BODY DEVELOPMENT AND FUNCTIONAL FITNESS OF HIGH-SCHOOL STUDENTS IN THE PREŠOV REGION

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- body height,
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Abstract:

The paper presents the partial results of a research task supported by the Slovak Research and Development Agency based on agreement No. APVV-0768-11 titled 'Physical, functional and motoric development of high-school youth in relation to their physical activity'. The research problem is focused on identifying the current level of physical development and functional fitness of high-school students in the Prešov region. The screened sample consisted of 207 boys aged between 15 – 19 years from five High Vocational schools. We examined body height, body weight, BMI and thickness of five skin folds in each participant. Functional fitness was assessed using the Ruffier test. Data of body development were evaluated according to national growth charts and comparison with data collected from measurements of the Slovak school population using Eurofit in 1993 and 1994.

Result analysis indicates that the average values of body height, body weight and BMI of the examined group are at the level of reference values of the general Slovak population of the same age. 20 years on, we can state an increase in average body weight and the sum of skin folds in all monitored age categories which points to an increase in the proportion of body fat in body composition. Analysis of functional fitness reveals that average values of Ruffier index in all age categories are at a level of poor functional state.

INTRODUCTION

Nowadays, a negative worldwide trend is increasing hypokinesis of the population as a result of the modern technological age. A life-style characterised by an absence of physical activity has become a widespread social problem which includes children and youths. Mostly passive leisure activities result in decreased physical fitness and mean a higher risk of excessive body fat stores as well as a higher risk of diseases. Physical activity belongs to the strongest risk factor for cardiovascular and metabolic diseases. Therefore, physical activity is considered an important factor positively influencing one's health [1]. The optimal period to create a permanent relationship with sport and physical activities is considered to be in childhood and adolescence. Within the education system, school physical education plays an irreplaceable role as many times it is the only subject in the current model of education which prepares a pupil not only from the physical point of view but also in terms of health. Studies indicate that spontaneous physical activity decreases in adolescence, especially in girls after 14 year and in boys between 16 – 18 years [2]. Based on these findings, it is necessary to constantly monitor the physical and functional development of the school population and to adopt adequate measures for their enhancement.

The aim of the papers is, within project No. APVV-0768-11, to evaluate the current level of body development and functional fitness in high-school students in five selected high schools in the Prešov region.

METHODS

The research group consisted of 207 boys from the 1st to the 4th grade of High Vocational schools in Svidník, Stropkov, Medzilaborce, Stará Ľubovňa and Svit. The 1st grade consisted of 50 boys (age x = 15.83 ± 0.37), the 2nd grade included 66 boys (age x = 16.72 ± 0.35), the 3rd grade 42 boys (age x = 17.86 ± 0.64) and the 4th grade 49 boys (age x = 19.20 ± 0.37).

Testing took place in the gyms of the selected High Vocational schools in September and October of the 2014/2015 academic year. This study was supported by the Slovak Research and Development Agency based on agreement No. APVV-0768-11 titled 'Physical, functional and motoric development of high-school pupils in relation to their physical activity'. Participants were properly informed about the process of testing.

We examined basic anthropometric parameters – body height, body weight, BMI (Body mass index) and thickness of five skin folds. Body height was measured using a Seca body length meter with accuracy of 0.1 cm and body weight was measured using an InBody 230 device with accuracy of 0.1 kg. BMI was calculated according to the following equation: BW (kg) : BH^2 (m). Thickness of skin folds (above triceps, above biceps, on the back – subscapularis skin fold, on the hip – supraspinalis skin folds and on the calf - calf medialis skin fold) was detected using a Best calliper with accuracy of 0.5 mm.

Body height, weight and BMI were further assessed according to national growth charts for the particular age categories. The monitored parameters of body development were compared to results of nationwide testing of the school population using the Eurofit test battery in 1993 and 1994, which enabled researchers to evaluate a trend in body development of the adolescent population over the last 20 years. The level of functional fitness was examined using the Ruffier test.

A time interval for 30 squats in 45 seconds was started and stopped using an audible signal. Participants' pulse was assessed using palpation on a. carotis. The obtained values of three pulse frequencies were further entered into the formula for the Ruffier test calculation: I = (PF1 + PF2 + PF3 - 200) : 10 and described according to the Ruffier index [4] presented in Table 1. Data were finally processed using basic statistical characteristics.

Table 1. Evaluation of the Ruffier index [4]

Index	**Functional level**
0 and less	Excellent
1 – 5	Good
5.1 – 10	Average
10.1 – 15	Poor
over 15.1	Insufficient

RESULTS AND DISCUSSION

Body development

Longitudinal monitoring of anthropometric indicators of Slovak children and youths carried out in 10-year intervals within Slovak anthropometric surveys enables us to monitor trends in changes in growth and development of children and youths. Conclusions of the last 7th nationwide anthropometric survey from 2011 point to the fact that acceleration trends in growth as well as secular trend in body height are already ceasing. The unfavourable is an

accelerated increase of body weight values along with decelerated growth which is inevitably reflected in increased BMI values in all age categories of boys and girls [6].

Basic statistical characteristics of anthropometric indicators of the tested group of boys are presented in Table 2. According to national growth charts, average values of boys' body height in particular age categories take place at the level from the 50th to the 55th percentile, i.e. in the area of medium body height.

Average values of body weight oscillate around the 75th percentile and are in the area of normal weight. BMI is the basic, commonly used parameter for assessment of overweight and obesity in population. However, it must be taken into account that it does not reflect the ratio between body fat and fat free mass in body composition.

The groups of boys in particular age categories took place between the 50th and 70th percentile with their average values of BMI. The lowest average BMI was 20.6 and was found in 15-years-old boys, while the highest value 23.1 in 18-years-old boys. Using an intra-individual analysis, we identified 12 boys (5.8%) in the degree of overweight (the 90th – the 97th percentile) and 19 boys (9.2%) at the level of obesity (over the 97th percentile). Apart from one participant, all these higher BMI values were accompanied by higher sums of skin folds, which indicate an increased proportion of body fat in the body composition.

Along with increasing age, we recorded the increase in average values of body height up to the 17th year, while body weight had an upward trend up to the 18th year. The most significant increase of BH and BW was between the 15th and 16th year by 2.3 cm and 6.4 kg. 18-years-old boys achieved average body height 175.8 cm, body weight 72.4 and BMI 23.1 $kg.m^{-2}$.

Table 2. Basic statistical characteristics of anthropometric parameters in the sample of boys

		BH (cm)	**BW** (kg)	**BMI** (kg . m^{-2})
1st grade (n = 50)	**x**	**173.9**	**62.3**	**20.6**
	s	7.6	11.1	3.0
2nd grade (n = 66)	**x**	**176.2**	**68.7**	**22.1**
	s	6.0	10.3	3.1
3rd grade (n = 42)	**x**	**177.4**	**69.8**	**22.0**
	s	6.1	14.4	4.0
4th grade (n = 49)	**x**	**175.8**	**72.4**	**23.1**
	s	6.3	11.8	3.0

Note: BH – body height BW – body weight n- number x – arithmetic mean s – standard deviation

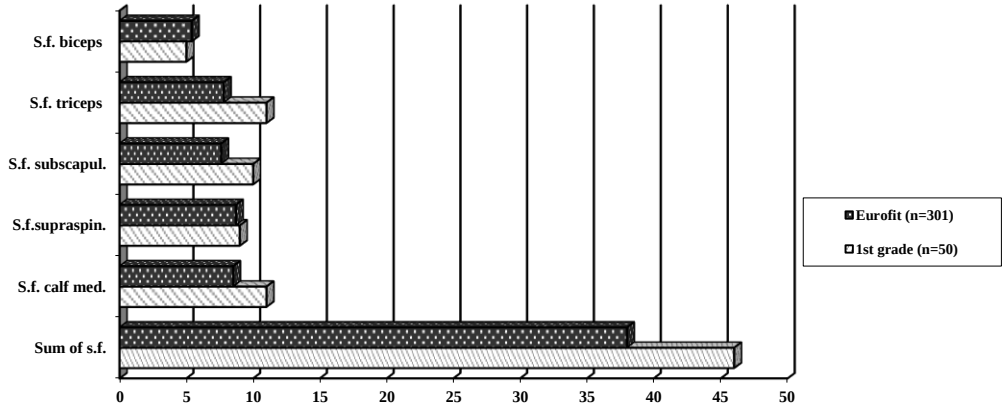
Comparing body development of the tested group of boys with measurements of the Slovak school population using the Eurofit battery in 1993 and 1994

Based on the comparison with results of subjects measured using the Eurofit battery in 1993 and 1994, we detected average values of body height in 15-years-old to 17-years-old boys on the similar level than their peers before 20 years, while in the 18-years old boys we revealed lower average values, namely by 3.6 cm when compared with boys tested in 1993 and 1994.

Concerning the values of body weight, as well as the sum of skin folds, we revealed their increase in the currently tested group of boys in all age categories in comparison to the tests carried out 20 years ago; this fact points to the increased proportion of fat in body composition. The greatest difference in the sum of skin folds was found in 16-years-old boys which made 20.3 mm and in 18-years-old boys which means 20.0 mm. On the contrary, the slightest difference was found in 15-years-old boys and it was 8.0 mm. Analysis of average

values of skin fold thickness (Figure 1 – 4) revealed increased values in all age categories apart from the minimal difference in thickness of the skin fold above triceps in 15-years-old boys.

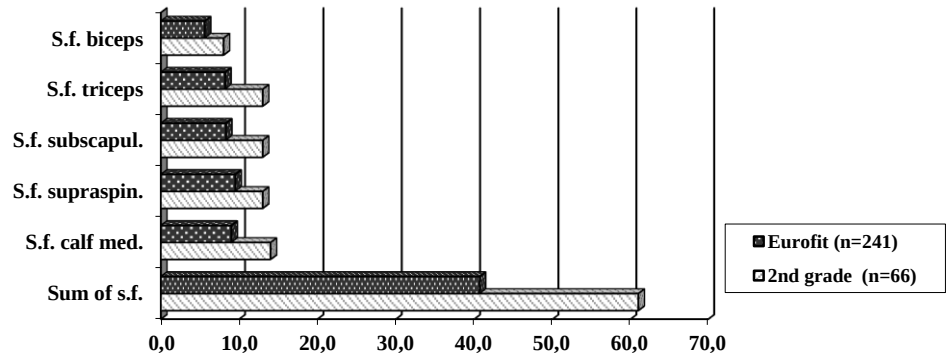
As illustrated in Figure 1, the greatest difference in thickness of skin folds in 15-years-old was found above triceps (3.2 mm) and the minimal difference in the skin fold above biceps (0.04 mm). The difference in the sum of skin folds was the lowest from all monitored categories, namely it was 8.0 mm.



	Sum of s.f.	S.f. calf med.	S.f.supraspin.	S.f. subscapul.	S.f. triceps	S.f. biceps
Eurofit (n=301)	38,0	8,5	8,7	7,6	7,8	5,4
1st grade (n=50)	46,0	11,0	9,0	10,0	11,0	5,0

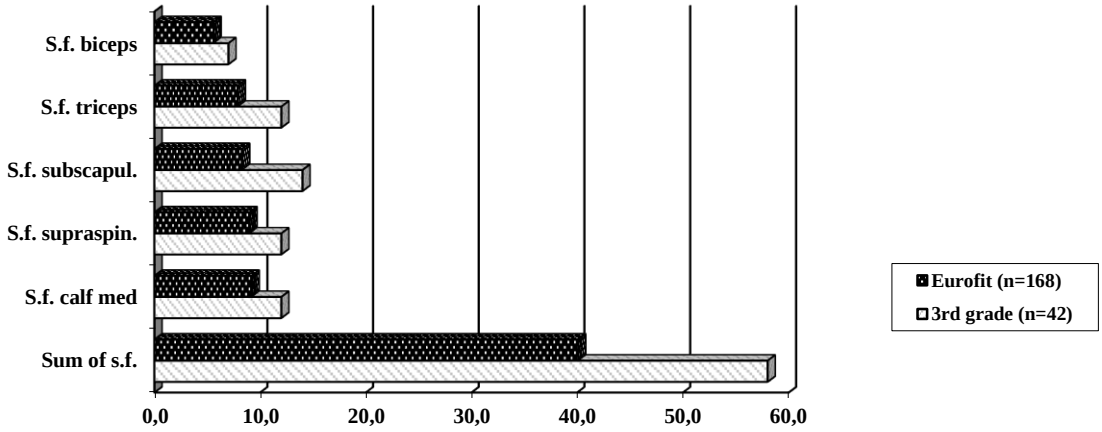
Figure 1. Comparison of average values of thickness of skin folds (mm) in boys of the 1st grade (n = 50, age x = 15.8) and the sample measured using Eurofit in 1993 and 1994 (n=301, age x = 15.5)

In 16-years-old participants (Figure 2), we detected the greatest difference in thickness of s.f. calf medialis (5.0 mm) and the lowest difference in s.f. above biceps (2.4 mm). The difference in the sum of s.f. was greatest from all monitored age categories; namely it was 20.3 mm. In the 17-years-old participants (Figure 3) we found the greatest difference in thickness of s.f. subscapularis (5.7 mm) and the lowest in s.f. above biceps (1.4 mm). The difference in the sum of s.f. was 17.9 mm.



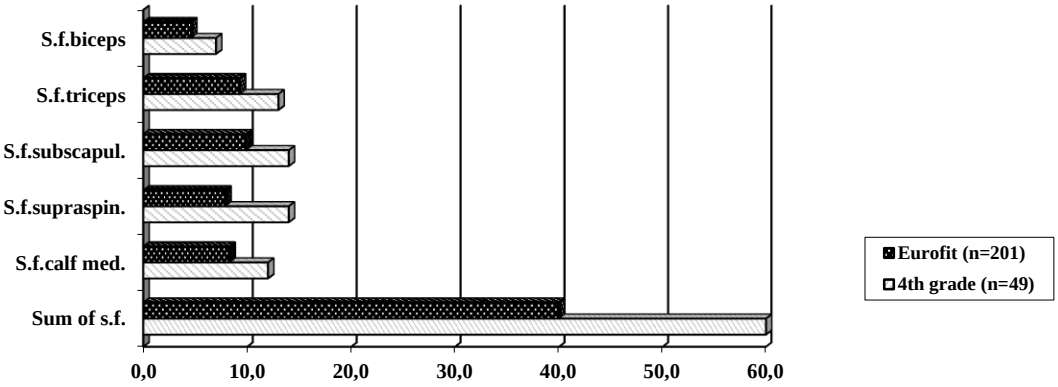
	Sum of s.f.	S.f. calf med.	S.f. supraspin.	S.f. subscapul.	S.f. triceps	S.f. biceps
Eurofit (n=241)	40,7	9,0	9,5	8,3	8,2	5,6
2nd grade (n=66)	61,0	14,0	13,0	13,0	13,0	8,0

Figure 2. Comparison of average values of thickness of skin folds (mm) in boys of the 2nd grade (n = 66, age x = 16.7) and the sample measured using Eurofit in 1993 and 1994 (n=241, age x = 16.5)



	Sum of s.f.	S.f. calf med	S.f. supraspin.	S.f. subscapul.	S.f. triceps	S.f. biceps
Eurofit (n=168)	40,1	9,2	9,0	8,3	7,9	5,6
3rd grade (n=42)	58,0	12,0	12,0	14,0	12,0	7,0

Figure 3. Comparison of average values of thickness of skin folds (mm) in boys of the 3rd grade (n = 42, age x = 17.9) and the sample measured using Eurofit in 1993 and 1994 (n=168, age x = 17.4)



	Sum of s.f.	S.f.calf med.	S.f.supraspin.	S.f.subscapul.	S.f.triceps	S.f.biceps
Eurofit (n=201)	40,0	8,3	7,9	9,9	9,3	4,6
4th grade (n=49)	60,0	12,0	14,0	14,0	13,0	7,0

Figure 4. Comparison of average values of thickness of skin folds (mm) in boys of the 4th grade (n = 49, age x = 19.2) and the sample measured using Eurofit in 1993 and 1994 (n=201, age x = 19.5)

As illustrated in Figure 4, in 18-years-old boys we found the greatest difference in thickness of s.f. supraspinalis (6.1 mm); on the contrary, the lowest difference was found in s.f. above biceps (2.4 mm). The difference in the sum of s.f. was 20.0 mm.

The results of physical development showed unfavourable changes in body composition noticeable over last decades and related mainly to the sedentary way of life.

FUNCTIONAL FITNESS

The Ruffier test belongs to simple functional tests assessing cardiovascular system work on the basis of monitoring heart rate. In its evaluation there is the rule that the lower value of index, the higher level of functional fitness. Basic statistical characteristics of the

monitored group's functional capacity assessment are presented in Table 3 and percentages of subjects according to the achieved values of the Ruffier index are depicted in Figure 5.

The analysis of assessment of functional fitness indicates that average values of the index in all age categories take place at the level of poor functional capacity. Intra-individual analysis of particular age categories showed that the average functional state category (5.1 – 10.0 points) had the greatest proportion, i.e. 48 % of subjects from the 1st grade, 40.0% subjects from the 3rd grade and 47% of subjects from the 4th grade, while participants form the 3rd grade (45.0%) fell to poor functional state category.

In any of the age category, participants with excellent functional state were not identified and there was only the minimal proportion of participants with good functional state. Another unfavourable finding is that almost the fifth of all subjects in each age category achieved an insufficient functional level with values above 15.1 points. The best result of the Ruffier test was achieved by a student from the 1st grade with the value of 1.6 points; on the contrary, another subject from the 1st grade achieved the worst result with 24.4 points. The results of functional fitness underline a very negative state of functional capacity in the monitored high school population.

Table 3. Basic statistical characteristics of the Ruffier index in the sample of boys

	1st grade (n = 50)	**2nd grade (n = 66)**	**3rd grade (n = 42)**	**4th grade (n = 49)**
x	**11.1**	**11.7**	**10.9**	**11.5**
s	5.1	4.2	4.1	4.0
max	24.4	22.0	20.0	19.6
min	1.6	2.0	2.0	3.2

Note: x – arithmetic mean s – standard deviation n - number max – maximum value
min - minimum value

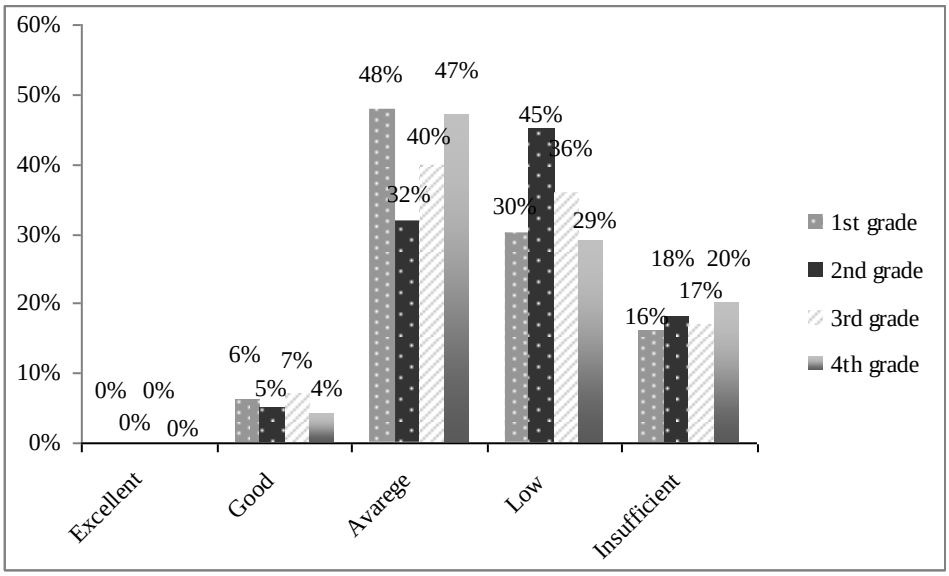


Figure 5. Percentage proportion of boys in the categories according to the achieved values of the Ruffier index

CONCLUSIONS

The analysis of parameters of body composition and functional fitness of the monitored group of high-school students in the Prešov region pointed revealed an unfavourable state. Based on the assessment of BMI according to national growth charts, we

identified 5.8% of boys in the degree of overweight (90^{th} – 97^{th} percentile) and 9.2 % in the degree of obesity (over the 97^{th} percentile), which corresponded with higher values of the sum of skin folds, apart from one participant. After 20 years, we detected increased values of body weight and the sum of skin folds in all age categories although body height was almost identical. Very unfavourable results were also found in the level of functional state. According to the assessment using the Ruffier index, the tested groups of boys of individual age categories achieved only poor functional state with points in the range between 10.1 – 15.0 and no subject, i.e. only minimal number of subjects achieved the level of excellent (0 and less points) and good (1 – 5 points) functional state.

According to the above stated, we suppose that the detected level of body development and functional capacity is the result of insufficient habitual physical activity and improper diet. However, also number of subjects and individual variability of small sample played some role. This finding is related to the need for searching effective intervention procedures focused on enhancing physical activity of children and youth so that it would become a natural lifelong lasting habit.

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