

SECULAR TREND OF MORPHOFUNCTIONAL STATUS OF LITHUANIAN CHILDREN

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Abstract: The study was carried out in Vilnius secondary schools and kindergartens in 1985. The sample consisted of 3792 children from 2 to 18 years of age. The data of morphofunctional status of modern children were compared with the data of 1965 study. It was determined positive trend of stature (due to lengthening of legs with maximal values at the middle of adolescence). Body mass and chest circumference increased proportionally to height only in boys, while in girls relative decreasing of these indices was found. Gracilization and leptosomization of the upper part of the body (decreasing of head and chest widths) was evident, while bicristal diameter increased proportionally to stature acceleration. The all functional characteristics had negative tendency since 1965 (blood pressure increased, vital capacity and grip of both hands diminished at all age and in both sexes). The most striking factors of negative changes were worsened socio-economical and ecological situation in Lithuania during last two decades, also decreasing of physical activity and wrong nutrition.

Key words: Secular trends; Morphofunctional status; Vilnius Growth Study.

Introduction

The examination of the variability of man in time and space, the determination of the main directions of secular trends of modern youth still is one of the main problem of anthropology as well as genetics, paediatrics and ecology. Biological changes reflect the stresses of all kinds of life as a mirror: socio-economic situation, natural environment, industrial and urbanization transformations. Therefore studies of secular trends now represent an important part of research in human biology, but the whole question still is unsolved (see Wolanski 1988).

The course and the main directions of secular trends in various countries are different. Secular trends can be positive, negative or absent, also secular changes are not universal and are reversible (Malina 1990). The main part of the investigators confirms the positive secular trends of growth and development (Hajnis et al. 1983, Roede – Wieringen 1985, Eiben 1989, Jaeger et al. 1990), but at the same time the positive changes of one indices and the negative of the other ones (Farkas 1983, Vercauteren et al. 1984, Rode – Shephard 1984, Tomazo-Ravnik 1988, Hulanicka et al. 1990, Lausvee 1991), disproportional development (Ostersehl – Danker-Hopfe 1991) are evident. There are also the references on the diminishing or stopping of the rate and tempo of acceleration of the main morphofunctional indices (Chinn – Rona 1984, Shohoji – Sasaki 1984, Eiben 1988, Miklashevskaya – Godina 1988, Lindgren 1988, Lindgren 1991). In some countries the trend at least slowed down (see Malina 1990).

As with the data on growth and development of Lithuanian children, the positive secular trends of all morphofunctional indices were observed until the 1965s (Pavilonis et al. 1974). It was interesting to determine the peculiarities of secular changes of morphofunctional status of Lithuanian children after 1965s until 1985s.

Subjects and Methods

The present results are based on a growth study carried out in Vilnius (the capital of Lithuania) secondary schools and kindergartens in 1985. The sample totalled 3792 children from 2 to 18 years of age. More than 100 children of each age and sex group were examined. The children aged from 2 to 6 years were examined according to the short programme (see *Table 1*). The morphological as well as functional indices also sexual maturation were recorded to each children aged from 7 to 18 years (see *Table 2*). Standard anthropometric and physiometric methods were used (Martin – Saller 1957). Sexual maturation was evaluated by Tanner (1973) and by Pavilonis methods (Pavilonis et al. 1974). Data were computed using standard programs of packet BMDP 4M. Present results were compared with the data of morphofunctional status of Vilnius children in 1965s (Pavilonis et al. 1974) for the purpose to reveal various changes. The statistical significance of the differences was determined using Student *t*-test.

Table 1. Morphological measurements of Lithuanian (Vilnius) children of 2–6 years

Age (year)	N	Height (cm)		Weight (kg)		Chest circumference (cm)	
		x	SD	x	SD	x	SD
<i>Boys</i>							
2	106	89.17	4.56	13.13	1.57	51.24	2.17
3	120	95.19	5.26	14.67	1.83	52.00	1.99
4	105	104.33	5.03	16.72	2.08	54.51	2.19
5	113	110.05	5.13	18.65	2.60	56.23	2.66
6	125	118.12	5.58	21.85	4.42	59.07	3.98
<i>Girls</i>							
2	100	87.60	4.54	12.34	1.62	49.76	2.18
3	110	95.27	4.79	14.30	2.16	51.51	2.58
4	121	103.20	5.02	16.44	2.76	53.47	2.67
5	117	111.02	5.20	18.91	2.79	55.38	2.69
6	118	116.66	5.47	20.56	3.82	56.85	3.42

Results and Discussion

Summarising data of selected morphological and functional indices at various age periods (*Table 1* and *2*) and comparing them with the data from the other countries we can make a conclusion that modern Lithuanian children are one of the tallest in the world. Lithuanians have similar relative weight and slightly less transverse diameters of the upper part of the body (according to height), functional characteristics don't differ notably from the data of the other countries, but the blood pressure is considerably higher.

Analyzing our two comparable samples, it was found the absence of secular trend in younger children aged from 2 to 6 years. It corresponds the data of Polish population very well (Hulanicka et al. 1990). We are in the same opinion as the Polish investigators: this absence of secular trend is due to worsened economic and ecological situation during last two decades in Lithuanian also as in Poland. For example in Netherlands (Roede – Wieringen 1985) positive secular trend of growth indices at this period of life was evident.

Table 2. Means of selected morphological and functional measurements of Lithuanian (Vilnius) children of 7–18 years

Body measurements	Age groups (year)					
	8	10	12	14	16	18
<i>Boys</i>						
Stature, cm	131.4	140.7	150.7	164.8	176.2	179.6
Head height, cm	21.0	21.2	21.3	22.1	22.8	22.9
Face height, cm	10.5	10.8	11.1	11.5	12.1	12.3
Trunk length, cm	38.6	40.7	43.9	48.8	53.9	54.8
Leg length, cm	69.4	76.1	83.1	90.9	95.7	96.2
Weight, kg	28.3	33.5	41.4	51.1	65.3	70.7
Head circumference, cm	52.7	54.1	54.8	55.4	57.0	57.0
Chest circumference, cm	62.6	67.3	72.8	77.4	89.6	92.0
Abdomen circumference, cm	56.3	60.0	64.3	68.1	74.1	76.8
Hip circumference, cm	66.0	71.6	77.4	83.6	92.1	95.0
Shoulder width, cm	28.9	29.9	31.4	35.2	38.2	40.0
Chest width, cm	19.4	20.3	22.1	23.8	25.4	27.7
Chest depth, cm	12.9	14.1	15.5	16.5	18.2	19.4
Hip width, cm	20.4	21.3	23.2	25.1	27.3	27.8
Vital capacity, ml	1437	1887	2303	2978	4110	4338
Right hand grip, KG	13.0	18.3	25.6	32.8	45.8	46.5
Left hand grip, KG	12.0	16.4	23.6	30.8	42.6	43.1
Systolic B.P., mmHG	104.2	110.2	109.6	117.4	126.1	127.6
Diastolic B.P., mmHG	59.9	70.2	71.1	73.7	78.6	79.8
<i>Girls</i>						
Stature, cm	130.4	139.9	150.0	161.9	165.5	165.6
Head height, cm	20.1	20.5	20.5	21.3	21.3	21.3
Face height, cm	10.3	10.4	11.0	11.1	11.3	11.3
Trunk length, cm	37.8	39.9	42.6	47.7	51.0	51.0
Leg length, cm	69.6	76.3	83.0	88.8	88.9	89.2
Weight, kg	27.0	32.5	39.4	52.2	59.0	60.0
Head circumference, cm	52.0	53.3	54.0	55.3	56.0	56.0
Chest circumference, cm	60.4	64.0	70.2	80.1	84.3	84.3
Abdomen circumference, cm	53.8	57.0	60.0	66.0	69.0	69.2
Hip circumference, cm	65.7	71.2	77.5	89.9	95.0	96.2
Shoulder width, cm	28.2	29.7	31.4	34.5	35.5	35.7
Chest width, cm	18.7	19.7	21.2	23.3	23.7	24.3
Chest depth, cm	12.3	13.5	14.8	16.4	16.9	17.4
Hip width, cm	20.1	21.5	23.3	26.3	27.5	27.9
Vital capacity, ml	1315	1687	2155	2695	2952	3096
Right hand grip, KG	10.0	15.9	21.3	27.5	29.2	27.6
Left hand grip, KG	9.5	14.2	18.9	24.8	26.9	24.0
Systolic B.P., mmHG	101.8	106.8	110.5	120.3	125.4	126.8
Diastolic B.P., mmHG	58.6	65.4	70.1	75.5	80.0	81.6

All these changes of growth and development occur with the beginning of the adolescence. Therefore the sample of children from 7 to 18 years of age was examined carefully according to the large programme. Let us discuss our results:

(1) Positive secular trend in height was observed in all age and sex groups (*Table 3*). The maximal values of height acceleration were found in the middle of adolescence. Secular trend of stature is more expressed in boys than in girls. This fact confirms the opinion about more sensitive male organism compare to female one (Stinson 1985, Wolański 1988). As with the other longitudinal measurements, only the positive changes of face and leg length was observed, while the trunk length didn't change between 1965 and 1985s. Consequently, the increment of the height in both sexes during last two decades is due to lengthening of the legs. It coincides with the data of the other authors (Gonzales et al. 1982, Dahlström 1984).

(2) Absolute amount of body mass increased in both sexes, but this increment was proportional to the height acceleration only in boys, while in girls relative decreasing of this index was found (*Table 3*). The very similar data of cities also were confirmed by Polish (Hulanicka et al. 1990) and the other authors (Tomazo-Ravnik 1988). On the other hand, positive and considerable secular changes of body mass in boys as well as in girls were found by several investigators also (Ostersehl – Danker-Hopfe 1991, Silla – Teoste 1991). We would like to relate changes of weight in Lithuanian girls more with the changes in life stile and modern canons (fashion) of optimal body mass than with the other factors.

(3) Secular trend of head circumference is absent and it shows a big stability of the head in time. Chest circumference in boys increased only at the end of the adolescence (*Table 3*). No evident changes of this index were observed in girls. That is why modern girls have relative less chest circumference (compare to the increment of height). The same results have been reported by Farkas (1983), by Eiben (1988) and by Lausvee (1991). Summarizing the changes in the other circumferences of the body of Lithuanian children, it should be pointed out proportional increment of abdomen circumference in boys, but in girls the same process is evident only at the end of adolescence. It is necessary to stress that the hip circumference in boys did not change significantly while this index in modern girls is relatively less. We can call such process in girls as becoming the shape of the body more "cylindrical". One can found the similar data in auxological literature also (Vercauteren et al. 1984).

(4) Analyzing the changes of transverse diameters of the body the significant and big diminishing of the indices of the upper part was determined (*Table 4*). For example the width of head and face, also both diameters of the chest in modern youth is remarkable less while hip (bicristal) width increased significantly in all age and sex groups. How to explain two different trends in girls – the relative decreasing of hip circumference and increment of hip width? It can be related to diminishing of subcutaneous soft tissues (fat, muscles), because relative less body mass in modern girls was found also. We have although data on body composition of contemporary youth; unfortunately these data from 1965s are not available and comparison is impossible. As to shoulder (biacromial) width no evident changes were found. Consequently the gracilization and leptosomization of the upper part of the body took place between 1965 and 1985s. There are also the data in the auxological literature on the same process of the lower part of the body (Tomazo-Ravnik 1988).

Table 3. Estimated differences in the main morphological indices of Lithuanian (Vilnius) children in 1965 and 1985 studies

Age (year)	Height	Face height	Leg length	Weight	Chest circumference	Abdomen circumference	Hip circumference
<i>Boys</i>							
7	1.6**	0.8***	0.6	-0.8	0.0	0.3	-0.6
8	2.6***	0.7***	1.7***	0.1	-0.4	0.2	-1.0
9	3.6***	0.5***	1.1*	1.1	-1.0	1.0	-1.1
10	2.3***	0.6***	1.7***	0.5	-0.9	0.5	-0.9
11	4.2***	0.7***	2.1***	1.7	0.0	1.5*	0.3
12	4.3**	0.6***	1.3***	2.4*	0.2	1.9*	0.6
13	4.2***	0.6***	1.8***	2.5*	0.5	3.0***	1.3
14	5.2***	0.5***	1.7***	2.2*	0.9	2.4***	0.8
15	5.0***	0.4***	1.3***	3.5**	1.1	2.9***	2.3*
16	5.1***	0.4***	1.2**	3.7***	3.0***	3.0***	0.3
17	4.4***	0.6***	1.2***	1.7	1.8*	2.4***	0.3
18	4.0***	0.5***	1.2**	1.7	2.0*	2.3**	1.3
<i>Girls</i>							
7	0.2	0.5***	1.1*	-1.1	-0.5	-1.9***	-2.9***
8	2.8***	0.8***	1.2**	-0.3	-1.9***	-1.0*	-3.4***
9	2.2***	0.7***	1.3***	0.3	-0.8	-0.4	-2.2**
10	2.7***	0.6***	2.0***	-0.3	-2.4***	-1.7*	-2.5***
11	4.1***	0.9***	2.9***	2.1*	-0.7	-0.7	-1.7
12	2.0*	0.7***	1.2**	0.7	-1.6	-1.4	-1.8
13	4.9***	0.7***	3.0***	1.3	0.7	0.2	-0.3
14	3.0***	0.5***	2.2***	1.3	0.5	-0.8	-0.2
15	2.8***	0.3***	1.1*	0.9	1.5*	0.2	-0.7
16	2.9***	0.4***	1.1*	1.6	1.0	1.2	-0.1
17	3.2***	0.5***	1.1**	2.1**	2.3***	2.1**	0.3
18	2.2***	0.5***	1.2**	1.4	-0.3	2.1**	0.5

— $p > 0.05$
 * — $p > 0.05$
 ** — $p < 0.01$
 *** — $p < 0.001$

Table 4. Estimated differences in the transverse measurements of Lithuanian (Vilnius) children in 1965 and 1985 studies

Age (year)	Head width	Face width	Chest width	Chest depth	Shoulder width	Hip width
<i>Boys</i>						
7	-0.8***	-1.9***	-0.6***	-1.9***	1.3***	1.2***
8	-0.9***	-1.6***	-0.6**	-1.8***	1.3***	1.7***
9	-0.6***	-1.5***	-0.4*	-2.0***	1.1***	1.9***
10	-0.9***	-1.2***	-0.8***	-1.5***	0.6**	1.8***
11	-0.7***	-1.0***	-0.5**	-1.5***	0.9**	1.8***
12	-0.7***	-0.8***	-0.4*	-0.8***	-0.4	1.7***
13	-0.5***	-0.8***	-0.5*	-0.9***	-0.0	2.3***
14	-0.4***	-1.0***	-0.6**	-1.0***	1.0**	2.1***
15	-0.6***	-1.1***	-1.0***	-1.1***	1.3***	2.6***
16	-0.7***	-1.4***	-1.5***	-0.9***	1.4***	2.7***
17	-0.7***	-0.9***	-0.9***	-0.9***	1.8***	2.2***
18	-0.6***	-0.8***	-0.9***	-0.9***	1.0**	2.4***
<i>Girls</i>						
7	-1.0***	-1.4***	-0.8***	-1.0***	0.4	1.1***
8	-0.8***	-1.5***	-0.3	-1.7***	0.3	1.3***
9	-0.5***	-1.2***	-0.2	-1.6***	0.3	1.3***
10	-0.8***	-0.9***	-0.7***	-1.0***	0.7***	1.7***
11	-0.6***	-0.7***	-0.5*	-0.9***	0.8***	2.0***
12	-0.5***	-0.8***	-0.4*	-1.2***	-0.4	1.3***
13	-0.4***	-0.8***	-0.5*	-0.7***	0.3	1.4***
14	-0.4***	-0.8***	-0.5*	-0.8***	0.3	1.5***
15	-0.5***	-1.2***	-0.9***	-0.7***	0.1	1.0***
16	-0.5***	-1.1***	-0.9***	-0.4*	0.0	1.1***
17	-0.6***	-0.7***	-1.0***	-0.5*	0.3	1.7***
18	-0.6***	-0.8***	-0.8***	-0.5*	0.1	1.8***

— p > 0.05
 * — p > 0.05
 ** — p < 0.01
 *** — p < 0.001

Table 5. Estimated differences in the functional characteristics of Lithuanian (Vilnius) children in 1965 and 1985 studies

Age (year)	Systolic blood pressure	Diastolic blood pressure	Vital capacity	Right hand grip	Left hand grip
<i>Boys</i>					
7	0.8	3.2***	-99***	-2.0***	-2.2***
8	6.8***	6.3***	-246***	-3.1***	-2.7***
9	7.7***	7.7***	-212***	-4.3***	-4.1***
10	8.5***	12.8***	-156***	-8.4***	-6.3***
11	7.4***	10.6***	-100	-5.3***	-5.2***
12	4.2***	13.3***	-131*	-4.8***	-4.5***
13	5.5***	11.6***	29	-5.5***	-4.1***
14	9.3***	11.3***	-273***	-8.4***	-6.8***
15	9.4***	7.4***	-294***	-8.7***	-7.3***
16	8.3***	7.3***	-187*	-7.8***	-7.0***
17	12.2***	8.0***	-287**	-10.0***	-8.2***
18	3.6*	5.8***	-558***	-15.5***	-12.8***
<i>Girls</i>					
7	5.4***	4.1***	-242***	-1.7***	-1.3***
8	5.1***	1.6	-314***	-3.3***	-2.2***
9	4.9***	3.3***	-292***	-3.2***	-3.0***
10	6.8***	5.8***	-367***	-5.3***	-5.7***
11	7.9***	6.1***	-128*	-4.7***	-5.1***
12	5.1***	8.9***	-54	-5.0***	-5.2***
13	7.2***	11.2***	-46	-4.5***	-4.1***
14	11.0***	7.1***	-176**	-7.1***	-6.8***
15	9.1***	7.9***	-254***	-7.5***	-5.9***
16	12.1***	9.2***	-326*	-9.5***	-8.1***
17	12.1***	7.8***	-225**	-8.5***	-9.1***
18	12.7***	9.7***	-136**	-12.3***	-12.5***

— $p > 0.05$
 * — $p > 0.05$
 ** — $p < 0.01$
 *** — $p < 0.001$

(5) All the functional characteristics have significant negative changes (*Table 5*). The severe increasing of blood pressure, striking diminishing of vital capacity (it was the cause of deceleration of chest diameters) and hand grip took place in growth and development of modern youth. It must be stressed that all these indices diminished while stature increased at the same time. It means that we have some degree of asthenization of the body the causes of which took place in the environment during last two decades in Lithuania.

Let us try to explain such situation. As it concerns diminishing of strength and vital capacity we can point out the decreasing of physical activity, "sitting" life style. Such a big increment of blood pressure we can not explain only with the acceleration of height. More vulnerable factors such as increasing of urbanization, social and other stresses, changes in life style (fast tempo and rate), also the worsening of the ecological situation during last decades can play the important role.

(6) Sexual maturation of boys have no evident changes during the period between 1965 and 1985s: the mean age of oigarche in 1985s was $M = 14.72 \pm 0.09$ year ($SD = 0.93$) and was on 0.6 month younger ($P > 0.05$) then that in 1965s. As with maturation of girls it may be concluded that nowadays the average maturation process takes place in a shorter time, because the intervals between the beginning and the finishing of various second sexual characteristics are shorter and the whole process of maturation is more sharp and quick. The same results have been reported also by Roede – Wierengen (1985). The most striking fact is that in the middle of adolescence severe deviations occurred since SD became relative very high. The acceleration of menarche was observed only until 1980s (it was 13.07) while later it retarded: in 1985s menarche was $M = 13.37 \pm 0.11$ year ($SD = 1.08$). In some countries this trend also seems to have stopped or even retarded, e.g. Poland (Laska-Mierzejewska et al. 1989, Hulanicka et al. 1990), Hungary (Eiben 1982, Farkas 1983), United Kingdom (Roberts 1985), USSR (Miklashevskaya – Godina 1988), Sweden (Lindgren 1991) and in other (see Danker-Hopfe 1986). It can be related with different causes. One might suppose that retardation of menarche suggests that biological maximum was reached (Lindgren 1988, Malina 1990). As it concerns Lithuania we are of the same opinion as the Polish investigators – the worsened economic and ecological situation in Lithuania took place during last time.

Summarizing results of present study we can stress that until 1965s in Lithuania high acceleration of all morphological as well as functional indices was observed while later severe negative trends took place. As the stature is the most stable morphological index negative factors did not influence the height so severe like such sensitive indices as functional measurements and sexual maturation. Is it normal or abnormal – this is the difficult question. Maybe it is only the phase or moment of the whole process of long-term biological changes of man in time and space which exhibit fluctuations (Wangermez 1984, Wolanski 1988). Some authors associate it with changes in solar activity (Nikityuk and Alpatov 1984). Consequently, such morphofunctional status is the norm of modern youth. If it leads to diminishing of power, strength and activity of growing organism – such changes are negative and very striking. Not only anthropologists and pediatricians, but also the whole society must take it into account.

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