

Growth tendencies of the “generation of independence”: the relation between socioeconomic factors and growth indices

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Background. The aim of the study was to evaluate the physical status of children born in 1990 in Vilnius City and Region from birth up to the end of puberty, and to investigate the epochal changes and tendencies of their growth.

Materials and methods. 1 535 personal health records of children born in 1990 in Vilnius City and Region were analyzed. The main growth indices (height and weight) were recorded from birth up to the age of 18 years. The prevalence of overweight and obesity in children was found using the cut-off points for body mass index recommended by the International Obesity Task Force (Cole et al., 2000). The results of the present study were compared with the results of Lithuanian growth studies, as well as with the growth standards of the World Health Organization (WHO).

Results. The prevalence of overweight and obesity in children born in 1990 in Vilnius City and Region was low: 13.60% and 2.40% in the 18-year-old boys and 9.51% and 1.90% in the 18-year-old girls, respectively. The retardation of growth was observed during the first years of independence. The main growth indices have changed in girls more than in boys: both their height (from 166.5 ± 7.0 cm to 167.9 ± 6.2 cm, during the two past decades) and their BMI (from 20.37 ± 2.27 kg/m² to 21.28 ± 3.33 kg/m², over the past ten years) increased.

Conclusions. Certain retardation in growth of the children born in 1990 was related with the great political, social and economic transition in Lithuania. However, the retardation process was reversible. The main indices of the physical status (height, weight and body mass index) of children did not change much during the two past decades (the acceleration had stabilized). The growth patterns of the “generation of independence” by the end of adolescence showed the tendency towards a higher body weight, though the prevalence of overweight and obesity remained low.

Key words: children’s growth, longitudinal study, socioeconomic factors, obesity

INTRODUCTION

The most obvious changes in human physical status appear during the growth period. They include huge physical, mental and social changes. Not only human body measurements depend on the characteristics of this period, but also the health condition (since health programming proceeds) and the quality of life. For all these reasons, the human growth process and its factors are under constant investigation.

Child's growth and maturation are determined by interaction of various internal and external factors (1–5). Internal factors are related to inherited factors that determine the growth and maturation, while external factors are environmental conditions under which growth takes place. Though the main growth indices (height, weight and body mass index) are inherited, the environmental factors may change the growth process and even cause growth retardation. Currently, many growth factors are under exploration, the entire models of their interactions were created (6). Anyway, all growth factors may be relatively divided into different categories: ethnic, social, economic, cultural, physical and others. The interaction of the aforementioned factors is complex and not fully understood. In recent years, the studies of the growth factors gave controversial results: some authors stated that the internal factors had the bigger impact on child's growth, some argued that the impact of the external ones was greater (4, 6–9).

The epochal changes of physical status are the mirror of socioeconomic conditions. Over the past century, the acceleration in height was observed worldwide. During the last decade, the acceleration in our country has stabilized, the height of children and adolescents was almost the same as 10–15 years ago. Recently, auxological data from other countries showed that stabilization in height was followed by an increase in the prevalence of overweight and obesity in children. Certain growth factors, associated with acceleration in height (for example, changes in dietary patterns), are thought to promote later disproportionate increase of body mass index (10). In recent times, the aforementioned processes emerge in Lithuania, therefore the auxological studies in our country become very important.

Besides, the world's obesity epidemic is recently spreading among children (11). However, the

prevalence of overweight and obesity in Lithuania a decade ago was low in comparison with the rest of the developed world (12). Unfortunately, the experience of other countries (13–14) has showed that the prevalence of overweight and obesity among children and adolescents in our region may start to grow in the nearest future.

MATERIALS AND METHODS

The main growth indices of children born in the 1990 in Vilnius City and Region (the "generation of independence") were investigated. The permission to conduct the study (No. 57) was received from the Lithuanian Bioethics Committee. Our study was longitudinal because we followed the growth of the same individuals from birth up to the age of eighteen years. Data were collected in 2009–2010 at three largest out-patient clinics located in Vilnius City (Antakalnio, Centro and Šeškinės) and at the Central Out-Patient Clinic of Vilnius Region (CCVR). In total, personal health records of 1 535 children were analysed.

The prevalence of overweight and obesity in children was found using the cut-off points as recommended by IOTF (International Obesity Task Force) (15). These cut-off points at the age of 18 years are related with the cut-off values for adult BMI (25 kg/m² for overweight, 30 kg/m² for obesity).

The data were checked to fit normal distribution. Parametric tests (t-test) were applied for comparison if data fit normal distribution. If not, non-parametric tests (Mann-Whitney) were used.

RESULTS

The body height of Lithuanian male and female newborns was 52.66 ± 2.62 cm and 52.01 ± 2.41 cm, respectively. By the end of growth (at the age of 18 years) they reached the final height of 179.72 ± 7.19 cm and 167.90 ± 6.16 cm. The body weight of Lithuanian male and female newborns was 3 578 ± 507 g and 3 449 ± 471 g, respectively. By the end of growth they reached the final weight of 71.192 ± 11.309 kg and 59.953 ± 9.752 kg. The BMI of Lithuanian male and female newborns was 12.88 ± 1.22 kg/m² and 12.72 ± 1.19 kg/m², respectively. By the end of growth the body mass index in boys and girls reached 22.00 ± 3.21 kg/m² and 21.28 ± 3.33 kg/m², respectively. The prevalence of

overweight and obesity according to IOTF cut-off points for BMI is presented in Tables 1–2.

DISCUSSION

The results of the present study were compared with the following:

1. The results of the longitudinal study of Lithuanian infants (16). The Lithuanian children of both sexes born in 1990 were significantly taller and heavier than the newborns born in 1967–1968. Nevertheless, starting from the second or third month and up to the age of one year, the main growth indices of infants from our study became

Table 1. The prevalence of overweight and obesity among boys according to IOTF cut-off values for BMI (kg/m²)

Age, years	n	Cut-off point for OW	n (OW)	% (OW)	Cut-off point for OB	n (OB)	% (OB)
2	533	18.4	89	16.70	20.1	28	5.25
3	452	17.9	43	9.51	19.6	8	1.77
4	372	17.6	19	5.11	19.3	2	0.54
5	379	17.4	31	8.18	19.3	3	0.79
6	455	17.6	25	5.49	19.8	4	0.88
7	562	17.9	38	6.76	20.6	7	1.25
8	322	18.4	26	8.07	21.6	4	1.24
9	284	19.1	23	8.10	22.8	4	1.41
10	310	19.8	40	12.90	24.0	4	1.29
11	362	20.6	44	12.15	25.1	4	1.10
12	423	21.2	49	11.58	26.0	5	1.18
13	524	21.9	62	11.83	26.8	7	1.34
14	558	22.6	63	11.29	27.6	8	1.43
15	589	22.3	88	14.94	28.3	5	0.85
16	579	23.9	68	11.74	28.9	12	2.07
17	516	24.5	70	13.57	29.4	12	2.33
18	250	25.0	34	13.60	30.0	6	2.40

Table 2. The prevalence of overweight and obesity among girls according to IOTF cut-off values for BMI (kg/m²)

Age, years	n	Cut-off point for OW	n (OW)	% (OW)	Cut-off point for OB	n (OB)	% (OB)
2	521	18.0	93	17.85	20.1	13	2.50
3	453	17.6	51	11.26	19.4	10	2.21
4	346	17.3	30	8.67	19.1	3	0.87
5	345	17.1	32	9.28	19.2	1	0.29
6	457	17.3	36	7.88	19.7	9	1.97
7	538	17.8	49	9.11	20.5	15	2.79
8	330	18.3	35	10.61	21.6	6	1.82
9	273	19.1	36	13.19	22.8	5	1.83
10	308	19.9	27	8.77	24.1	5	1.62
11	357	20.7	35	9.80	25.4	4	1.12
12	448	21.7	34	7.59	26.7	4	0.89
13	502	22.6	32	6.37	27.8	6	1.20
14	568	23.3	40	7.04	28.6	6	1.06
15	591	23.9	38	6.43	29.1	8	1.35
16	570	24.4	47	8.25	29.4	7	1.23
17	512	24.7	48	9.38	29.7	9	1.76
18	263	25.0	25	9.51	30.0	5	1.90

n – the number of children, OW – overweight, OB – obesity.

smaller (Table 3). Certain retardation in growth of the infants born in 1990 might be related with the great socioeconomic changes in Lithuania at the beginning of the period of Independence. Some macroeconomic indicators might help to visualize those changes. For example, the gross domestic product in 1990 decreased drastically and achieved the level of 1988 only in 1996 (17–18) (Fig. 1). High inflation was also registered (Fig. 2).

These findings might be explained by the fact that maternal factors had an important impact on the size of the newborns (the year before 1989–1990 was the last one before huge political changes). An

organism of a female from the very beginning of its growth “accumulates” the impact of various growth factors and later, during the pregnancy, transmits it to the offspring (the growth programming proceeds). Therefore, the main body size indices of the newborns reflected the growth factors of the previous generation. The mothers of the children born in 1990 were taller than the mothers of the newborns born in 1966–1967 due to the acceleration process that took place in the second half of the twentieth century in Lithuania, as well as in most other European countries. Besides, before 1990 the health care system and nutritional conditions were

Table 3. Growth indices of Lithuanian infants during 1990–1992 and 1966–1968

Boys														
m.	Weight							Height						
	M*, g	SD*, g	n*	M**, g	SD**, g	n**	p	M*, cm	SD*, cm	n*	M**, cm	SD**, cm	n**	p
0	3 628	459	187	3 543	449	231	>0.05	52.87	2,37	183	51.26	1.51	231	<0.001
1	4 583	671	179	4 620	507	196	>0.05	56.00	2.83	171	55.89	1.78	196	>0.05
2	5 591	633	164	5 610	574	196	>0.05	59.26	2.70	157	59.86	1.99	196	<0.05
3	6 522	660	159	6 517	647	203	>0.05	62.50	2.42	157	63.23	2.14	203	<0.01
4	7 332	730	146	7 343	723	191	>0.05	65.16	2.35	141	66.08	2.26	191	<0.001
5	7 962	824	128	8 090	798	204	>0.05	67.15	2.65	121	68.48	2.35	204	<0.001
6	8 581	843	118	8 761	870	204	>0.05	69.00	2.86	110	70.40	2.42	204	<0.001
7	9 064	864	114	9 359	934	197	<0.01	70.79	2.85	110	72.18	2.47	197	<0.001
8	9 617	992	105	9 886	986	198	<0.05	72.30	2.55	104	73.63	2.51	198	<0.001
9	10 110	1 048	87	10 334	1 025	187	>0.05	73.61	2.48	86	74.90	2.56	187	<0.001
10	10 521	1 042	60	10 737	1 046	186	>0.05	74.87	2.90	60	76.06	2.63	186	<0.01
11	10 663	1 083	71	11 066	1 046	188	<0.01	76.04	2.68	72	77.18	2.71	188	<0.01
12	11 311	1 305	160	11 334	1 022	190	>0.05	78.59	3.64	160	78.32	2.83	190	>0.05
Girls														
m.	Weight							Height						
	M*, g	SD*, g	n*	M**, g	SD**, g	n**	p	M*, cm	SD*, cm	n*	M**, cm	SD**, cm	n**	p
0	3 459	400	187	3 328	381	210	<0.01	52.08	2.09	181	50.57	1.62	210	<0.001
1	4 228	497	178	4 326	466	182	>0.05	54.85	2.24	168	54.79	1.82	182	>0.05
2	5 122	541	160	5 239	547	183	<0.05	57.85	2.29	151	58.43	1.96	183	<0.05
3	5 937	579	153	6 072	623	185	<0.05	60.97	2.03	146	61.56	2.10	185	<0.05
4	6 703	667	144	6 832	692	184	>0.05	63.49	2.11	140	64.24	2.19	184	<0.01
5	7 352	787	123	7 525	754	186	>0.05	65.61	2.92	119	66.53	2.25	186	<0.01
6	8 003	837	132	8 157	808	186	>0.05	67.29	2.59	130	68.48	2.29	186	<0.001
7	8 454	857	112	8 733	852	185	<0.01	68.73	2.25	108	70.15	2.31	185	<0.001
8	8 923	833	99	9 260	886	181	<0.01	70.31	2.22	95	71.61	2.32	181	<0.001
9	9 206	885	86	9 745	909	182	<0.001	71.67	2.51	85	72.9	2.33	182	<0.001
10	9 708	947	67	10 192	919	176	<0.001	73.02	2.26	64	74.09	2.34	176	<0.01
11	10 027	897	71	10 608	916	177	<0.001	74.68	2.80	70	75.24	2.35	177	>0.05
12	10 549	993	157	10 999	899	178	<0.001	76.87	3.21	157	76.41	2.37	178	>0.05

m. – month, M – mean, SD – standard deviation, n – the number of children, *1990–1992, **1966–1968.

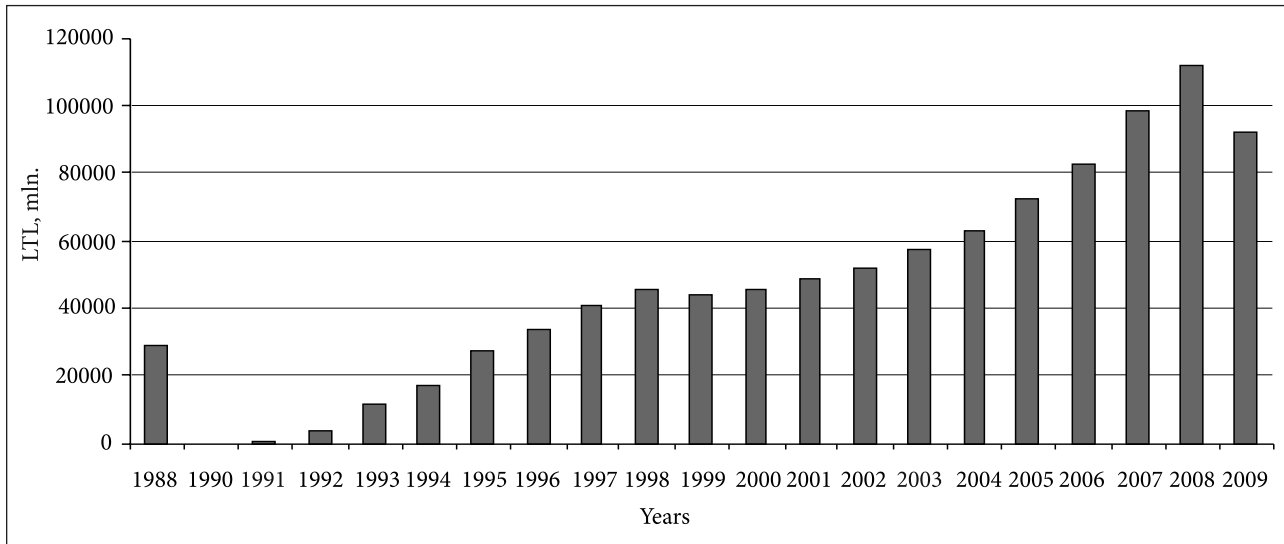


Fig. 1. Gross domestic product in Lithuania (1988–2009)

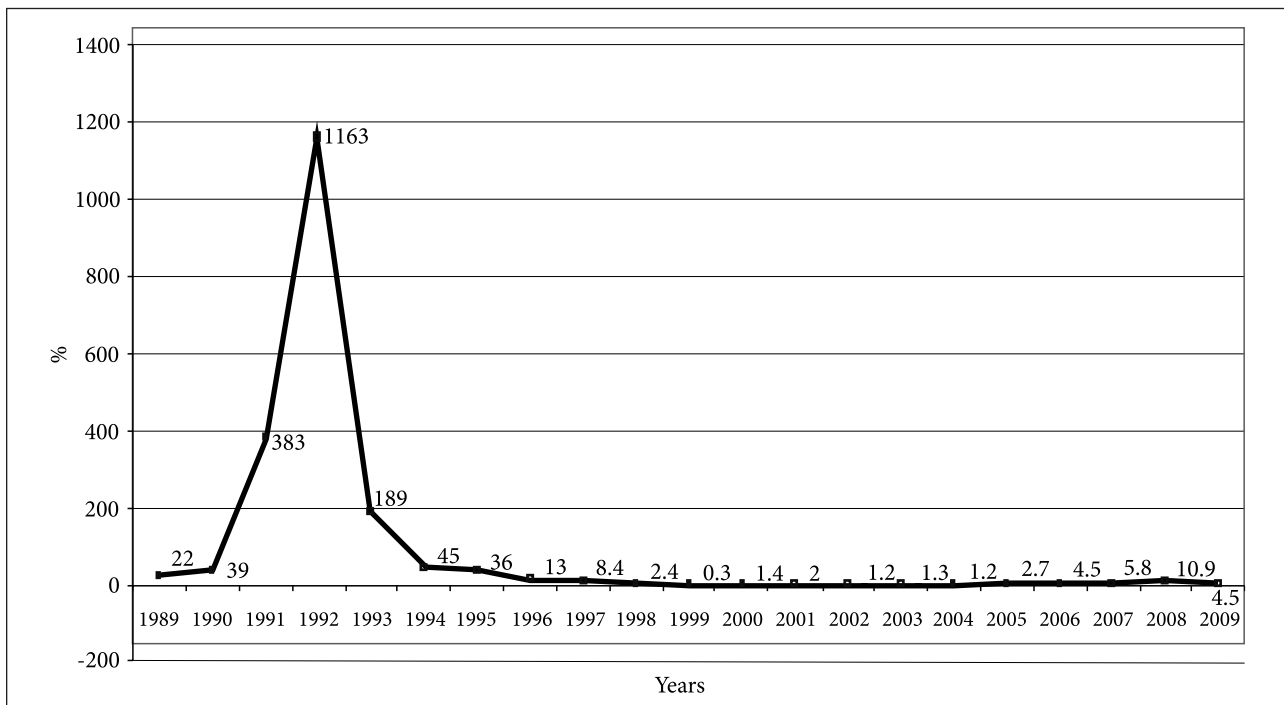


Fig. 2. Average annual inflation in Lithuania (1989–2009)

more or less appropriate and equal for the majority of inhabitants in Lithuania. Thus, it might be possible that women born under the stable conditions after the sixth decade of the twentieth century “transmitted” more positive growth “fund” to their children in comparison with the women born outright after (or during) the Second World War. Nowadays, when no drastic political and socio-economic changes take place, the main body size indices of newborns are quite stable (10, 19–21).

2. The results of the cross-sectional study of the morphological and physical status in Lithuanian children and adolescents in 1985–1994 (22). The retardation in growth of the children from our survey was observed at the age of 1–4 and 7 years, that matched the curves of the main macroeconomic indicators (Fig. 1–2). The children from our study were significantly taller in comparison with the results of the cross-sectional Lithuanian growth study from 1985–1994. In

some age groups (12-year-old girls) the differences in height exceeded 4 cm. Though no differences in height of the 18-year-old boys were found, certain acceleration in girls' height was observed during the first decades of independence (from 166.5 ± 7 cm to 167.9 ± 6.2 cm).

The weight of the children did not change much either. No statistically significant differences in the boys' BMI were obtained at the age of 18 years. Nevertheless, the girls' BMI decreased significantly. Since we could not relate these changes to the insufficient nutrition, it might be explained by the impact of mass media – the pressure for extremely slim female's body as the ideal one prevailed at that time (12, 23).

3. The cross-sectional study of the main body indices of Lithuanian children in 2000–2005 (24). The retardation in growth of the children from our survey was observed at the age of 1–4 years; the possible factors were discussed above. There was an increase in BMI of modern girls starting from the age of 15 years ($p < 0.05$) which could not be explained by the different time of maturity as far as the differences remained up to the end of the growth period. BMI of 18 year-old girls from our longitudinal study (in comparison with the results of the 2000–2005 data) increased for more than 1 kg/m^2 ($21.28 \pm 3.33 \text{ kg/m}^2$ and $20.37 \pm 2.27 \text{ kg/m}^2$, respectively).

After the comparison of the results from our study and those two other Lithuanian growth studies (performed in 1985–1994 and 2000–2005), we could conclude that the growth of children during the two decades of Independence did not change much. Obviously, the acceleration in height had stabilized, the boys' BMI remained almost unchanged, though diminished BMI values in older adolescents girls from 2000–2002 study started to increase recently and almost reached the level of 1985. However, in order to clarify the aforementioned tendencies more detailed auxological studies should be performed.

4. The results of physical status in preschool children (3–6 years of age) (25). The time of adiposity rebound in our and 2003–2007 study was at the same age: in boys it happened during their seventh year of life, in girls during the sixth year.

5. The growth standards of the World Health Organization (WHO) (26–27). Lithuanian children were taller and heavier at almost all ages

($p < 0.05$). There were no differences in BMI of boys starting from the age of 13 years, and in the BMI of girls starting from the age of 4 years (i. e. their body mass index did not differ much from the WHO standards for BMI). Nevertheless, due to the multiple and statistically significant differences in body height and weight, WHO growth charts seem to be inappropriate for our country.

CONCLUSIONS

Certain retardation in growth of the children born in 1990 was related to the great political, social and economic transition that happened in Lithuania in 1990–1993. However, the retardation process was reversible. The main physical indices (height, weight and body mass index) of children did not change much during the last two decades (the acceleration had stabilized). The growth patterns of the “generation of Independence” by the end of adolescence showed the tendency towards the bigger body weight, though the prevalence of overweight and obesity among Lithuanian children remained low.

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„NEPRIKLAUSOMYBĖS KARTOS“ VAIKŲ AUGIMO TENDENCIJOS: SOCIALINIŲ IR EKONOMINIŲ VEIKSNIŲ ŠAŠAJOS SU AUGIMO RODIKLIAIS

Santrauka

Darbo tikslas. Ištirti 1990 m. gimusių Vilniaus miesto ir rajono vaikų augimo ypatumus nuo gimimo iki brendimo pabaigos, nustatyti jų fizinės būklės pokyčius ir augimo tendencijas.

Darbo medžiaga ir metodai. Išanalizuotos 1990 m. gimusių 1 535 Vilniaus miesto ir rajono vaikų ambulatorinės kortelės. Surinkti duomenys apie vaikų fizinės

būklės rodiklius (ūgį ir svorį) nuo gimimo iki aštuoniolikos metų amžiaus. Tirtų vaikų kūno stambumo kraštiniai variantai nustatyti pagal Tarptautinės nutukimo darbo grupės (angl. *IOTF – International Obesity Task Force*) atsvario ir nutukimo kūno masės indekso ribines vertes (T. Cole ir kt., 2000). Tirtų vaikų fiziniai rodikliai palyginti su kai kurių Lietuvos auksologinių tyrimų rezultatais, taip pat su tarptautiniais Pasaulinės sveikatos organizacijos sudarytais augimo standartais.

Rezultatai. Atsvario ir nutukimo paplitimas tarp 1990 m. gimusių Vilniaus miesto ir rajono vaikų buvo mažas: tarp 18 metų amžiaus berniukų – 13,60 ir 2,40 % (atitinkamai), o tarp mergaičių – 9,51 ir 1,90 % (atitinkamai). Pirmaisiais nepriklausomybės metais nustatytas tirtų vaikų augimo atsilikimas. Mergaičių fiziniai rodikliai pakito daugiau nei berniukų: Lietuvos nepri-

klausomybės laikotarpiu padidėjo vidutinis jų ūgis (nuo $166,5 \pm 7,0$ cm iki $167,9 \pm 6,2$ cm), per pastarąjį dešimtmetį – ir kūno masės indeksas (nuo $20,37 \pm 2,27$ kg/m² iki $21,28 \pm 3,33$ kg/m²).

Išvados. Didelių politinių, socialinių ir ekonominių pertvarkų laikotarpiu vaikų fizinių rodiklių augimas, palyginti su stabiliais šalies raidos laikotarpiais, atsiliko. Neigiami šio laikotarpio vaikų augimo pokyčiai buvo grįžtami. Pagrindiniai vaikų fiziniai rodikliai (ūgis, svoris, kūno masės indeksas) per pastaruosius dešimtmečius beveik nepakito, t. y. akceleracijos procesas stabilizavosi. Nustatyta vaikų kūno stambėjimo tendencija brendimo pabaigoje, tačiau vaikų atsvario ir nutukimo paplitimas išliko mažas.

Raktažodžiai: vaikų augimas, longitudinalinis tyrimas, socialiniai-ekonominiai veiksniai, nutukimas