

THE SECULAR TREND IN THE SOMATIC DEVELOPMENT AND MOTORIC PERFORMANCE OF BOYS IN THE OLOMOUC REGION WITHIN THE LAST 36 YEARS

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In his study, the author analyses the changes in somatic development and motoric performance of boys from 7 to 15 years of age in the Olomouc region within the last 36 years. The author found a positive functioning of the secular trend regarding body height. The present probands have significantly higher height but almost the same weight as the boys of the same age examined 36 years ago. In the monitoring of changes in motoric performance, the author found that the present probands achieve the same results in 50 m runs, in the standing long jump with legs together, in throwing the medicine ball and in pull-ups as the boys examined 36 years ago. In conclusion, the author states that there is no improvement in the development of motoric abilities, on the contrary there is a stagnation of the development of the speed and strength abilities of boys from 7 to 15 years of age in the Olomouc region.

Keywords: Secular trend, boys 7 to 15 years of age, motoric abilities, motoric tests, motoric performance.

INTRODUCTION

The secular trend of somatic parameters has been monitored within the post-war program of regular anthropological measurements of our population starting in 1951 and the development trends of the population have been well mapped. The secular trend in the motoric performance of the non-sporting population has not been monitored as regularly as in the above mentioned anthropological research.

The first statewide representative measurement of the motoric performance of the common population was of children and youth aged 7 to 19 years and was carried out in 1966 by Pávek (1968), another research project was carried out in the years from 1968 through 1974 within the International biological program of the population aged 12 to 55 years by Seliger (1977), and in 1972, another measurement of the somatic parameters and motoric performance of the members of ČSTV (Czech Union of Sports and Physical Training) was carried out by Čelikovský (Čelikovský et al., 1973). The last representative measurement of our population was carried out by Moravec in 1987 (Moravec et al., 1990).

Although in somatic parameters we could observe a positive secular trend, in motoric performance the positive secular trend cannot be unambiguously confirmed (Čelikovský et al., 1985; Moravec et al., 1990). Moravec et al. (1990) compared the motoric performance of the population aged 7 to 18 years as measured in 1987 with results obtained by Pávek (1968) in 1966. Following

the finding of these results, he came to the conclusion that boys showed lower performance in all monitored motoric tests and girls have lower performance in the endurance run in comparison with the population evaluated by Pávek (1968) in 1966.

In the Olomouc region, somatic and motoric developments have been reviewed by many authors. The first study of somatic development and motoric performance was probably carried out in 1968 by Kubánek (1971). He monitored motoric performance and somatic development in primary school pupils of grades 6 to 9 and compared the results found with the study carried out by Pávek (1968). The relationships between parameters of somatic development and motoric tests in 12 year old boys in Olomouc were examined by Drlík (1970). The dependence of motoric development on physical conditions was examined by Drlík and Vaverka (1970). They used the electric dynamometer for testing strength in static action in a set of 86 untrained boys aged 12 years old. They analyzed the mutual interaction of the linear dimensions of upper limbs and active body mass in relationship to the strength of flexion and extension in the elbow. Riegerová (1984) in her semi-longitudinal study evaluated the development of children in relationship to intensive physical activities using the method of biological proportional age. She observed sets of boys and girls with a standard body height at Olomouc primary schools in sports classes specializing in ice-hockey and swimming. The efficiency of the physical training process in grammar schools was studied by Frömel (1987) in the period 1981–1983. He found out that the motoric

performance of boys improved within a period of two years. In comparison with the performance of twenty years ago he found out that motoric performance has improved only in girls. The highest deficiencies were found in the development of the endurance of boys and girls. Procházka (1990) studied the changes of somatotype in a set of 346 boys of 11 to 13 years of age within a semi-longitudinal anthropological study in the period 1987–1988. He observed and compared the changes of somatotype of boys in special sports classes (swimming, track athletics, volleyball, ice-hockey and football) and boys in classes with standard physical training lessons.

Monitoring of the physical loading of primary school pupils in lessons of physical training was carried out by Mazal and Spilka (1987). They monitored the heart rate of pupils using the tactile board and the BIOCARD reader. The main objective of the study was to monitor the heart rate values of pupils during their sporting activities in physical training classes.

Frömel, Novosad and Svozil (1999) studied the sports activities of children and youth on a long-term basis. They found out that the total amount of sports activities within a day's or week's schedule is declining and their interest in organized sports activities in their leisure time is also decreasing. This study also confirmed that both boys and girls have a noticeably negative attitude towards the development of endurance abilities.

Kopecký, Bezděková and Hřivnová (2002) examined somatic parameters and the level of motoric performance in children of 12 years of age. The measured values were compared with referential values of the International biological programme from 1968–1974 (Seliger, 1977). They found a positive influence of the secular trend in somatic parameters and a stagnancy in motoric performance. Similar results were found by Kopecký (2004) when comparing the motoric performance of boys who were tested in 2002 with the referential data from 1987 (Moravec, 1990).

The submitted study aims to add some new information on somatic and motoric development of boys of the Olomouc region of 7 to 15 years of age within the past 36 years.

OBJECTIVE OF THE STUDY

The objective of the study is to evaluate secular changes in somatic parameters and motoric performance in boys of 7 to 15 years of age measured in the period 2001–2002, in comparison with the first statewide research project on the physical performance of youth carried out by Pávek (1968) in 1966 and the study carried out by Kubánek (1971) in the Olomouc region.

METHODS

The study set includes 615 boys of 7 to 15 years of age. The research was carried out in 7 primary schools of both rural and urban type in the Olomouc region in the period 2001–2002. None of these schools specialized in sports. The chronological age of probands was set as to the date of the measurements in tenths of years following the principles of IBP (Weinier & Lourie, 1969). Probands were divided into particular age categories according to their chronological age within the span of ± 0.5 year (e. g. 10 years old = 9.51–10.50 years of age). The body height and weight were measured in accordance with the standard anthropometrical methodology, as stated by Riegerová and Ulbrichová (1998). The referential values of Pávek (1968), (hereinafter boys CR 1966), and Kubánek (1971), (hereinafter boys OL 1968), are compared with the examined set of Olomouc boys (hereinafter boys OL 2002) in the following somatic parameters: body height, body weight and in motoric parameters: 50 m run, standing long jump with legs together, throwing of the medicine ball using both hands, and pull-ups. The choice of motoric tests enabled the researchers to particularly observe the dynamic strength of the large muscle groups and speed abilities (Měkota & Blahuš, 1983).

For numeric processing of the observed data, we used mathematical statistical methods (Hendl, 2004) and STATISTICA.CZ programme package, release 6. For statistical evaluation, the one choice Student T-test was used to compare our sets with the population constants found in referential sets of statewide research projects on the physical performance of youth carried out in 1966 (Pávek, 1968) and with the results of the study of the motoric performance of pupils in the Olomouc region in 1968 presented by Kubánek (1971). The referential values adopted from Pávek (1968) from 1966, were obtained by measurements of somatic parameters and the motoric performance of primary school pupils of 7 to 15 years of age in Czech urban regions. The somatic and motoric parameters of pupils in the Olomouc region stated by Kubánek (1971) have values separated for urban and rural probands. Considering the fact that in these sets some age groups of boys were weaker in number ($n < 30$), the weighted averages were counted for each age group and gender following the supposed average values and the number of probands (Hendl, 2004). Tests were carried out on the level of significance (* $p < .05$, ** $p < .01$).

RESULTS AND DISCUSSION

Secular changes in somatic parameters

The differences in somatic development between the compared sets of boys were evaluated following their body height and weight.

Average values and development curves of the body height of boys suggest a declining trend in the age group 7–15 years of age in Pávek's (1968) sets and Olomouc boys (TABLE 1, Fig. 1). The average body height of Olomouc boys suggests a positive secular trend in all age groups in comparison with boys from 1966. Statistically significant variances in average body height were found in the age group of boys of 7, 8 and 13–15 years of age. In comparison with the average body height of boys in the Olomouc region from 1968 (Kubánek, 1971), there

is an obvious height predominance of present-day boys of the age group 12–15. The difference in the observed sets is obvious in the period when the boys reach the peak of their growth speed. In the set of boys from 1966, we found the peak of their growth speed between the 12th and 13th year of age, with the inter-annual increment of 6.45 cm, while in the set of boys from 1968 the maximum increment is 8.65 cm and in the set of present-day boys it is 9.1 cm and this peak of growth speed was achieved coincidentally between the 14th and 15th years of age (TABLE 1). Kubánek (1971) states that the body height of boys in 1968 in comparison with boys from 1966 varies within the framework of statewide standards. Considering the secular trend, the present Olomouc boys have higher body height by 5.57 cm in comparison with boys from 1966 and by 4.61 cm in comparison with boys from 1968 (TABLE 1).

TABLE 1

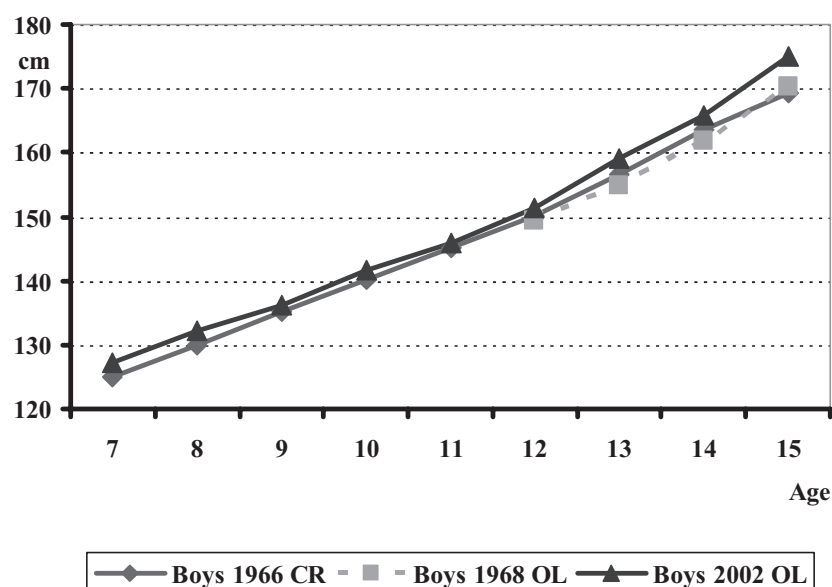
Body height (cm)

| Age | Boys 1966 CR | | | Boys 1968 OL | | Boys 2002 OL | | |
|-----|--------------|-----------|------|--------------|-----------|--------------|-----------|------|
| | n | \bar{x} | s | n | \bar{x} | n | \bar{x} | s |
| 7 | 798 | 124.92* | 5.63 | - | - | 28 | 127.26 | 6.69 |
| 8 | 944 | 130.02** | 5.63 | - | - | 78 | 132.18 | 5.85 |
| 9 | 981 | 135.20 | 6.07 | - | - | 58 | 136.28 | 7.31 |
| 10 | 1026 | 140.27 | 6.36 | - | - | 70 | 141.64 | 6.25 |
| 11 | 1159 | 145.24 | 6.56 | - | - | 80 | 145.84 | 7.27 |
| 12 | 1093 | 150.04 | 7.46 | 87 | 149.33** | 78 | 151.31 | 6.58 |
| 13 | 1142 | 156.49* | 8.26 | 85 | 154.96** | 68 | 159.06 | 7.30 |
| 14 | 1186 | 163.49* | 8.75 | 45 | 161.71** | 71 | 165.87 | 8.50 |
| 15 | 1056 | 169.40** | 7.60 | 88 | 170.36** | 84 | 174.97 | 7.95 |

(*p < .05. **p < .01.)

Fig. 1

Body height (cm)



The body weight of the observed sets of boys does not suggest a noticeable positive secular trend in comparison with body weight (TABLE 2, Fig. 2). The average body weight of present-day boys from the Olomouc region is approximately of the same value as of the boys of the same age from 1966 and 1968 in the age groups of 7–14 years of age. More distinctive variance in the body weight of boys is obvious at 15 years of age. Present-day Olomouc boys had significantly higher weight by 5.12 kg

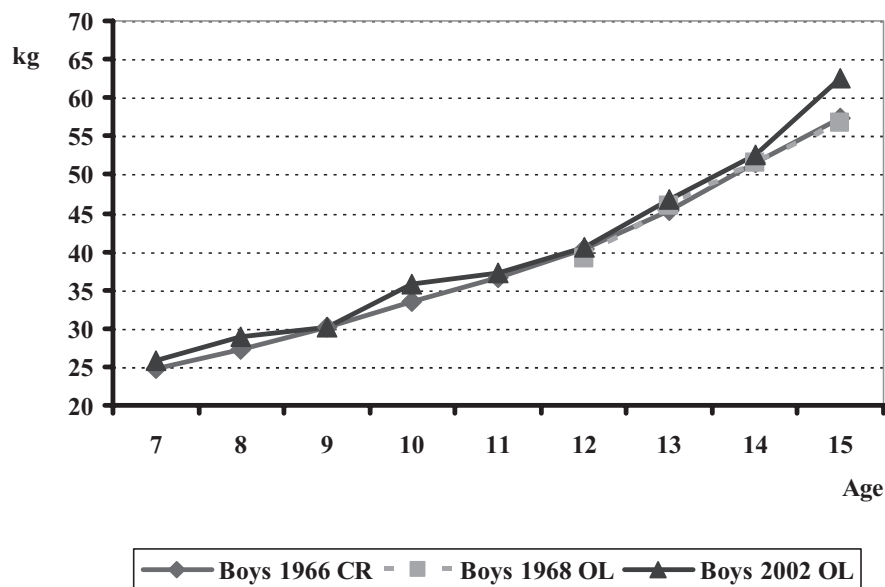
in comparison with boys from 1966 (Pávek, 1968) and by a 5.72 kg higher weight than boys from the Olomouc region from 1968 (Kubánek, 1971). The highest increment in body weight is in boys in 1966 between the 13th and 14th years of age (6.21 kg), in boys from 1968 between the 12th and 13th years of age (6.84 kg), in present-day boys it corresponds with the period of peak growth between the 14th and 15th years of age and it equals 9.96 kg (TABLE 2).

TABLE 2
Body weight (kg)

| Age | Boys 1966 CR | | | Boys 1968 OL | | Boys 2002 OL | | |
|-----|--------------|-----------|------|--------------|-----------|--------------|-----------|-------|
| | n | \bar{x} | s | n | \bar{x} | n | \bar{x} | s |
| 7 | 798 | 24.78 | 3.54 | - | - | 28 | 25.91 | 6.10 |
| 8 | 944 | 27.35** | 4.27 | - | - | 78 | 28.98 | 6.04 |
| 9 | 981 | 30.07 | 4.70 | - | - | 58 | 30.16 | 5.66 |
| 10 | 1026 | 33.48** | 6.03 | - | - | 70 | 35.80 | 8.53 |
| 11 | 1159 | 36.69 | 6.62 | - | - | 80 | 37.12 | 9.85 |
| 12 | 1093 | 40.30 | 7.41 | 87 | 39.07 | 78 | 40.63 | 8.36 |
| 13 | 1142 | 45.40 | 8.82 | 85 | 45.91 | 68 | 46.83 | 8.06 |
| 14 | 1186 | 51.61 | 9.28 | 45 | 51.52 | 71 | 52.49 | 9.77 |
| 15 | 1056 | 57.33** | 8.71 | 88 | 56.73** | 84 | 62.45 | 10.17 |

(*p < .05. **p < .01.)

Fig. 2
Body weight (kg)



Secular changes in motoric performance

The described positive development and growth changes that were found in the present population of children and youth in the past 36 years reflect the genetic disposition of each individual and the environmen-

tal factors (nutrition, health care, family background and peace of mind) that influence growth (Vignerová et al., 2005) as a result of social and economical changes within the stated period. It is obvious that the biological aspect of these changes reflect, besides morphological changes, also changes in the motoric performance of the present generation.

The development of the running speed of the observed sets of boys (TABLE 3, Fig. 3) in the 50 m run test has taken a similar course. It is obvious that the running speed increases with age in boys until 15 years of age. It is surprising that present-day boys have a similar or even lower level of performance in the 50 m run in comparison with referential data from 1966 (Pávek, 1968) and 1968 (Kubánek, 1971).

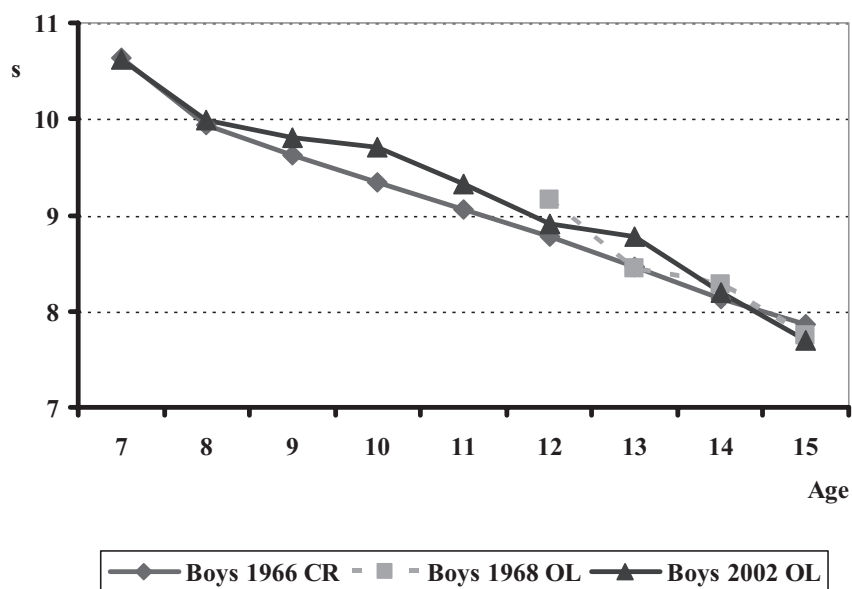
Following the results of measurements of the 50 m run of boys, Kubánek (1971) states that the performance of youth in the Olomouc region corresponds with the standards of youth in Czech regions stated by Pávek (1968). When comparing the results of Pávek (1977), Moravec et al. (1990) came to the conclusion that the boys in 1987 achieved in the 50 m run almost the same results as boys measured in 1966 (Pávek, 1977).

TABLE 3
50 m run (s)

| Age | Boys 1966 CR | | | Boys 1968 OL | | Boys 2002 OL | | |
|-----|--------------|-----------|------|--------------|-----------|--------------|-----------|------|
| | n | \bar{x} | s | n | \bar{x} | n | \bar{x} | s |
| 7 | 754 | 10.64 | 1.15 | - | - | 28 | 10.61 | 1.33 |
| 8 | 932 | 9.94 | 1.00 | - | - | 78 | 9.98 | 1.24 |
| 9 | 951 | 9.63 | 0.84 | - | - | 58 | 9.81 | 0.97 |
| 10 | 998 | 9.34** | 0.78 | - | - | 70 | 9.70 | 0.97 |
| 11 | 1081 | 9.06** | 0.77 | - | - | 80 | 9.33 | 0.89 |
| 12 | 1027 | 8.77 | 0.76 | 87 | 9.15* | 78 | 8.91 | 0.91 |
| 13 | 1043 | 8.46** | 0.75 | 85 | 8.44** | 68 | 8.77 | 0.75 |
| 14 | 1065 | 8.13 | 0.67 | 45 | 8.27 | 71 | 8.20 | 0.70 |
| 15 | 951 | 7.87* | 0.65 | 88 | 7.75 | 84 | 7.70 | 0.55 |

(*p < .05. **p < .01.)

Fig. 3
50 m run (s)



The motoric test of the standing long jump with legs together evaluated the development of the dynamic instant strength of lower limbs of boys and possible changes of this motoric ability since 1966 (Pávek, 1968).

The results of the boys' standing long jump suggest that the performance of boys is unequally increasing from the 7th to the 15th year of age. The average results

of the boys' standing long jump suggest that the highest increments basically correspond with the period of rapid body growth, i. e. between the 12th and 15th years of age (TABLE 4, Fig. 4). When evaluating motoric performance we must take into account the degree of body development. Comparison of motoric performance in present-day boys with the referential data from 1966

(Pávek, 1968) and from 1968 (Kubánek, 1971) does not suggest any improvement in this discipline (TABLE 4, Fig. 4). Development curves of the boys' standing long jump in the observed sets are practically equal. The results of this test confirm that present-day boys achieve practically the same performance as boys from 1966 and 1968 (TABLE 4, Fig. 4) and suggest the boys' dynamic instant strength of their lower limbs is stagnating. The presented conclusions are supported by the fact that the performance of present boys does not exceed the

performance of boys of the same age from 1966 and 1968, although a positive secular trend in body height has been found, which partially influences performance on this motoric test. For completeness, we can mention that in 1968 (Kubánek, 1971) the performance of pupils in the Olomouc region was the same as stated by statewide standards from 1966 (Pávek, 1968). When comparing the populations of children and youth from 1987 with that of 1966, Moravec et al. (1990) found the same results of boys' standing long jump tests.

TABLE 4

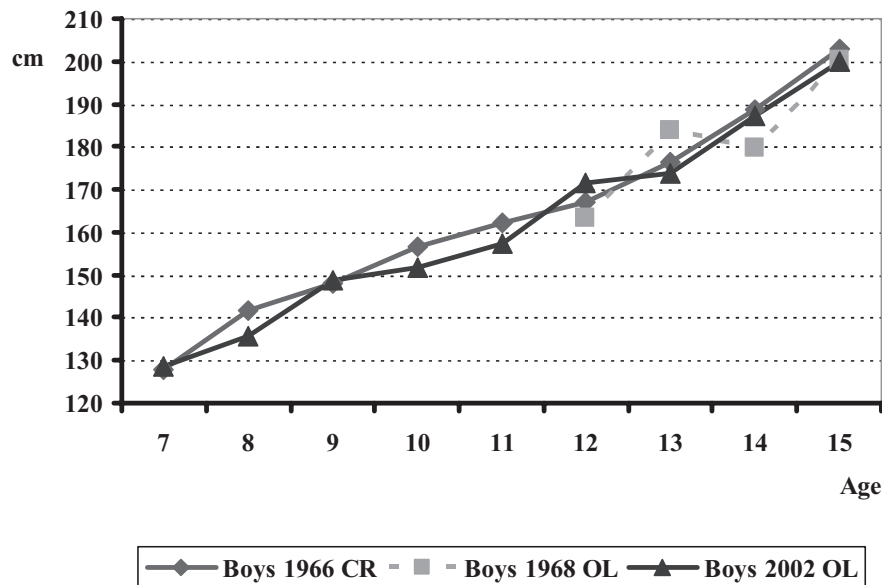
Standing long jump with legs together (cm)

| Age | Boys 1966 CR | | | Boys 1968 OL | | Boys 2002 OL | | |
|-----|--------------|-----------|-------|--------------|-----------|--------------|-----------|-------|
| | n | \bar{x} | s | n | \bar{x} | n | \bar{x} | s |
| 7 | 784 | 127.69 | 26.63 | - | - | 28 | 128.50 | 15.26 |
| 8 | 933 | 141.53* | 23.26 | - | - | 78 | 135.55 | 17.82 |
| 9 | 967 | 148.18 | 21.65 | - | - | 58 | 148.85 | 20.61 |
| 10 | 1011 | 156.65 | 22.69 | - | - | 70 | 151.90 | 18.95 |
| 11 | 1116 | 162.23* | 20.03 | - | - | 80 | 157.18 | 18.55 |
| 12 | 1079 | 167.02 | 22.19 | 87 | 163.37** | 78 | 171.41 | 17.35 |
| 13 | 1130 | 176.27 | 21.79 | 85 | 183.84** | 68 | 173.74 | 18.73 |
| 14 | 1159 | 188.79 | 25.30 | 45 | 179.70** | 71 | 187.21 | 21.08 |
| 15 | 1040 | 202.81 | 23.04 | 88 | 200.22 | 84 | 199.94 | 18.41 |

(*p < .05. **p < .01.)

Fig. 4

Standing long jump with legs together (cm)



A similar developmental secular trend of the motoric performance of present-day boys was found in the throwing the medicine ball test (TABLE 5, Fig. 5). Average values of the medicine ball throw confirm that present boys throw the 2 kg ball to the same distance as the boys of the same age 36 years ago. Development curves suggesting the level of dynamic instant-strength abilities of the upper limbs of observed sets of boys from 1966, 1968 and 2002, are nearly the same. From the stated results, it is obvious that it is not possible to confirm

a positive secular trend of motoric performance in the medicine ball throw test of present boys for the past 36 years. According to Kubánek (1968), pupils in the Olomouc region do not reach the same performance in this discipline as stated by nationwide performance found in 1966 (Pávek, 1968). On the contrary, Moravec et al. (1990) found a slightly higher results of performance in this discipline in 1987 when comparing them with the statewide standards found in 1966 (Pávek, 1968).

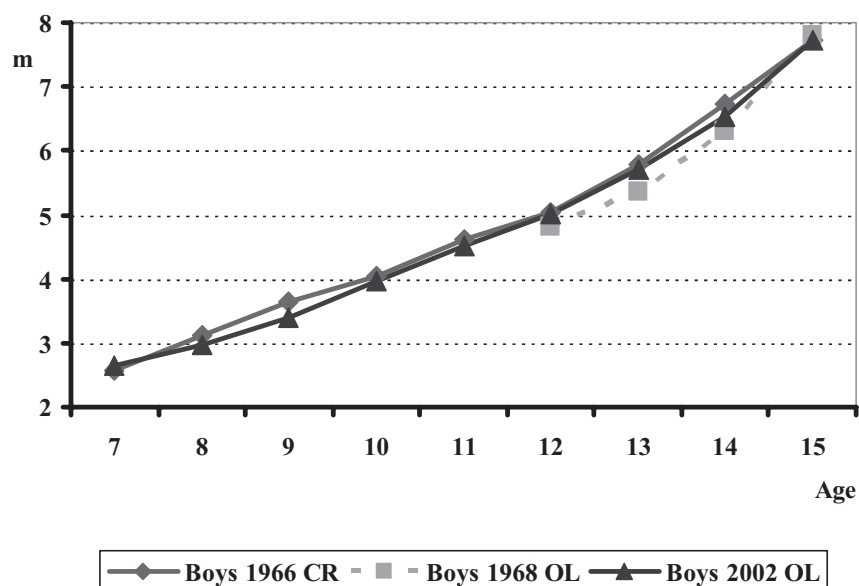
TABLE 5

Throwing medicine ball (m)

| Age | Boys 1966 CR | | | Boys 1968 OL | | Boys 2002 OL | | |
|-----|--------------|-----------|------|--------------|-----------|--------------|-----------|------|
| | n | \bar{x} | s | n | \bar{x} | n | \bar{x} | s |
| 7 | 785 | 2.58 | 0.81 | - | - | 28 | 2.65 | 0.63 |
| 8 | 932 | 3.12 | 0.62 | - | - | 78 | 2.98 | 0.61 |
| 9 | 966 | 3.65* | 0.75 | - | - | 58 | 3.40 | 0.74 |
| 10 | 1000 | 4.04 | 0.81 | - | - | 70 | 3.97 | 0.72 |
| 11 | 1138 | 4.61 | 0.87 | - | - | 80 | 4.51 | 0.87 |
| 12 | 1075 | 5.03 | 0.91 | 87 | 4.82 | 78 | 5.02 | 0.90 |
| 13 | 1125 | 5.79 | 1.15 | 85 | 5.37* | 68 | 5.70 | 1.21 |
| 14 | 1159 | 6.73 | 1.39 | 45 | 6.30 | 71 | 6.54 | 1.27 |
| 15 | 1032 | 7.73 | 1.41 | 88 | 7.79 | 84 | 7.73 | 1.40 |

(* $p < .05$. ** $p < .01$.)**Fig. 5**

Throwing medicine ball (m)



The last evaluated motoric performance test consists of pull-ups of boys of 12 to 15 years of age (TABLE 6). The level of dynamic, endurance-strength ability of the upper limbs and shoulder girdle has not changed for the past 36 years. In comparison with the statewide standards from 1966 (Pávek, 1968), we can find a stagnation of this motoric ability. In comparison with boys of the Olomouc region in 1968 (Kubánek, 1971), the found

performance levels are lower. The number of overgrasp pull-ups made on the horizontal bar by the present Olomouc boys of 14 to 15 years of age is lower by one when compared with the boys of the same age in 1968 (Kubánek, 1971).

Moravec et al. (1990) came to a similar conclusion; he found lower performance in the pull-up in 1987 in comparison with statewide standards from 1966 as stated by Pávek (1977).

TABLE 6
Pull-ups (number)

| Age | Boys 1966 CR | | | Boys 1968 OL | | Boys 2002 OL | | |
|-----|--------------|-----------|------|--------------|-----------|--------------|-----------|------|
| | n | \bar{x} | s | n | \bar{x} | n | \bar{x} | s |
| 12 | 673 | 3.39 | 2.39 | 87 | 2.94 | 78 | 3.16 | 1.94 |
| 13 | 821 | 4.05 | 2.76 | 85 | 3.37 | 68 | 3.47 | 3.00 |
| 14 | 964 | 4.66 | 3.03 | 45 | 5.00** | 71 | 3.93 | 2.82 |
| 15 | 936 | 5.40 | 3.13 | 88 | 6.42** | 84 | 5.24 | 3.25 |

(*p < .05. **p < .01.)

CONCLUSION

Comparison of the average values of the somatic and motoric development of present-day boys in the Olomouc region with the results of a statewide study of the physical performance of youth in 1966 (Pávek, 1968) and the study of Olomouc boys in 1968 (Kubánek, 1971) basically confirmed the present knowledge of somatic and motoric development of the present-day population of children and youth.

The results confirmed a positive secular trend in the body height of boys from 1966 to 2002. Considering body weight, no noticeable changes were found; we can speak rather about a stagnation. The results confirmed the unequal development of body height and weight in the observed sets of boys within the past 36 years, which has been observed for several decades (Bláha, Vignerová, Kobzová, Krejčovský, & Riedlová, 2003; Moravec et al., 1990; Vignerová et al., 2005).

The development trend of motoric performance in the compared motoric tests of boys in the Olomouc region has not remarkably changed since 1966 and for the non-sporting population this is a constant state. The results confirm the fact that present-day boys of 7 to 15 years of age achieve almost the same motoric performance in comparison with the boys of the same age in 1966 (Pávek, 1968) and 1968 (Kubánek, 1971). Similar conclusions have been found by Měkota (1985), Moravec et al. (1990) and others.

The finding of stagnation of the motoric performance of boys is probably caused by the present way of life that offers to children and young people a number of time consuming activities, which results in the decrease

of motoric stimulation in their daily programmes; as well as by a lower involvement of young people in organized forms of sports activities in their leisure time (Frömel, Novosad, & Svozil, 1999) and a predominant sedentary lifestyle that leads to hypokinesia with all its consequences.

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**SEKULÁRNÍ TREND V SOMATICKÉM VÝVOJI
A MOTORICKÉ VÝKONNOSTI CHLAPCŮ
V OLOMOUCKÉM REGIONU
ZA POSLEDNÍCH 36 LET
(Souhrn anglického textu)**

Ve své studii autor analyzuje změny somatického vývoje a motorického výkonu chlapců ve věku 7 až 15 let z Olomouckého kraje v průběhu posledních 36 let. Autor konstatoval pozitivní fungování sekulárního trendu v oblasti tělesné výšky. Současní probandi vykazují významně větší výšku, ale téměř tutéž hmotnost jako chlapci téhož věku před 36 lety. Při monitorování změn motorického výkonu autor konstatoval, že v běhu na 50 m, ve skoku dalekém z místa odrazem snožmo, v hodu těžkým míčem a ve shybu dosahují současní probandi totožných výsledků jako chlapci před 36 lety. Závěrem autor konstatuje, že nedošlo k zlepšení vývoje motorických schopností a že naopak u chlapců ve věku od 7 do 15 let z Olomouckého kraje dochází ke stagnaci vývoje rychlostních a silových schopností.

Klíčová slova: sekulární trend, chlapci ve věku 7 až 15 let, motorické schopnosti, motorické testy, motorický výkon.

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