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## **Comparison of dynamics of development of physical height, mass and explosive power capacity of lower limbs in boys from the Olomouc region and Zielona Góra**

Key words: physical development, motor efficiency, international comparison.

### **Abstract**

Authors in the presented study compare the physical development and level of explosive power capacity of lower limbs in 531 boys from the Olomouc region and 889 boys from Zielona Góra aged from 7 to 14. Based on analysis of the results the study concludes that the average body height is identical, but the body mass of the boys from Zielona Góra is higher than the average mass of the boys from Olomouc. In motor test — broad 2-foot jump — the boys from Olomouc achieve significantly better performance, especially at the younger school age, as compared with performances of the boys from Zielona Góra.

### **Porównanie dynamiki rozwoju wysokości ciała, wagi i eksplozywnie siłowych zdolności dolnych kończyn chłopców z regionu Ołomuńca i Zielonej Góry**

Kluczowe słowa: rozwój cielesny, wydajność motoryczna, porównanie międzynarodowe.

### **Introduction**

Continuous social, political and economic changes have taken place recently in the Eastern Europe; these changes influence all areas of the human life in both positive and negative way, in which the development of physical parameters and motor performance level of the current population is no exception. The main

objective of systematic anthropologic population researches is to determine the current development of physical and motor development of children and youth with regard to the age and sexual dimorphism. The obtained anthropologic parameters and data regarding the physical performance shall then provide a basis for creation of reference standards, by means of which we will be able to evaluate the somatic condition of the current population. The obtained results of representative sets will then allow for comparing the values measured in the current population to the previous researches, and thus to study development trends, and the like.

Unfortunately, there are currently few scientific studies dealing with the issue of development of children and youth on the international level aimed at capturing potential changes in the area of physical and motor development.

The presented partial study is an attempt to partially fill this gap. Based on analysis of physical and motor development of boys aged from 7 to 14, it is the main objective to compare current somatic and motor development of boys in selected regions of the Czech and Polish Republic.

This study is a result of partial research realised within the research scheme “Research of somatic and psychic condition of the Czech Republic’s population with application in anthropology, pedagogical psychology, clinical anthropology and ergonomics” for the period from 1999 – 2003, which is investigated by the Department of Anthropology and Hygiene, Teachers Faculty, Palacký University, Olomouc.

## Procedure

The investigated set includes 531 boys from the Olomouc region and 889 boys from Zielona Góra. The individual probands were assigned to age groups in decimal notation according to IBP principles as indicated by Weiner [6]. The age intervals were determined according to Polish criteria for assigning probands into age groups based on a 6-month interval  $\pm 0.5$  year (e.g. a 7-year old proband is assigned into the age interval from 6.50 to 7.49 year).

The organisation of measurement and the research itself took place from 2001 to 2002 at 7 elementary schools in the district of Olomouc, Czech Republic. The research in the territory of Poland in the city of Zielona Góra took place in the academic year 1996/1997 from September to December 1996 at 4 schools. The measurement of the probands’ basic anthropometrical characteristics, physical height and mass was performed according to standard conventional anthropometrics, as indicated by Martin and Saller [3].

The development level of explosive power capacity of lower limbs was determined by means of standard motor test — a 2-foot broad jump according to assignment, as indicated by Měkota [4], Denisiuk [2] and Pawlucki [5], see Figure 1.

The proband stood in a slightly straddling stand, lopped, put his hands behind, bent the trunk forward and jumped with his feet next to each other with simultaneous swing of arms forward. It was his task to jump as far as possible from the clearly marked jump-off line. The length of the most successful jump out of the three jumps performed was recorded. Reliability of the test is  $r_{\text{stab}} = 0.93$ , as indicated by Měkota [4].

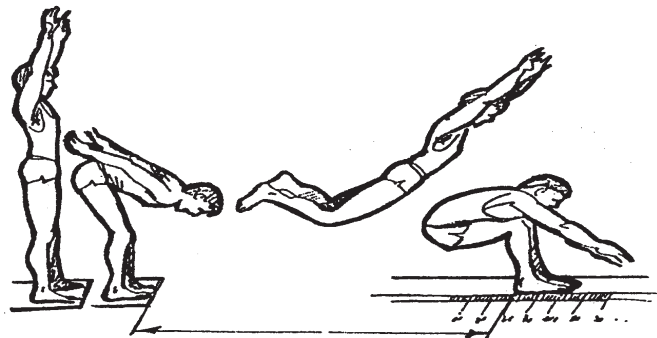


Figure 1. Test — 2-foot broad jump

The measured values of somatic and motor parameters were processed by means of mathematical statistic methods using EXCEL 2000 and Statgraphics Version 5 programs. The basic statistic characteristics were calculated for each group. The method of pair comparison  $t$  – test was used for statistic evaluation of the result of the set of Olomouc children and set of children from Zielona Góra. The test was performed on significance level  $p < 0.05^*$  and  $p < 0.01^{**}$ .

## Results and discussion

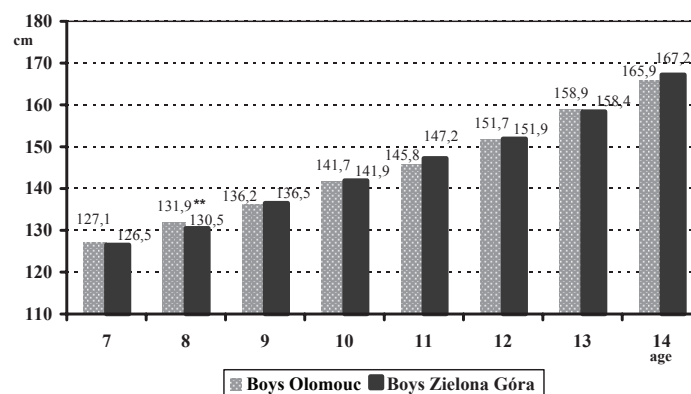
**Physical height** develops almost identically in the boys from Olomouc and the boys from Zielona Góra, as indicated in Table 1 and Chart 1. The only significant difference ( $p < 0.05$ ) in physical height was determined in the 8-year age group in favour of the Olomouc boys, who are higher by 1.4 cm than the boys of the same age from Zielona Góra. All through the monitored period, the differences in physical height between both sets of boys were within  $\pm 1.5$  cm range. From Table 1 and Chart 1 it follows that the development of physical height at the age from 7 to 12 is approximately identical, physical height increases are constant, ranging from 4 to 5.5 cm. The biggest increase of physical height is obvious between the age of 12 and 13, when pubertal growth acceleration occurs. In this development period, the physical height increase achieves 7.3 cm in boys from the Olomouc region as compared with the boys from the Polish region with the increase of 6.5 cm. This trend is the same in the set of Olomouc boys at the age of 14 too, while the increase in the boys from Zielona Góra is higher, achieving 8.8 cm. At the age of 14, the boys from the Olomouc

region achieve the physical height of 165.9 cm and boys measured in Zielona Góra 167.2 cm.

**Table 1.** Physical height (cm)

Age	Boys Olomouc			Boys Zielona Góra			t-test P
	n	$\bar{x}$	sd	n	$\bar{x}$	sd	
6,50 – 7,49	27	127,1	6,74	102	126,5	5,36	0,658
7,50 – 8,49	76	131,9	5,73	100	130,5	5,71	0,033*
8,50 – 9,49	59	136,2	7,12	104	136,5	6,30	0,732
9,50 – 10,49	71	141,7	6,24	110	141,9	6,19	0,771
10,50 – 11,49	80	145,8	7,25	122	147,2	6,03	0,090
11,50 – 12,49	81	151,7	6,89	108	151,9	7,98	0,761
12,50 – 13,49	66	158,9	7,28	137	158,4	8,46	0,583
13,50 – 14,49	71	165,9	8,50	106	167,2	8,41	0,209

(\*  $p < 0.05$ , \*\*  $p < 0.01$ )



**Chart 1.** Physical height (cm)

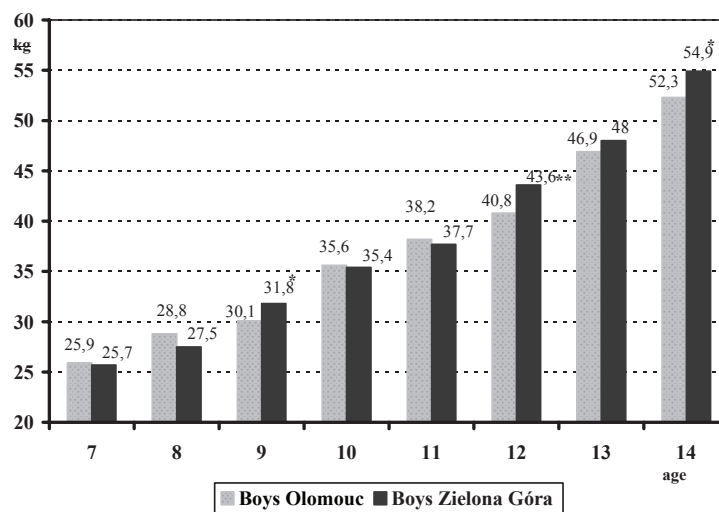
**Body mass development dynamics** in both sets being monitored develops almost identically as compared with physical height. For development of body mass, see Table 2 and Chart 2. The biggest statistically significant differences in the boys' mass were determined at the age of 9, when the boys from Zielona Góra are heavier by 1.7 kg, and then at the age of 12, when the Olomouc boys achieve the mass of 40.8 kg and the boys from Zielona Góra are heavier by 2.8 kg. Their body mass at this age is 43.6 kg. The last statistically significant difference in body mass in favour of the boys from Zielona Góra was determined at the age of 14, when they are heavier by 2.6 kg than the boys from the Olomouc region. The biggest increase of body mass in both sets of boys take

place simultaneously with the biggest increases of physical height at the age of 13 and 14. The body mass of the boys of the Olomouc region at the age of 14 is 52.3 and the body mass of the boys from Zielona Góra at the same age is 54.9 kg.

**Table 2.** Body mass (kg)

Age	Boys Olomouc			Boys Zielona Góra			t – test P
	n	$\bar{x}$	sd	n	$\bar{x}$	sd	
6,50 – 7,49	27	25,9	6,21	102	25,7	4,32	0,195
7,50 – 8,49	76	28,8	6,06	100	27,5	5,63	0,051
8,50 – 9,49	59	30,1	5,56	104	31,8	6,21	0,021*
9,50 – 10,49	71	35,6	8,35	110	35,4	7,87	0,831
10,50 – 11,49	80	38,2	9,91	122	37,7	6,79	0,677
11,50 – 12,49	81	40,8	8,32	108	43,6	9,68	0,003**
12,50 – 13,49	66	46,9	8,16	137	48,0	10,18	0,294
13,50 – 14,49	71	52,3	9,73	106	54,9	10,69	0,032*

(\*  $p < 0.05$ , \*\*  $p < 0.01$ )



**Chart 2.** Body mass (kg)

The level of motor performance of the Olomouc boys and the boys from Zielona Góra, which means their ability to achieve specific performances repeatedly on a stable level in a certain time period, were determined by means of motor test: a foot broad jump. Čelikovský [1] indicates that the motor performance is an element of physical fitness. The physical fitness is a complex ability to

provide an effective and efficient respond to stimuli of the ambient environment; it also includes proper somatic development and functional capacity.

In the test of **2-foot broad jump** we determined significant differences in development dynamics of explosive power capacity of lower limbs between the Olomouc boys and the boys from Zielona Góra. For the development in broad jump from the sport, see Table 3 and Chart 3. The boys from the Olomouc region achieve significantly better average performance at the age from 7 to 12 (except for 11-year old boys). The biggest differences in explosive power capacity of lower limbs were determined at the age of 9 and 10, where the difference in 2-foot broad jump was 16 cm in favour of the Olomouc boys, and at the age of 12, when the Olomouc boys jump farther by 21 cm than the boys of the same age from Zielona Góra. There is an obvious turn in development of jump-off capacity at the age of 13 to 14, when significant improvement of this motor capacity occurred in boys from Zielona Góra. The said significant growth of performance in Polish boys is documented by interim increases in broad jump, which achieved to 17 cm in the said period.

**Table 3.** 2-foot broad jump (cm)

Age	Boys Olomouc			Boys Zielona Góra			t – test P
	n	$\bar{x}$	sd	n	$\bar{x}$	sd	
6,50 – 7,49	27	128,7	15,52	102	115,4	15,87	0,000**
7,50 – 8,49	76	136,8	19,45	100	128,5	19,10	0,000**
8,50 – 9,49	59	152,0	23,39	104	136,0	17,33	0,000**
9,50 – 10,49	71	155,6	20,71	110	139,2	15,97	0,000**
10,50 – 11,49	80	155,1	28,34	122	150,0	16,23	0,124
11,50 – 12,49	81	173,0	18,12	108	151,3	15,86	0,000**
12,50 – 13,49	66	175,0	23,10	137	168,4	19,93	0,128
13,50 – 14,49	71	187,9	22,86	106	185,9	26,13	0,454

(\*  $p < 0.05$ , \*\*  $p < 0.01$ )

The question is how to explain the differences in motor performance between the Olomouc boys and the children from Zielona Góra in 2-foot broad jump between the age of 7 and 12 with subsequent significant acceleration of explosive power capacity of lower limbs in 13-year and 14-year old Polish boys? From various studies dealing with the issue of influence of somatic parameters on performance in 2-foot broad jump it is obvious that the level of motor capacity also depends, in a part, on somatic parameters, as indicated by Čelíkovský [1] and Měkota [4]. However, from our analysis it follows that the physical height and body mass of the boys from the Olomouc region and Zielona Góra is almost identical, although certain singular statistically significant

differences in the said somatic parameters were determined, but only in a certain age period. We can therefore partially exclude this factor and look for potential causes of differences in performances achieved in 2-foot broad jump in the sets of Olomouc and Polish children at younger and older school age in different motor behaviour in the area of organised and recreational motor activity, especially in the period of younger school age.

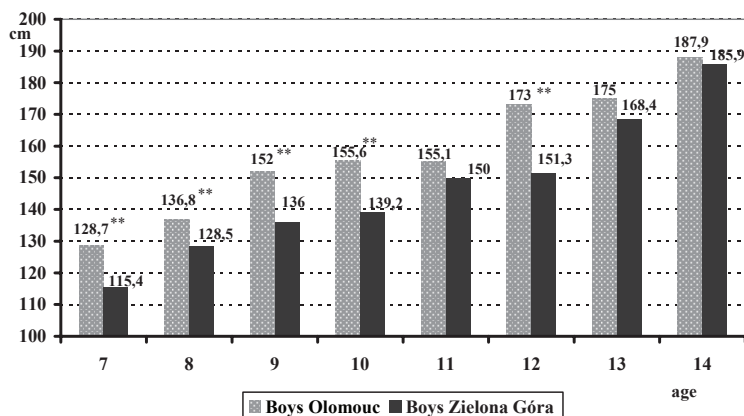


Chart 3. 2-foot broad jump (cm)

## Conclusion

Based on the performed analysis of somatic and motor development of the boys from the Olomouc region and the boys from Zielona Góra at the age from 7 to 14 we can conclude the following.

Dynamics of physical height development in both sets of boys takes place in parallel without any major difference and the boys achieve approximately the same average physical height. The development of body mass shows that the boys from Zielona Góra on average achieve higher body mass than the boys of the same age from the Olomouc region. The monitored indicators of physical development confirm that the development takes place in a characteristic way and time sequence, while acceleration and subsequent deceleration of the development occurs in this period as a consequence of natural biological development. The results measured during the motor test of 2-foot broad jump indicate better level of explosive power capacity of lower limbs of the Olomouc boys as compared with the boys from Zielona Góra.

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