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TREND OF FITNESS AND SELECTED ANTHROPOLOGICAL CHARACTERISTICS OF THE YOUNG POPULATION IN THE NORTH MORAVIAN REGION (CZECH REPUBLIC) IN THE PAST 25 YEARS

ABSTRACT: The group of 719 boys and girls aged 15.1 to 18.9 years were tested. Anthropometric examination and continual stress exercise testing up to maximum was used. The results were compared to the results of the similar sample of the young population of the same age which were published by Seliger and Bartůněk in 1977 and with the results of the 5th All-state Anthropological Research of Children and Adolescents (1991), done in the selected markers. The Student's t-test for testing the statistical significance was used.

The sample included 424 boys and 295 girls. Tested group was taller in all age categories in comparison with that of 1977 and with the exception of 18 year-old girls, also heavier than the control group. Both sexes in all age categories had significantly less of body fat. The boys reached with the exception of the oldest age group a higher value of maximal oxygen uptake (VO_2 max) the girls reached a higher value of VO_2 max only in the category of the sixteen and seventeen year-olds. There were no important differences between both groups in the values per 1 kg of body weight (VO_2 max.kg^{-1}) with the exception of the youngest group of girls. The boys had in average 30% higher value of VO_2 max than the girls. Higher physical fitness of our sample in comparison with the individuals of the same age of the control sample is mainly given by a higher lean body mass and total dimensions of the present population.

In comparison with the results of the 5th National-wide Anthropological Survey of Children and Adolescents 1991, no statistical differences were found, except higher body weight and body mass index in 15 year-old girls and boys. The differences between both samples disappear with age.

The results of this research are in accordance with the findings of other authors, about slowing down a secular trend of increasing body height in the past few years. Results show a speeding up of growth in younger age categories, whereas the eighteen-year-old boys and girls have probably reached their maximum in their ontogeny in 1991.

KEY WORDS: Young population – Anthropology – Fitness – Czech Republic

INTRODUCTION

Changes which happened in the past two decades in the Czech Republic in the political and economical fields, have undoubtedly influenced life conditions and lifestyle of the young generation. The aim of our paper was to verify what kind of impact the aforementioned changes had on physical fitness and total development of the young generation of the North Moravian region (Czech Republic).

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METHODOLOGY

During the years 1999–2001, a sample of 719 boys and girls from the age of 15.1 to 18.99 years were tested. The sample included students of secondary schools (two classical high schools, one sports high school and three secondary technical colleges) and first-year university students of Ostrava University and VSB – Technical University of Ostrava. Basic internal examination, biochemical and hematological examinations, anthropometric, spirometric examinations and stress exercise test on bicycle ergometer were performed. For the stress exercise test a continual stress exercise test to maximum was used. Ventilation of lungs and the analysis of expiratory gases were measured by the machine AEROSPORT KB-1C (Medical Graphics Systems Inc.). Anthropometric examination included the measurement of 24 markers inclusive of the percentage of body fat ascertainment. The percentage of body fat was ascertained using the method of 10 skinfolds (Pařízková 1966).

A detailed anamnestic questionnaire including data about physical activity and life habits of the students, apart from personal and family anamneses, was also a part of the examination. The results were compared to the values of the control sample of the population of boys and girls of the same age from the Czech and Slovak Republics, which were published by Seliger and Bartůněk in 1977. A comparison with the results of the 5th All-state Anthropological Research of Children and Teenagers was done in the selected markers (Lhotská *et al.* 1993). We used the same methodology and instrument equipment for the anthropometric examination as in the control sample (Seliger, Bartůněk 1977), because of a maximal comparability of the measured data.

The Student's t-test on the level of importance of α=0.05 was used for testing the statistical importance of differences of arithmetic means. Statistical software Stata, version 7, was used for the evaluation. The symbol * is a mark for a statistically important difference ($p<0.05$), ** is a mark for a statistically very important difference ($p<0.01$), and *** is a mark for a statistically highly important difference ($p<0.001$).

RESULTS

The sample included 424 boys and 295 girls (*Table 1*). Lifestyle was evaluated according to physical activity, eating habits, consumption of alcohol and smoking. 50.7% of the students of our sample were doing competitive sports, 45.7% recreationally; only 3.4% of the tested do not do any sports. The number of teenagers doing competitive sports reduces with age; more so in girls. On the contrary, the percentage of teenagers doing sports recreationally or not doing any sports increases slightly (*Figures 1a, b*). 71% of the boys and 61.4% of the girls do sports activities three or more times a week, 10.6% of the boys and 21% of the girls do not do any sports or do sports less than once a week. More than 60% of the tested do sports for 9 or more hours a week, 17.4% for fewer than 6 hours a week. 13.2% of the boys and 15.3% of the girls smoke regularly (mainly up to 10 cigarettes per day). About 10% of the present non-smokers used to smoke before. 72.3% of the boys and 63.7% of the girls state the consumption of alcohol (mainly occasionally). Boys consume mainly beer, girls mainly wine. A predominant part of the students have meals at home and in the school canteen, 8.9% do not eat regularly or consume only cold meals. More girls (51.1%) than boys (21.8%) pay attention to quality composition of food. 44.1% of the girls, but only 17.3% of the boys are careful about having enough vegetables in food.

The boys and girls of the tested group were significantly taller in all age categories than the control group (*Figures 2a, b*), and with exception of 18 year-old girls also were heavier (*Figures 3a, b*). The tested group have significantly

TABLE 1. The number of tested boys and girls.

Age	Boys	Girls	Total
15.0–15.9	76	70	146
16.0–16.9	127	79	206
17.0–17.9	149	93	242
18.0–18.9	72	53	125
Total	424	295	719

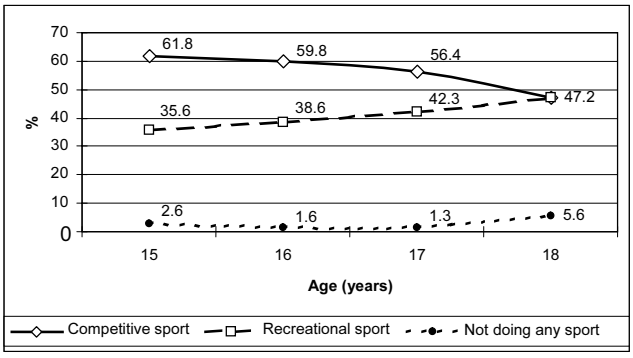


FIGURE 1a. Dependence of sport activity on age – boys.

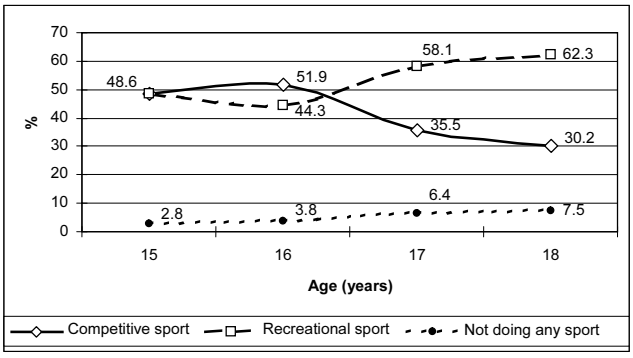


FIGURE 1b. Dependence of sport activity on age – girls.

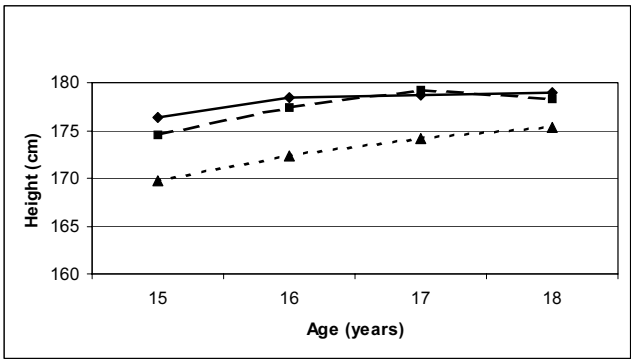


FIGURE 2a. Body height – boys.

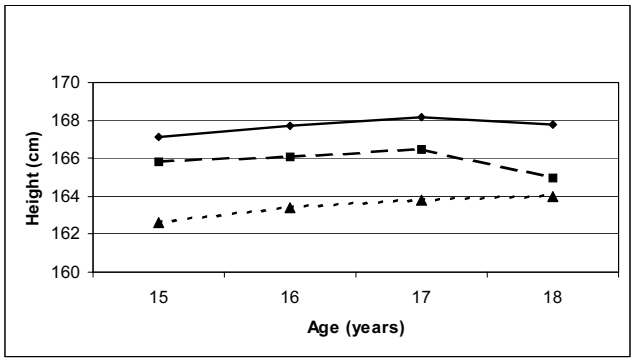


FIGURE 2b. Body height – girls.

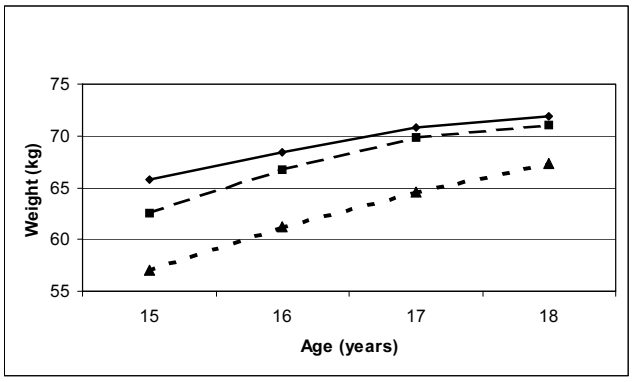


FIGURE 3a. Body weight – boys.

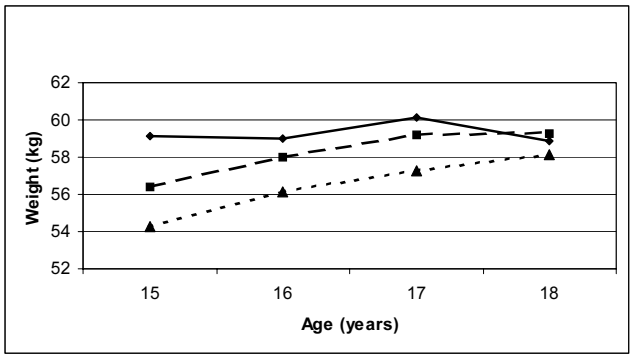


FIGURE 3b. Body weight – girls.

Tested group – Jirák *et al*. 2000

5th NSA 1991 0150 – 5th Nation-wide Anthropological Survey of Children and Adolescents 1991 (Lhotská *et al.* 1993)

Control group – Seliger and Bartůněk 1977

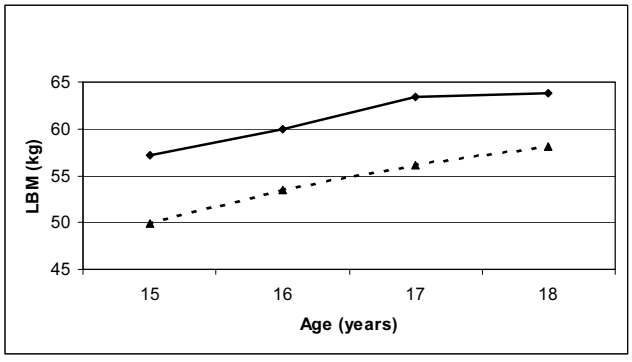


FIGURE 4a. Lean body mass – boys.

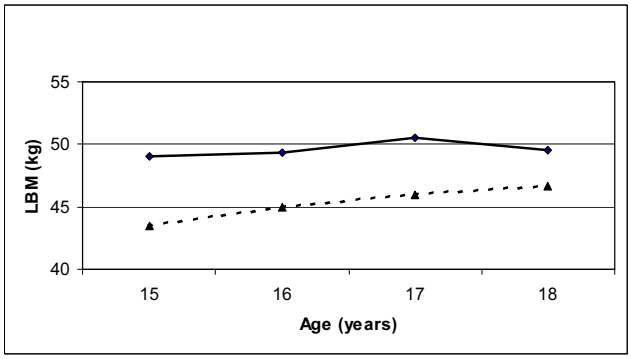


FIGURE 4b. Lean body mass – girls.

Tested group – Jirák *et al*. 2000

Control group – Seliger and Bartůněk 1977

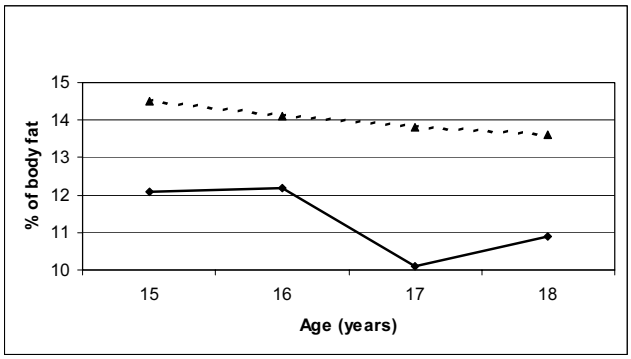


FIGURE 5a. Percentage of body fat – boys.

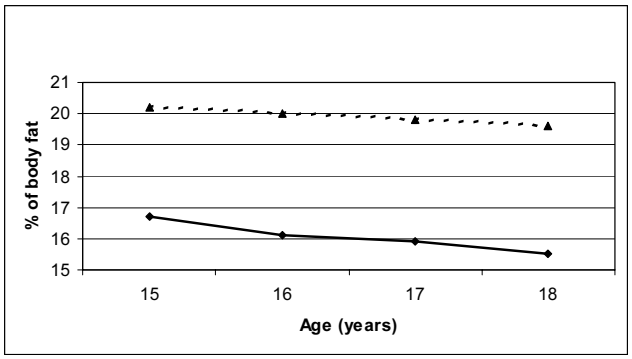


FIGURE 5b. Percentage of body fat – girls.

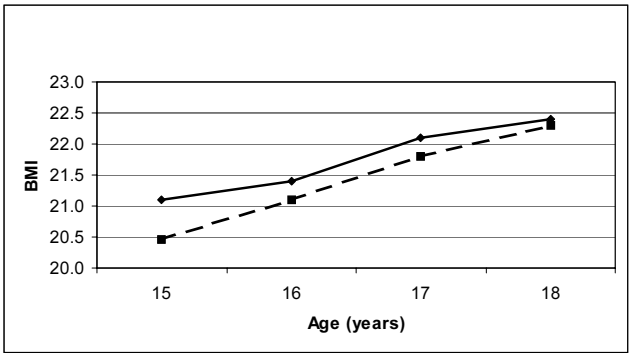


FIGURE 6a. Body mass index – boys.

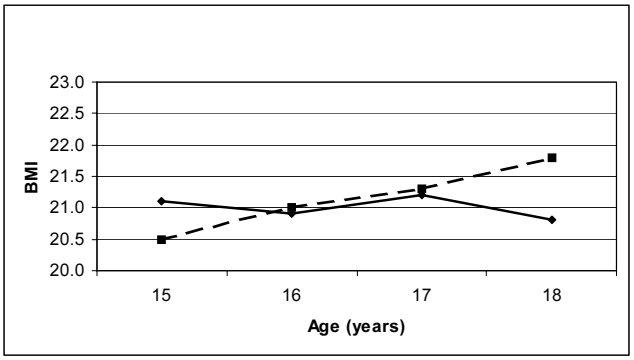
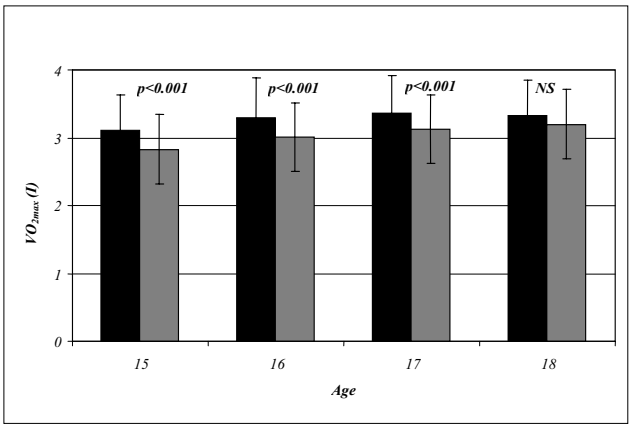
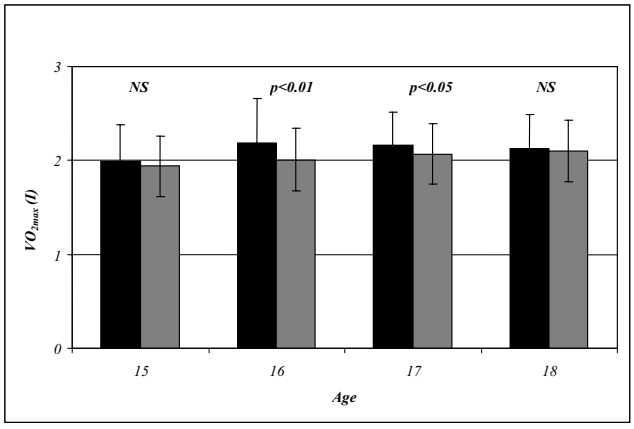


FIGURE 6b. Body mass index – girls.

Tested group – Jirák *et al*. 2000
5th NSA 1991 – 5th Nation-wide Anthropological Survey of Children and Adolescents 1991 (Lhotská *et al*. 1993)





Tested group – Jirák *et al*. 2000 **Control group** – Seliger and Bartůněk 1977

FIGURE 7a. Maximum oxygen uptake (VO_2 max) – boys.

FIGURE 7b. Maximum oxygen uptake (VO_2 max) – girls.

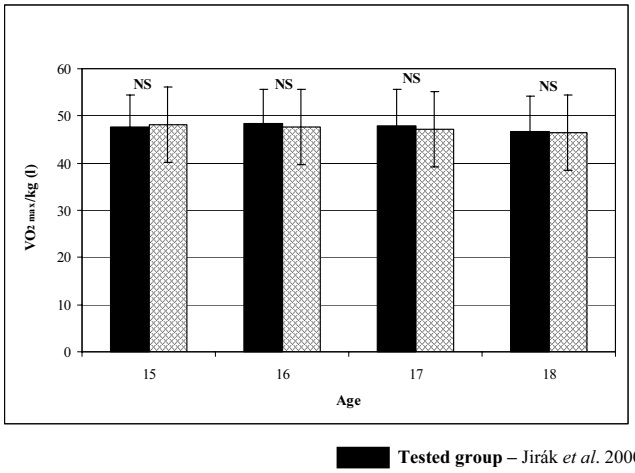


FIGURE 8a. Maximum oxygen uptake in the values per 1 kg of body weight (VO_2 max) – boys.

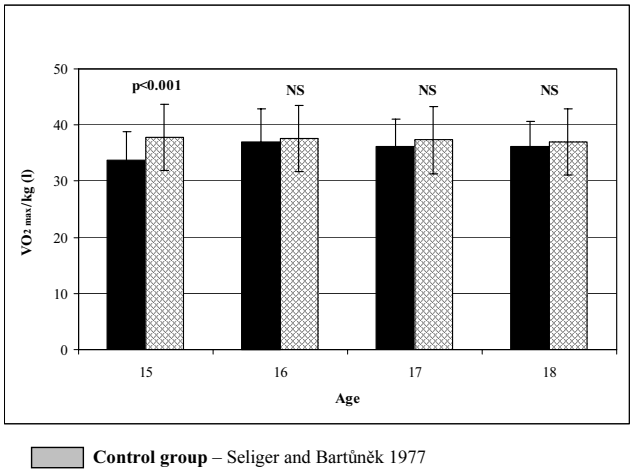


FIGURE 8b. Maximum oxygen uptake in the values per 1 kg of body weight (VO_2 max) – girls.

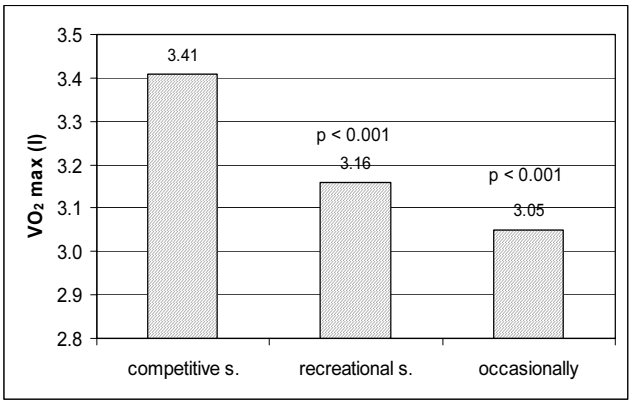


FIGURE 9a. Dependence of maximum oxygen uptake to the sport activity – boys.

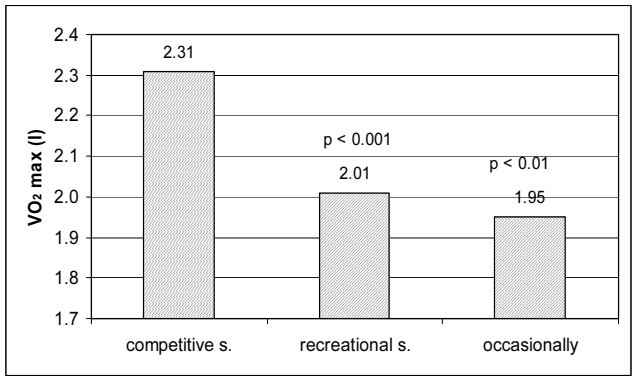


FIGURE 9b. Dependence on maximum oxygen uptake to the sport activity – girls.

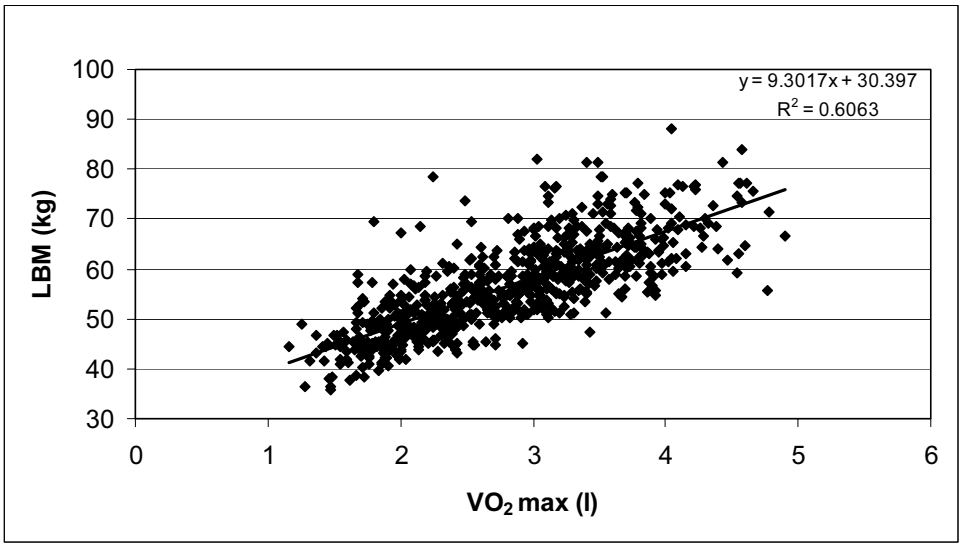


FIGURE 10. Correlation between lean body mass and VO_2 max.

TABLE 2. Boys 15.00–15.99 years old.

Age (years)	BOYS					
	Control group		5th NSA 1991		Tested group	
15.00 - 15.99	$\bar{x}$ [1)]	s	$\bar{x}$ [2)]	s	$\bar{x}$	s
Body height (cm)	169.70 ***	6.80	174.61 NS	7.62	176.26	7.97
Body weight (kg)	57.00 ***	8.90	62.58 *	9.54	65.81	11.73
LBM (kg)	49.90 ***	6.30			57.15	7.69
Body fat (%)	14.50 **	4.50			12.61	4.99
BMI (kg.m^{-2})			20.46 *	2.52	21.06	2.87
Sitting height (cm)	87.70 ***	4.20			90.84	4.46
Chest circumference I, middle	82.40 ***	5.90	85.53 **	6.78	88.53	6.82
Chest circumference I, insp.	87.20 ***	5.70			93.44	6.68
Chest circumference I, exp.	79.90 ***	6.20			85.16	6.53
Chest circumference II, middle.	76.70 ***	5.80			82.05	5.34
Chest circumference II, insp.	84.20 ***	5.50			88.16	6.18
Chest circumference II, exp.	77.00 ***	5.80			80.12	6.26
Bicristal width (cm)	25.50 ***	2.30			28.74	2.08
Bitrochanteric width (cm)	29.40 ***	2.40			32.78	2.16
Relax arm circumfer. R (cm)	25.40 ***	2.40			27.07	2.72
Relax arm circumfer. L (cm)	25.10 ***	2.40	26.08 **	2.62	27.10	2.90
Forearm circumference R (cm)	24.70 ***	1.60			25.57	1.82
Forearm circumference L (cm)	24.30 ***	1.60			25.01	1.84
Thigh circumference R (cm)	50.40 ***	4.10			54.82	5.89
Thigh circumference L (cm)	50.20 ***	4.10			54.60	5.80
Calf circumference R (cm)	34.10 ***	2.40			36.20	3.00
Calf circumference L (cm)	33.90 ***	2.50			36.19	3.00
Hand grip R (kp)	36.80 ***	8.60			45.53	8.62
Hand grip L (kp)	33.90 ***	8.10			42.14	8.51

[1)] Comparison control group and tested group
[2)] Comparison 5th NSA 1991 and tested group
* $p<0.05$; ** $p<0.01$; *** $p<0.001$; NS – no significant difference
Tested group – Jirák *et al*. 2000
5th NSA 1991 – 5th Nation-wide Anthropological Survey of Children and Adolescents 1991 (Lhotská *et al*. 1993)
Control group – Seliger and Bartůněk 1977

TABLE 3. Boys 16.00–16.99 years old.

Age (years)	BOYS					
	Control group		5th NSA 1991		Tested group	
16.00 - 16.99	$\bar{x}$ [1)]	s	$\bar{x}$ [2)]	s	$\bar{x}$	s
Body height (cm)	172.40 ***	6.80	177.65 NS	7.00	178.36	9.64
Body weight (kg)	61.20 ***	8.90	66.72 NS	9.60	68.39	7.48
LBM (kg)	53.50 ***	6.20			59.98	7.73
Body fat (%)	14.10 ***	4.50			12.19	3.97
BMI ($kg.m^{-2}$)			21.11 NS	2.53	21.41	2.34
Sitting height (cm)	89.20 ***	4.20			92.64	3.87
Chest circumference I, middle	85.20 ***	5.90	88.21 **	6.46	90.11	5.77
Chest circumference I, insp.	90.00 ***	5.70			95.04	5.53
Chest circumference I, exp.	82.30 ***	6.20			86.88	5.69
Chest circumference II, middle.	79.10 ***	5.80			82.20	5.64
Chest circumference II, insp.	86.60 *	5.50			88.09	5.44
Chest circumference II, exp.	79.20 NS	5.80			80.04	5.70
Bicristal width (cm)	26.10 ***	2.30			28.61	2.02
Bitrochanteric width (cm)	30.10 ***	2.50			33.05	2.83
Relax arm circumfer. R (cm)	26.30 ***	2.30			27.91	2.56
Relax arm circumfer. L (cm)	26.00 ***	2.40	27.12 **	2.71	27.77	2.55
Forearm circumference R (cm)	25.40 **	1.70			26.06	2.56
Forearm circumference L (cm)	25.10 NS	1.60			25.45	1.90
Thigh circumference R (cm)	51.70 ***	4.10			55.56	4.59
Thigh circumference L (cm)	51.50 ***	4.00			55.21	4.49
Calf circumference R (cm)	34.90 ***	2.40			36.57	2.88
Calf circumference L (cm)	34.70 ***	2.50			36.55	2.81
Hand grip R (kp)	39.80 ***	8.60			48.13	9.05
Hand grip L (kp)	36.70 ***	8.00			45.58	8.82

[1)] Comparison control group and tested group
[2)] Comparison 5th NSA 1991 and tested group
* $p<0.05$; ** $p<0.01$; *** $p<0.001$; NS – no significant difference
Tested group – Jirák *et al*. 2000
5th NSA 1991 – 5th Nation-wide Anthropological Survey of Children and Adolescents 1991 (Lhotská *et al*. 1993)
Control group – Seliger and Bartůněk 1977

TABLE 4. Boys 17.00–17.99 years old.

Age (years)	BOYS					
	Control group		5th NSA 1991		Tested group	
17.00 - 17.99	$\bar{x}$ 1)	s	$\bar{x}$ 2)	s	$\bar{x}$	s
Body height (cm)	174.10 ***	6.80	179.16 NS	6.72	178.72	6.95
Body weight (kg)	64.60 ***	9.50	69.93 NS	9.56	70.82	10.19
LBM (kg)	56.10 ***	6.30			63.38	7.48
Body fat (%)	13.80 ***	4.50			10.13	4.13
BMI (kg.m^{-2})			21.77 NS	2.64	22.08	2.67
Sitting height (cm)	90.30 ***	4.20			92.86	4.51
Chest circumference I, middle	87.60 ***	5.80	90.55 **	6.68	92.09	6.06
Chest circumference I, insp.	92.40 ***	5.60			96.81	5.78
Chest circumference I, exp.	84.20 ***	5.60			89.08	6.30
Chest circumference II, middle.	81.20 ***	5.70			84.03	5.68
Chest circumference II, insp.	88.50 *	5.40			89.83	5.64
Chest circumference II, exp.	80.80 NS	5.80			81.79	5.87
Bicristal width (cm)	26.60 ***	2.20			28.95	1.98
Bitrochanteric width (cm)	30.60 ***	2.50			33.15	1.70
Relax arm circumfer. R (cm)	27.00 ***	2.40			28.60	2.73
Relax arm circumfer. L (cm)	26.70 ***	2.40	27.92 **	2.66	28.51	2.76
Forearm circumference R (cm)	26.00 ***	1.70			26.58	1.75
Forearm circumference L (cm)	25.60 *	1.60			26.02	1.68
Thigh circumference R (cm)	52.80 ***	4.10			56.30	4.96
Thigh circumference L (cm)	52.60 ***	4.00			56.10	4.99
Calf circumference R (cm)	35.30 ***	2.50			36.97	2.71
Calf circumference L (cm)	35.40 ***	2.40			36.95	2.78
Hand grip R (kp)	42.10 ***	8.60			49.97	8.18
Hand grip L (kp)	38.90 ***	8.10			47.31	7.70

1) Comparison control group and tested group
2) Comparison 5th NSA 1991 and tested group
* $p<0.05$; ** $p<0.01$; *** $p<0.001$; NS – no significant difference
Tested group – Jirák *et al*. 2000
5th NSA 1991 – 5th Nation-wide Anthropological Survey of Children and Adolescents 1991 (Lhotská *et al*. 1993)
Control group – Seliger and Bartůněk 1977

TABLE 5. Boys 18.00–18.99 years old.

Age (years)	BOYS					
	Control group		5th NSA 1991		Tested group	
18.00 - 18.99	$\bar{x}$ [1)]	s	$\bar{x}$ [2)]	s	$\bar{x}$	s
Body height (cm)	175.30 ***	6.80	178.25 NS	7.13	178.94	6.57
Body weight (kg)	67.30 ***	8.90	70.97 NS	10.29	71.87	9.70
LBM (kg)	58.10 ***	6.20			63.87	7.21
Body fat (%)	13.60 ***	4.50			10.85	4.48
BMI ($kg.m^{-2}$)			22.30 NS	2.71	22.35	2.77
Sitting height (cm)	91.00 ***	4.20			93.28	3.51
Chest circumference I, middle	89.50 ***	5.80	91.43 NS	6.66	92.42	6.14
Chest circumference I, insp.	94.30 ***	5.70			97.07	6.02
Chest circumference I, exp.	85.80 ***	6.20			89.56	6.41
Chest circumference II, middle.	82.90 **	5.70			84.99	5.93
Chest circumference II, insp.	89.90 NS	5.50			90.59	5.61
Chest circumference II, exp.	82.10 NS	5.80			82.65	6.16
Bicristal width (cm)	27.00 ***	2.20			29.22	1.88
Bitrochanteric width (cm)	31.00 ***	3.40			33.27	1.74
Relax arm circumfer. R (cm)	27.60 ***	2.40			28.78	2.55
Relax arm circumfer. L (cm)	27.30 ***	2.40	28.50 NS	2.58	28.80	2.64
Forearm circumference R (cm)	26.50 NS	1.70			26.70	1.72
Forearm circumference L (cm)	26.10 NS	1.60			26.17	1.73
Thigh circumference R (cm)	53.60 ***	4.10			56.65	4.96
Thigh circumference L (cm)	53.40 ***	4.00			56.57	4.56
Calf circumference R (cm)	35.90 ***	2.50			37.50	2.70
Calf circumference L (cm)	35.90 ***	2.40			37.37	2.68
Hand grip R (kp)	44.00 ***	8.60			49.42	8.03
Hand grip L (kp)	40.70 ***	8.00			47.00	7.54

[1)] Comparison control group and tested group
[2)] Comparison 5th NSA 1991 and tested group
* $p<0.05$; ** $p<0.01$; *** $p<0.001$; NS – no significant difference
Tested group – Jirák *et al*. 2000
5th NSA 1991 – 5th Nation-wide Anthropological Survey of Children and Adolescents 1991 (Lhotská *et al*. 1993)
Control group – Seliger and Bartůněk 1977

TABLE 6. Girls 15.00–15.99 years old.

Age (years)	GIRLS					
	Control group		5th NSA 1991		Tested group	
15.00 - 15.99	$\bar{x}$ [1)]	s	$\bar{x}$ [2)]	s	$\bar{x}$	s
Body height (cm)	162.60 ***	6.50	165.82 NS	6.03	167.09	6.46
Body weight (kg)	54.30 ***	8.20	56.43 **	7.39	59.05	7.56
LBM (kg)	43.50 ***	5.00			48.99	5.23
Body fat (%)	20.20 ***	4.70			16.72	4.10
BMI (kg.m^{-2})			20.51 *	2.38	21.09	2.13
Sitting height (cm)	86.00 ***	3.60			88.21	3.55
Chest circumference I, middle	79.10 ***	5.90	83.73 **	5.75	86.22	5.19
Chest circumference I, insp.	83.50 ***	5.60			91.02	5.07
Chest circumference I, exp.	76.80 ***	6.00			83.95	5.15
Chest circumference II, middle.	72.10 *	5.80			73.77	5.13
Chest circumference II, insp.	76.00 ***	5.60			78.62	4.56
Chest circumference II, exp.	70.40 NS	6.00			71.16	5.12
Bicristal width (cm)	25.70 ***	2.30			28.24	1.94
Bitrochanteric width (cm)	29.70 ***	2.20			32.19	1.61
Relax arm circumfer. R (cm)	24.90 *	2.50			25.76	2.28
Relax arm circumfer. L (cm)	24.70 ***	2.40	24.73 ***	2.26	25.70	2.25
Forearm circumference R (cm)	23.30 NS	1.50			23.06	1.63
Forearm circumference L (cm)	23.00 NS	1.50			22.67	1.50
Thigh circumference R (cm)	54.00 ***	4.80			56.81	3.86
Thigh circumference L (cm)	53.80 ***	4.70			56.64	3.85
Calf circumference R (cm)	34.00 ***	2.50			35.24	2.48
Calf circumference L (cm)	34.00 ***	2.50			35.49	2.70
Hand grip R (kp)	26.40 ***	6.00			30.75	4.98
Hand grip L (kp)	24.30 ***	5.60			28.63	5.30

[1)] Comparison control group and tested group
[2)] Comparison 5th NSA 1991 and tested group
* $p<0.05$; ** $p<0.01$; *** $p<0.001$; NS – no significant difference
Tested group – Jirák *et al*. 2000
5th NSA 1991 – 5th Nation-wide Anthropological Survey of Children and Adolescents 1991 (Lhotská *et al*. 1993)
Control group – Seliger and Bartůněk 1977

TABLE 7. Girls 16.00–16.99 years old.

Age (years)	GIRLS					
	Control group		5th NSA 1991		Tested group	
16.00 - 16.99	$\bar{x}$ [1)]	s	$\bar{x}$ [2)]	s	$\bar{x}$	s
Body height (cm)	163.40 ***	6.50	166.14 NS	6.13	167.73	7.81
Body weight (kg)	56.10 **	8.10	58.03 NS	7.92	59.00	7.90
LBM (kg)	45.00 *	5.00			49.38	6.17
Body fat (%)	20.00 ***	4.70			16.11	4.01
BMI ($kg.m^{-2}$)			21.01 NS	2.55	20.89	2.14
Sitting height (cm)	86.70 ***	3.60			88.55	3.65
Chest circumference I, middle	80.50 ***	5.80	84.88 NS	6.05	85.71	4.54
Chest circumference I, insp.	84.70 ***	5.70			90.41	5.04
Chest circumference I, exp.	78.10 ***	5.90			83.21	4.53
Chest circumference II, middle.	73.10 NS	5.90			73.54	4.62
Chest circumference II, insp.	77.80 *	5.60			78.77	4.69
Chest circumference II, exp.	71.40 NS	6.00			71.28	5.14
Bicristal width (cm)	26.20 ***	2.30			28.07	2.18
Bitrochanteric width (cm)	30.30 ***	2.20			32.17	1.77
Relax arm circumfer. R (cm)	25.40 NS	2.50			25.72	2.22
Relax arm circumfer. L (cm)	25.10 NS	2.50	25.17 *	2.33	25.71	2.21
Forearm circumference R (cm)	23.60 NS	1.50			23.43	1.59
Forearm circumference L (cm)	23.30 NS	1.50			22.92	1.52
Thigh circumference R (cm)	54.90 **	4.80			56.67	4.21
Thigh circumference L (cm)	54.70 **	4.70			56.48	4.22
Calf circumference R (cm)	34.50 **	2.50			35.37	2.64
Calf circumference L (cm)	34.50 **	2.50			35.42	2.63
Hand grip R (kp)	27.40 ***	6.00			32.41	5.92
Hand grip L (kp)	25.20 ***	5.70			31.06	5.97

[1)] Comparison control group and tested group
[2)] Comparison 5th NSA 1991 and tested group
* $p<0.05$; ** $p<0.01$; *** $p<0.001$; NS – no significant difference
Tested group – Jirák *et al*. 2000
5th NSA 1991 – 5th Nation-wide Anthropological Survey of Children and Adolescents 1991 (Lhotská *et al*. 1993)
Control group – Seliger and Bartůněk 1977

TABLE 8. Girls 17.00–17.99 years old.

Age (years)	GIRLS					
	Control group		5th NSA 1991		Tested group	
17.00 - 17.99	$\bar{x}$ [1)]	s	$\bar{x}$ [2)]	s	$\bar{x}$	s
Body height (cm)	163.80 ***	6.50	166.53 *	6.18	168.15	6.70
Body weight (kg)	57.30 **	8.10	59.20 NS	7.96	60.12	6.61
LBM (kg)	46.00 ***	5.00			50.48	5.35
Body fat (%)	19.80 ***	4.60			15.89	4.20
BMI (kg.m^{-2})			21.33 NS	2.54	21.24	1.76
Sitting height (cm)	87.10 **	3.70			88.44	4.23
Chest circumference I, middle	81.50 ***	5.80	85.22 NS	6.32	85.83	3.90
Chest circumference I, insp.	85.70 ***	5.70			90.44	3.98
Chest circumference I, exp.	79.10 ***	5.90			83.20	3.75
Chest circumference II, middle.	73.90 NS	5.90			74.00	4.06
Chest circumference II, insp.	78.10 NS	5.60			79.05	3.86
Chest circumference II, exp.	72.20 NS	6.00			71.43	4.41
Bicristal width (cm)	26.60 ***	2.30			28.59	2.41
Bitrochanteric width (cm)	30.70 ***	2.10			32.45	1.96
Relax arm circumfer. R (cm)	25.80 NS	2.40			25.86	1.69
Relax arm circumfer. L (cm)	25.40 *	2.50	25.48 *	2.39	25.89	1.67
Forearm circumference R (cm)	23.80 *	1.50			23.47	1.19
Forearm circumference L (cm)	23.00 **	1.50			23.05	1.13
Thigh circumference R (cm)	55.50 ***	4.80			57.78	3.58
Thigh circumference L (cm)	55.30 ***	4.80			57.49	3.52
Calf circumference R (cm)	34.80 ***	2.50			35.97	1.96
Calf circumference L (cm)	34.80 ***	2.50			36.02	2.04
Hand grip R (kp)	28.20 ***	6.00			33.46	5.20
Hand grip L (kp)	26.00 ***	5.60			32.04	5.03

[1)] Comparison control group and tested group
[2)] Comparison 5th NSA 1991 and tested group
* $p<0.05$; ** $p<0.01$; *** $p<0.001$; NS – no significant difference
Tested group – Jirák *et al*. 2000
5th NSA 1991 – 5th Nation-wide Anthropological Survey of Children and Adolescents 1991 (Lhotská *et al*. 1993)
Control group – Seliger and Bartůněk 1977

TABLE 9. Girls 18.00–18.99 years old.

Age (years)	GIRLS					
	Control group		5th NSA 1991		Tested group	
18.00 - 18.99	$\bar{x}$ [1)]	s	$\bar{x}$ [2)]	s	$\bar{x}$	s
Body height (cm)	164.00 ***	6.50	164.99 **	6.29	167.74	7.51
Body weight (kg)	58.10 NS	8.20	59.30 NS	10.12	58.86	8.87
LBM (kg)	46.70 ***	5.00			49.48	6.06
Body fat (%)	19.60 ***	4.70			15.49	4.91
BMI ($kg.m^{-2}$)			21.76 **	3.39	20.82	2.27
Sitting height (cm)	87.40 NS	3.60			88.21	3.73
Chest circumference I, middle	82.40 **	5.80	85.28 NS	7.84	85.15	6.64
Chest circumference I, insp.	86.60 ***	5.60			89.71	6.52
Chest circumference I, exp.	79.90 ***	5.90			82.49	6.24
Chest circumference II, middle.	74.50 NS	5.90			73.26	5.33
Chest circumference II, insp.	78.80 NS	5.70			78.39	5.25
Chest circumference II, exp.	72.80 *	6.00			70.90	5.26
Bicristal width (cm)	26.90 **	2.30			27.86	2.59
Bitrochanteric width (cm)	30.90 **	2.20			31.89	1.82
Relax arm circumfer. R (cm)	26.10 NS	2.40			25.71	2.08
Relax arm circumfer. L (cm)	25.70 NS	2.50	25.91 NS	2.86	25.65	2.12
Forearm circumference R (cm)	24.00 **	1.50			23.29	1.45
Forearm circumference L (cm)	23.70 ***	1.50			22.77	1.53
Thigh circumference R (cm)	56.00 NS	4.80			56.85	4.61
Thigh circumference L (cm)	55.70 NS	4.80			56.36	4.58
Calf circumference R (cm)	35.00 NS	2.50			34.98	2.43
Calf circumference L (cm)	35.10 NS	2.40			35.19	2.30
Hand grip R (kp)	28.80 ***	6.00			32.82	5.41
Hand grip L (kp)	26.60 ***	5.60			31.29	4.82

[1)] Comparison control group and tested group
[2)] Comparison 5th NSA 1991 and tested group
* $p<0.05$; ** $p<0.01$; *** $p<0.001$; NS – no significant difference
Tested group – Jirák *et al*. 2000
5th NSA 1991 – 5th Nation-wide Anthropological Survey of Children and Adolescents 1991 (Lhotská *et al*. 1993)
Control group – Seliger and Bartůněk 1977

higher lean body mass (LBM) (*Figures 4a, b*). In comparison to the control group, boys and girls our sample reached statistically higher values in other anthropological markers which were followed (*Tables 2–9*). However, in contrast to the control group the boys and girls have a significantly lower percentage of body fat (*Figures 5a, b*).

Compared with the results of the 5th National-wide Anthropological Survey of Children and Adolescents 1991, important statistical differences have not been found, except higher body weight (*Figures 3a, b*) and body mass index (BMI) (*Figures 6a, b*) in 15 year-old girls and boys. The differences between both samples disappear with age with the exception of the eighteen-year old girls – they are significantly taller and have lower BMI than the girls of the same age in the year 1991 (*Figures 3b, 6b*).

The results of stress exercise test proved that the boys reached, with exception of the oldest age group, a significantly higher value of maximum oxygen uptake (VO_2 max) ($p<0.001$) (*Figure 7a*). The girls reached a significantly higher value of VO_2max only in the category of sixteen and seventeen year-olds ($p<0.05$) (*Figure 7b*). There were no differences between both samples in the values per 1 kg of body weight (VO_2 max.kg^{-1}) with the exception of the youngest group of girls (*Figures 8a, b*). The value of VO_2 max of boys was higher in average by 30% than in girls. The boys had the best fitness at the age of 17 to 17.9 years, the girls at the age of 16 to 16.9 years. The boys and girls practising competitive endurance sports reached a higher value of VO_2 max than the group doing recreational sport or not practising any sport (*Figures 9a, b*). The best correlation of VO_2 max exists with LBM ($r=0.778$) in the boys (*Figure 10*).

DISCUSSION

The results of this research are in accordance with the findings of other authors about slowing down a secular trend of increasing body height in the past few years (Prokopec *et al.* 1973).

Results show a speeding up of growth in younger age categories, whereas the eighteen-year old boys and girls have probably reached their maximum in their ontogeny in 1991. Concerning the percentage of body fat, there is a statistically important shift to lower values in both sexes in all age categories, in contrast to the year 1977. We understand this fact in boys by reason of a higher sporting activity. In the girls we attribute this fact to a decreased food intake and to more strenuous efforts on slimming. This finding bears on the fact that in the girls, the fitness is not commensurated with adequate total body weight and height.

Concerning BMI of our tested sample, it reached comparable values to the values of the population of the same age in the year 1991 (Lhotská *et al.* 1993).

Higher physical fitness of our sample in comparison with the individuals of the same age of the control sample is mainly given by a higher lean body mass and total dimensions of the present population. There are no significant differences between both samples concerning the values VO_2 max.kg^{-1}.

A favourable influence of regular and sufficiently intensive sports activity has been shown in our tested boys in the lower values of the percentage of body fat and the lower level of triacylglycerols and in the women in the higher level of HDL cholesterol.

REFERENCES

LHOTSKÁ L., BLÁHA P., VIGNEROVÁ J., ROTH Z., PROKOPEC M., 1993: V. Celostátní antropologický výzkum dětí a mládeže 1991 (České země). SZÚ Praha.

PAŘÍZKOVÁ J., 1966: Měření kožních řas jako ukazatel podílu tuku a aktivní hmoty při výzkumu tělesné zdatnosti. *Teor. praxe těl. výchovy*. 14: 614.

PROKOPEC M., SUCHÝ J., TITLBACHOVÁ S., 1973: Výsledky 3. Celostátního výzkumu dětí a mládeže 1971 (české kraje). *Čs. pediat.* Vol. 28, p. 341–346.

SELIGER V., BARTŮNĚK Z., 1977: *Tělesná zdatnost obyvatelstva ČSSR ve věku 12–55 r.* Universita Karlova Praha, 203 pp.

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