttle run. Contemporary boys achieved lower mean scores in 6 remaining tests, where differences between samples of boys were statistically significant in all six tests. Most significant differences in motor fitness were found for plate tapping, sit-and-reach test, standing broad jump and endurance shuttle run ($p<.01$) and for sit-ups ($p<.05$). The results of the study show declining motor fitness levels of contemporary adolescents. What plays an important role when testing motor fitness is motivation and willpower of tested individuals to achieve the highest performance possible.

Table 5. Comparison of general motor fitness parameters for 15-year-old boys and sample tested by Eurofit in 1993 and 1994 (n = 50, mean age = 15.8 years) and statistical significance (t-test)

Motor fitness parameters	**Boys** (n = 50)				**Eurofit sample** (n = 301)		
	x	**s**	**min**	**max**	**x**	**s**	**t**
Balance test (trials)	**7.6**	4.2	1	22	**9.8**	6.3	3.135**
Plate tapping (sec.)	**12.9**	2.9	8.4	24	**10.1**	1.5	6.615**
Sit-and-reach test (cm)	**2.6**	8.7	- 14.0	21	**23.8**	8.3	16.482**
Standing broad jump (cm)	**193.3**	26.5	140	248	**210.6**	20.3	4.365**
Hand dynamometry (kg)	**42.4**	8.4	14	6.1	**46.0**	7.7	1.460
Sit-ups (number/30 sec.)	**23.5**	4.0	16	36	**27.2**	4.7	2.540*
Bent-arm hang (sec.)	**41.9**	25.0	0	90	**34.2**	18.8	2.062*
Spring shuttle run (sec.)	**20.1**	3.1	4.4	25.6	**19.2**	1.8	1.978
Endurance shuttle run (number of 20-meter runs)	**38.1**	23.8	3.5	90	**70.3**	21.6	8.488**

Note: x - mean; s - standard deviation; min - minimal value; max - maximal value; n - number; t - testing criterion; *p<.05; **p<.01

CONCLUSIONS

The analysis of physical development parameters of 15-year-old boys participating in the study conducted 20 years after the national anthropometric survey showed moderate increase in both body weight and sum of skinfolds with plateauing values of body height. These results are consistent with the nationwide trend in adolescent physical development observed over the last few decades. The analysis of functional capacity and general motor fitness parameters showed unfavorable state of students' fitness level, which points to lack of movement stimuli in the lifestyle of adolescents participating in this study. Functional capacity of as much as 2 thirds of boys ranged from an average to poor functional levels. Twenty years after national anthropometric survey, evaluation of general motor fitness parameters revealed significantly lower trunk flexibility, lower-body explosive power, running endurance and upper-body frequency ability.

This emphasizes the need to deal with the issue of physical fitness in relation to health as sufficient level of physical fitness bears preventive relevance when dealing with health problems arising from hypokinesis. Engaging in physical activity during childhood and adolescence is crucial in terms of predicting active motor behavior in adulthood. Therefore, both school and parents play an irreplaceable role by fully realizing that children need to be led to engage in higher volume of physical activity especially within their leisure time and by becoming role models for their children in terms of adopting a healthy and active lifestyle.

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