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THE SECULAR TREND IN THE SOMATIC DEVELOPMENT AND MOTOR PERFORMANCE OF 7-15-YEAR-OLD GIRLS

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Abstract

Introduction: From anthropologic researches of somatic parameters a positive secular trend is established. Researches which deal with the issue of the motor performance of school youth rather refer to stagnation or a declining tendency of a secular trend in the motor performance of present population of children and youth.

Aim of the study: The aim of the study is to compare a somatic development and motor performance of the present 562 girls in the age of 7 to 15 years with reference data about the performance of Czechoslovak youth of 1966.

Materials and Methods: The representative sample consisted of 562 girls from 7 to 15 years of age. In each subject, we measured the somatic parameters (body height, weight) and we investigated the general motoric performance (in 50 m run, long jump, heavy ball throw with both hands).

Results: We have found that for the past 36 years there was a positive secular trend in the body height and weight. In the area of the development of speed and dynamic-explosive strength abilities - the stagnation of the motor performance was confirmed, indicating rather a negative secular trend.

Conclusions: In conclusion, there is an asymmetry in the somatic and motor performance of 7-15-year-old girls. Stagnation up to decline found in the motor performance of the set of girls under observation is probably caused by the action of a complex of factors reflecting a fast transformation of the present society, where in also a lack of physical activity is demonstrated in today's population of children and youth.

Key words: *somatic development, motor performance, secular trend*

Introduction

In the last century anthropologists have observed a marked process of growth and development acceleration in humans. The rate of postnatal growth, maturing as well as adult achieved values changed radically. In all countries with a higher socio-economic level the body height and weight of adults increased and the growth and development of children and youth speeded up (1-10).

Children of all age groups are bigger and heavier than children of the same age groups in the past. Acceleration of biological maturing, primarily during the 20th century has led to the differentiation of the size of children of all age groups. This tendency affects both the development speed of most bodily dimensions and the whole body, and also adolescence, completion of growth and also an increase in the final body size (3,5,10). These changes found in the biological human development are a demonstration of a secular trend.

This indisputably one of the most interesting biological phenomena of the 20th century affecting humans was observed in all industrially developed countries with a higher socio-economic level – in this connection we talk about a positive secular trend.

Anthropologists see elimination of existing retardation effects as the main cause of the quoted positive trend and it enabled that the growth curve proceeded according to genetic determination. Factors which provoked and promoted growth stimuli – own factors of growth acceleration (nourishment, hygienic measures and health care preventing serious and draining diseases, urbanization, elimination of heavy physical work of children, etc.) acted simultaneously (1,5,10).

A positive secular trend is established from anthropologic researches of somatic parameters, in case of a secular trend of the motor performance it is not possible to confirm a positive trend unambiguously (3,11-14). Researches which engage in the issue of the motor performance of school youth rather refer to stagnation or a declining tendency of a secular trend in the motor performance of today's population of children and youth in Germany (11), Poland (15), Czech Republic (13,14) and Slovakia (12,14). If we consider the fact that motor tests are regarded as indicators of the development and level of morphological and functional characteristics of an individual, this negative secular trend in the motor performance may be also a signification of a disruption of an individual's positive health and thus even the entire population (15,16).

In order to assess the changes of secular changes in somatic parameters and motor performance of today's population of girls the results of the performance of the Czechoslovak youth of 1966 were used which are the first picture of the performance of a representative selection of population in a set of selected motor indicators (17). The results were simultaneously compared with somatic and motor parameters of pupils in the Olomouc Region from 1968 (18).

Materials and methods

A transversal anthropological research took place in 2002 at seven primary schools of a village and city type in the Olomouc Region. The research set included 562 girls from 7 to 15 years of age. None of the quoted schools was specialized in sports. A chronological age of girls was determined as of the data of measurement in the decimal system in tenths of a year according to IBP principles (19). Girls were divided to a respective age category with a chronological age in the range of ± 0.5 year (for instance, 8 year-old = 7.51 – 8.50 year). Basic body parameters, body height and weight were measured according to methods of standard anthropometry (20). To compare average values of indicators of a somatic development and motor performance reference values of girls of 1966 (17) (further Girls 1966) and reference values measured in girls in the Olomouc Region of 1968 (18) (further Girls 1968) were chosen. Presented reference values have been compared with the set of Olomouc girls under observation (further Girls 2002) in somatic parameters: body height, body weight and in motor parameters which were found with the help of motor tests: 50 m run, standing long jump with legs together and heavy ball throw with both hands. Selection of motor tests enabled to encompass primarily dynamic strength of muscle groups and speed abilities (21).

In order to process the parameters under observation numerically methods of mathematical statistics

according to Hinton (22) and program package STATISTICA Cz, version 6 were used. To make a statistical evaluation Student's t - test for one selection with the help of which our sets have been compared with population constants, taken over from reference sets of the national research of youth body performance in 1966 (17) and further with the results of the pupils' motor performance in the district of Olomouc from 1968 (18). Tests were carried out on the significance level ($^*p < 0.05$, $^{**}p < 0.01$).

Results and discussion

The differences in the body development between the compared reference sets of girls from 1966 (17) and 1968 (18) are presented in the body height and weight.

Average values of the body height of girls indicate an ascending trend from 7 to 15 years of age in Pávek's (17) sets and Olomouc today's girls (table 1, fig 1). The average body height of Olomouc girls indicates a positive secular trend in all age groups in comparison with girls of 1966.

It is obvious from the comparison of the body height in sets of girls that today's girls surpass girls of 1966 and 1968 in all age groups under observation is shown in the table 1. Statistically significant differences in the body height were also found in girls from the national research of 1966 in the age of 10, 11, 13 to 15 years. In girls in the Olomouc Region of 1968 in the age group of 13 to 15 years of age. In girls of 1966 and 2002 the peak of the growth speed was identically recorded between the 10th and 11th year of age and in both sets under observation it is approximately 7 cm (table 1). In girls of 1968 the peak of the growth speed can not be determined exactly because age categories of girls from 7 to 11 years of age have not been measured. After reaching the peak of the growth speed a slowdown in the rate is evident in sets of girls under observation, which is in the data of 1966 and 1968 more distinct in comparison with the data of girls

Table 1. *Body height (cm)*

Age	Girls 1966			Girls 1968		Girls 2002		
	n	\bar{x}	sd	n	\bar{x}	n	\bar{x}	sd
6.51-7.50	849	123.64	5.50	-	-	36	124.74	5.01
7.51-8.50	943	129.01	5.91	-	-	59	129.86	5.86
8.51-9.50	1017	134.37	6.08	-	-	69	134.44	6.29
9.51-10.50	952	139.67*	6.89	-	-	74	141.51	6.86
10.51-11.50	1192	146.55*	7.54	-	-	63	148.68	7.15
11.51-12.50	1148	152.42	7.24	77	150.59	73	152.45	8.07
12.51-13.50	1117	157.42	6.32	70	156.52*	69	158.74	7.65
13.51-14.50	1067	160.67**	6.11	41	160.68**	66	162.97	6.86
14.51-15.50	1064	161.56**	5.74	73	161.65**	53	165.91	6.88

* $p < 0.05$. ** $p < 0.01$.

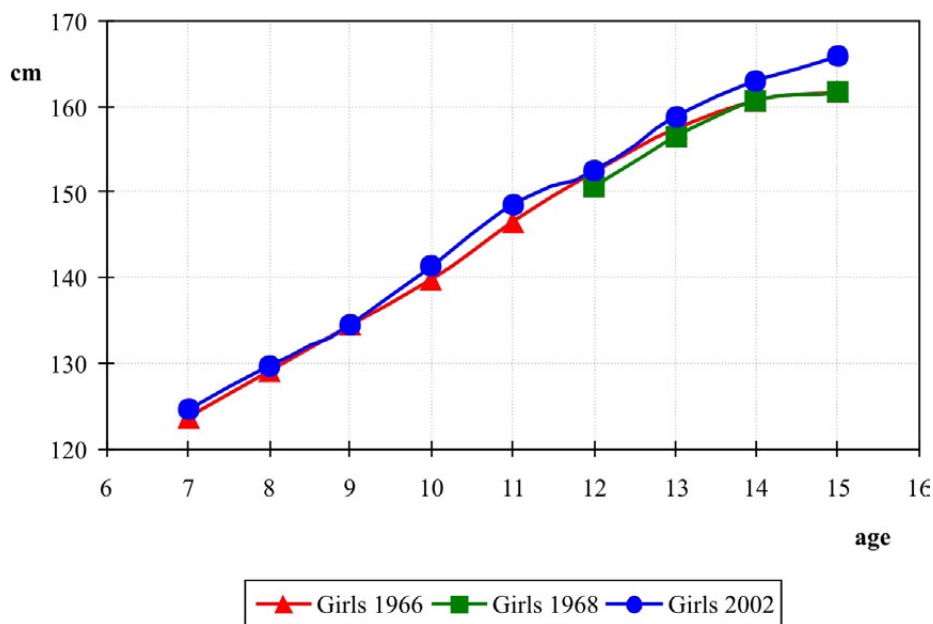


Fig. 1. *Body height (cm)*

of 2002 (table 1, fig 1). An action of a positive secular trend is obvious from the results of the comparison of the body height of girls. Today's Olomouc girls have a significantly higher body height in 15 years of age and surpass their contemporaries of 1966 and 1968 approximately by 4.3 cm (table 1).

The body weight of sets of girls under observation does not indicate such a significant positive secular trend in comparison with the body height since 1966 to 2002 (table 2, fig 2).

Less significant differences in the body weight were found in sets of girls under observation (table 2). The body weight of today's girls in the Olomouc Region has a small difference compared to the national average of 1966 (17) in all age groups and with regard to girls in the Olomouc Region of 1968 (18). Even in some age groups girls of 1966 and 1968 have a higher body weight in comparison with girls of 2002 (table 2, fig. 2). This fact is also proved by body weight increases of the

sets of girls under observation. The greatest increases in the body weight of the sets of girls under observation were found in girls of 1966 between the age of 11 and 12 years (5.04 kg), in today's girls between the 14th and 15th year of age (7.6 kg). The greatest body weight increases do not correspond with the period of the peak of the growth speed in time.

It is evident from the quoted results that body weight increases in girls for the period under observation since 1966 to 2002 are smaller than body height increases. In consequence of this there are changes in the body proportionality which is manifested in the figure slimming (9,10). Authors state that on the basis of the calculation of the mean figures of height and weight for the present girls in the Olomouc region between the ages of 7 and 15 it was found out that the figures acquired correspond to the referential standards of the 6th Nation-wide Anthropological Survey of Children and Adolescents (9,10).

Table 2. *Body weight (kg)*

Age	Girls 1966			Girls 1968		Girls 2002		
	n	\bar{x}	sd	n	\bar{x}	n	\bar{x}	sd
6.51-7.50	849	24.02	3.76	-	-	36	24.04	4.15
7.51-8.50	943	26.68	4.70	-	-	59	25.48	4.13
8.51-9.50	1017	29.67	5.14	-	-	69	29.12	5.70
9.51-10.50	952	32.87*	5.85	-	-	74	34.76	7.90
10.51-11.50	1192	37.88	7.77	-	-	63	38.06	8.32
11.51-12.50	1148	42.92	7.84	77	42.06	73	43.34	9.51
12.51-13.50	1117	47.71	8.13	70	48.56*	69	46.37	8.90
13.51-14.50	1067	51.58*	7.71	41	51.30	66	49.20	8.73
14.51-15.50	1064	54.08*	7.22	73	54.47	53	56.26	8.26

* $p < 0.05$, ** $p < 0.01$.

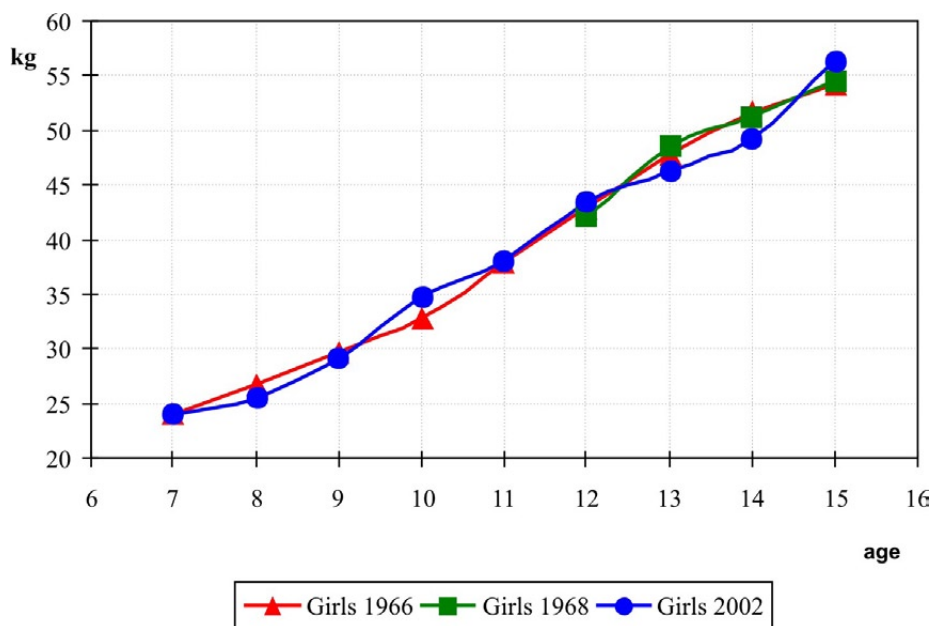


Fig. 2. Body weight (kg)

The described positive development and growth changes which were found in today's population of girls for the past 36 years in the Olomouc Region are a reflection of genetic dispositions of each individual and factors of the environment (nourishment, health care, family background, psychological well-being, etc.), which influence the growth of an individual as a consequence of socio-economic changes per a given period (1,5,6,10).

It is obvious that the biological essence of these changes captures not only morphological changes but even expected changes in the area of the motor performance of today's generation. To assess these changes in the motor performance, motor tests which indicate the level of speed and strength abilities of girls were used: 50 m run, standing long jump with legs together and heavy ball throw with both hands.

Dynamics of the running speed development of the sets of girls under observation in the test 50 m run has an approximately same course (table 3, fig 3). The results show that the running speed in girls demonstrates stagnation around the age of 13 years. Astonishing is the fact that today's girls have approximately the same or even worse performance in 50 m run in comparison with the reference data of 1966 (17) and 1968 (18).

Kubánek (18) notes on the basis of the results of measurement of boys and girls in the test 50 m run that the performance of youth in the district of Olomouc ranges between averages of youth in Czech lands, which is quoted by Pávek (17). Moravec et al (14) states that girls of 1987 reach in 50 m run approximately same performances in comparison with performances of girls measured in 1966 (17).

Table 3. 50 m run (s)

Age	Girls 1966			Girls 1968		Girls 2002		
	n	\bar{x}	sd	n	\bar{x}	n	\bar{x}	sd
6.51-7.50	819	11.28	1.21	-	-	36	10.57	0.99
7.51-8,50	909	10.59	1.08	-	-	59	10.36	1.19
8.51-9.50	961	10.00	0.90	-	-	69	10.33	1.19
9.51-10.50	928	9.67*	0.83	-	-	74	9.99	1.02
10.51-11.50	1164	9.30	0.81	-	-	63	9.63	1.17
11.51-12.50	1069	8.90	0.82	77	9.40	73	9.36	1.00
12.51-13.50	1025	8.72	0.79	70	8.57**	69	8.94	0.70
13.51-14.50	974	8.56	0.73	41	8.72	66	8.60	0.57
14.51-15.50	938	8.56	0.71	73	7.65**	53	8.52	0.66

* $p < 0.05$, ** $p < 0.01$.

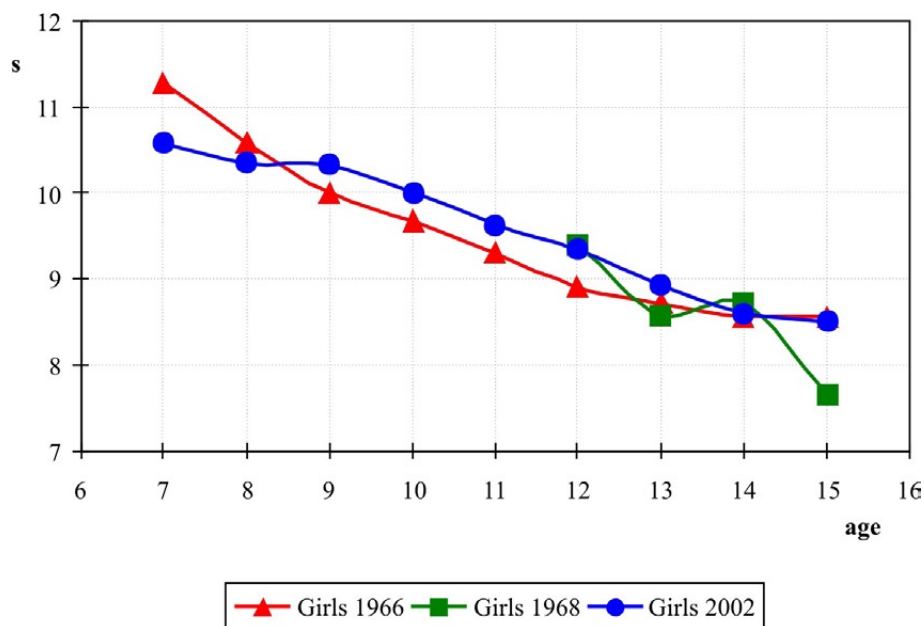


Fig. 3. 50 m run (s)

The level of development of dynamic, explosive strength of lower limbs and subsequently possibly changes with regard to 1966 (17) were evaluated by the motor test a standing long jump with legs together.

Table 4 and fig 4 show that the performance of girls increases unevenly from 7 to 15 years of age. Average values of performances in a long jump imply that girls reach the greatest increases between the age of 10 and 14 years. The quoted period, strictly speaking, corresponds with the period of an accelerated body growth in girls, i.e. between the 10th and 14th year.

The comparison of the motor performance of today's girls with reference data of 1966 (17) and 1968 (18) does not indicate improvement in the motor performance in this discipline. The results in this test

show that the performance of today's girls is in comparison with girls of 1966 and 1968 lower (table 4). The performance of today's girls is from the age of 10 to 15 years found below the national performance standards of 1966 (17) and even below the performance of girls in the Olomouc Region in 1968 (18). The results in a long jump indicate that in girls we may talk about a decrease in the level of dynamic-explosive strength abilities of lower limbs in comparison with the performance of girls of 1966 (17). The quoted conclusions are further supported by the fact that today's girls do not surpass their contemporaries of 1966 and 1968 in performance even though a secular positive trend was confirmed in them in the body height which partially affects also the performance in this motor test.

Table 4. Standing long jump with legs together (cm)

Age	Girls 1966			Girls 1968		Girls 2002		
	n	\bar{x}	sd	n	\bar{x}	n	\bar{x}	sd
6.51-7.50	828	121.66	21.34	-	-	36	127.56	15.80
7.51-8,50	932	134.03	23.85	-	-	59	131.86	14.75
8.51-9.50	1002	141.92	22.62	-	-	69	141.49	16.96
9.51-10.50	922	150.95	21.73	-	-	74	146.28	16.09
10.51-11.50	1169	157.09	22.16	-	-	63	155.17	16.20
11.51-12.50	1128	165.64**	22.80	77	162.58	73	158.40	18.18
12.51-13.50	1099	173.35**	22.59	70	169.68*	69	163.36	20.09
13.51-14.50	1031	176.82	23.14	41	172.10	66	171.38	19.01
14.51-15.50	1038	176.44	23.07	73	176.44	53	173.06	19.83

*p<0.05, **p<0.01.

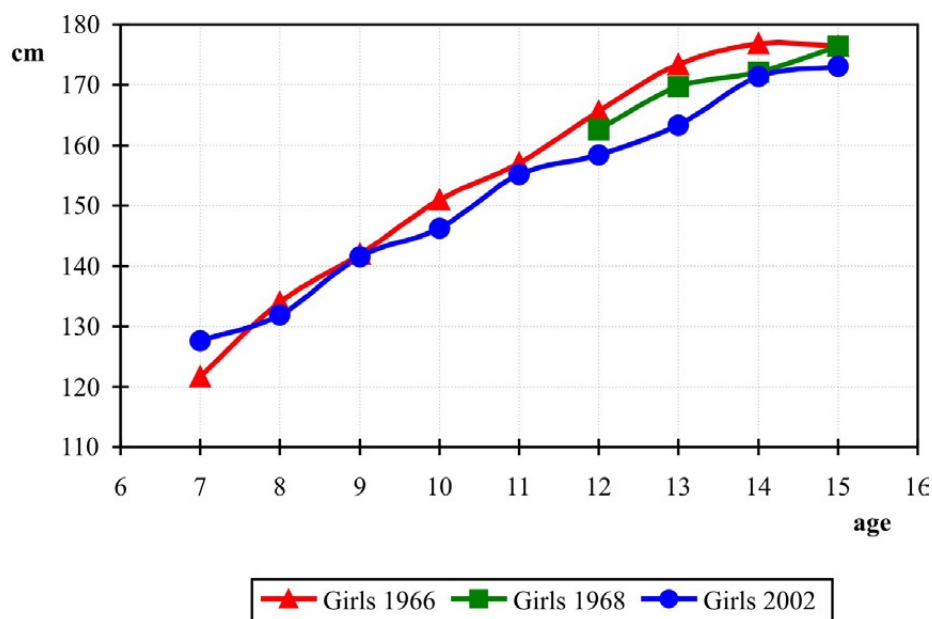


Fig. 4. Standing long jump with legs together (cm)

To make the picture complete it may be added that in 1968 the performance of pupils in the district of Olomouc corresponded with national standards of 1966. Moravec et al (14) then during the comparison of population of girls of 1987 with 1966 found the same performance of girls in a long jump.

A similar development secular trend in the motor performance of today's girls was found in the test heavy ball throw with both hands (table 5, fig 5). The average values in heavy ball throw with both hands show that today's girls throw a 2 kg ball to the same distance as girls of the same age of 1966 and 1968. The estimated

results imply again that a positive secular trend can not be confirmed in the motor performance in this test of today's girls for the past 36 years. According to Kubánek (18) pupils in the Olomouc Region do not reach the same performance in heavy ball throw with both hands in comparison with national performance standards of 1966. On the contrary, Moravec et al (14) in comparison of the motor performance of 1987 in comparison with national performance standards of 1966 (17) found a slightly higher performance of girls in a 2 kg ball throw.

Table 5. Throwing of the medicine ball using both hands (m)

Age	Girls 1966			Girls 1968		Girls 2002		
	n	\bar{x}	sd	n	\bar{x}	n	\bar{x}	sd
6.51-7.50	843	2.16	0.59	-	-	36	2.14	0.37
7.51-8,50	936	2.49	0.55	-	-	59	2.57	0.56
8.51-9.50	1005	3.03**	0.66	-	-	69	2.73	0.65
9.51-10.50	942	3.47	0.75	-	-	74	3.38	0.74
10.51-11.50	1179	4.06	0.86	-	-	63	4.11	0.73
11.51-12.50	1105	4.82*	0.98	77	4.27*	73	4.52	0.94
12.51-13.50	1070	5.30*	1.04	70	4.98	69	4.98	1.05
13.51-14.50	1022	5.74	1.12	41	5.50*	66	5.79	1.00
14.51-15.50	1026	5.90	1.14	73	6.13	53	6.16	0.91

*p<.05. **p<.01.

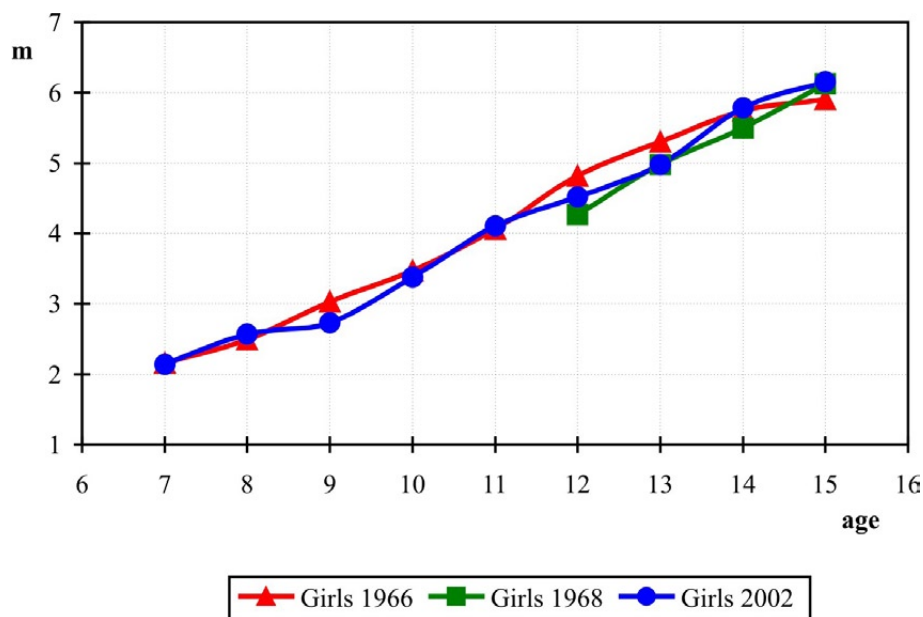


Fig. 5. Throwing of the medicine ball using both hands (m)

Conclusion

Presented results and comparison of average values of a somatic and motor development of today's girls in the Olomouc Region with reference body performance values of youth of 1966 (17) and 1968 (18) confirm existing knowledge of a somatic development and motor performance of today's population of children and youth. The results confirm a positive secular trend in the area of the development of the body height and weight in somatic parameters for the past 36 years which is demonstrated more noticeably in the body height, while body weight increases are lower (1,5,9).

The development trend in the motor performance in compared motor tests of girls in the Olomouc Region has not changed much since 1966. The results confirm the fact that today's girls in the age of 7 to 15 years reach approximately same motor performances in comparison with girls of the same age in 1966 and 1968, and rather indicate a decreasing tendency of the motor performance.

A different trend in the asymmetric development of somatic and motor performances in a set of girls under observation which are mentioned by many authors (3,11-15), was confirmed by comparison of the results.

Stagnation of the motor performance found in today's girls is probably caused by current way of life and fast transformation of today's society which offers a wide range of time demanding activities for children and youth, which cause a decrease in the motor stimulation in the daily routine. On account of this the youth's involvement in organised forms of physical

activities in free time decreases and rather a sedentary way of life prevails leading to hypokinesia with its all consequences (1,3,10,13,16).

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