Coll. Antropol. **27** (2003) 1: 321–334
UDC 572.512:612.65-055
Original scientific paper

Gender-Specific Growth Patterns for Stature, Sitting Height and Limbs Length in Croatian Children and Youth (3 to 18 Years of Age)

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A B S T R A C T

In a cross-sectional study of growth, 5,155 children (2,591 females, 2,564 males) from the town of Zagreb (Croatia) were measured. Four traits of linear dimensionality (stature, sitting height, arm and leg lengths) were studied in the age span of 3 to 18 years. A significant average annual increase of all four anthropometric parameters were observed up to 14 and 15 years of age in girls and 16 years of age in boys, showing that girls had a shorter growing period. In the prepubertal period until 9 years of age, gender differences were negligible. At the age of 10, boys were overgrown by girls in all parameters due to the earlier onset of puberty in girls. The growth gains for girls, when compared with those for boys, show a different pattern across variables. The female growth advantage remained in a two years period for the limbs length, but in a three year period for stature and the longest, for 4 years, for sitting height. The male predominance in size had an onset at the age of 13 for the limbs and in the age of 14 for stature and sitting height. The patterns of sexual dimorphism in stature and sitting height during growing years are similar to those observed in other populations of Europe. Growth of Croatian children and youth is very similar to that of the tallest European populations.

Key words: *children, growth patterns, gender, morphology, anthropometry, Croatia*

Received for publication December 18, 2002

Introduction

Linear body dimensions of children and youth predominantly reflect bone growth, which is especially dramatic in the pubertal period of life[1–4]. These dimensions are closely associated with structural and functional changes. For instance, pubertal height velocity is highly related to the menarcheal age[5] and the slow down of the locomotory system growth with the onset of growth of the respiratory system[6]. As any dynamic system, bone has to maintain a balance of proportions in its permanent change of size and structure. This process is known to be different in males and females during puberty[7], which can be recognised in the growth channels model described by Živičnjak and Pavičić[2] and Živičnjak et. al.[4].

Although growth of children is too complex to be described by a simple measurement, stature is usually the only parameter used in the assessment of changes in linear body dimensionality. In Croatian children, stature and body weight have been well documented[8–13] but data on other linear measurements from childhood to adulthood are scanty. A detailed description of body morphology in pubertal children from the Croatian town of Zagreb was given by Miličević et al.[14] and Živičnjak et al.[15]. Among numerous measurements, this study recorded stature, sitting height, leg and arm lengths in the age span of 11 to 15 years which was insufficient to reflect fully the linear growth kinetics from childhood to adolescence.

Since statural growth results from changes in length of upper and lower body segments with age, it is indispensable to include sitting height and limbs length in the analysis of growth. The patterns of relative growth of trunk and lower extremities vary among populations. While accepting a strong environmental component for body size, most authors have opted for genetic control of body proportions. It has been recognised recently that environmental factors influence body shape as well[16–19]. The changes of body proportions under the influence of improved quality of life are well documented in the Japanese[20] and Polish[21] populations. In contrast to the trunk and legs, the relative growth of arms has been poorly documented and there are scarce data on its sexual dimorphism and variability among populations.

Considering the importance of knowledge about growth of linear body dimensions in different populations for understanding human morphological variation, the aim of the present study was twofold: (1) to examine the patterns of growth in stature, sitting height and limbs length in Croatian children and youth, and (2) to analyse gender differences in growth of linear body dimensions in this population.

Subjects and Methods

The study was carried out in the population of the town of Zagreb, the capital of Croatia which constitutes one fourth of the total population of the country. Data have been collected in 5 primary and 4 secondary schools from April to June 1997. Additionally, children in 4 kindergartens were measured in March and May 2000 and 2001. Schools and kindergartens were chosen in different parts of Zagreb representing various socio-economic conditions. Thus, a cross-sectional sample of 5,155 children (2,591 females, 2,564 males) aged 3 to 18 years was measured. Children with chronic disease as well as disabled children were excluded from the study. The sample represents over 5% of the total Zagreb population of children in the age span of 3 to 18 years. Informed consent was obtained in each case and approval of the local ethics committee was given prior to the study. Thus, the study was in accordance with the eth-

ical standards of the Helsinki declaration of 1975 (revised in 1983).

The data used in this study are a subset of the database of the Institute for Anthropological Research, Zagreb that comprises measurements of 28 anthropometrical traits of Zagreb children and youth. The measurements were taken by the examiners who have passed a two-month training led by one of the authors (M. Ž.) prior to the study. Each examiner measured a subset of traits, the same one in the entire sample of children. In case of illness of an examiner, a trained substitute was provided so that maximally two examiners were responsible for each measurement, which kept the inter-observer variance as small as possible. The measurements analysed in the present study consisted of standing height (stature), sitting height, total arm length (arm length) and height of anterior superior iliac spine (leg length). The maximal inter-observer difference was below 4 mm for stature and 6 mm for sitting height, arm and leg lengths. Measurements were taken according to the IBP recommendations[22] using standard equipment. The accuracy of the measurements was 1 mm. The age cohorts were defined chronologically (e.g. the ages of 10.00 to 10.99 years as the age cohort of 10 years).

Descriptive statistics was used to present substantial characteristics of the data. Comparisons between genders and between successive age cohorts were carried out by means of univariate analysis of variance (ANOVA). The age-related changes were tested using post hoc multiple comparison (the least significant difference – LSD).

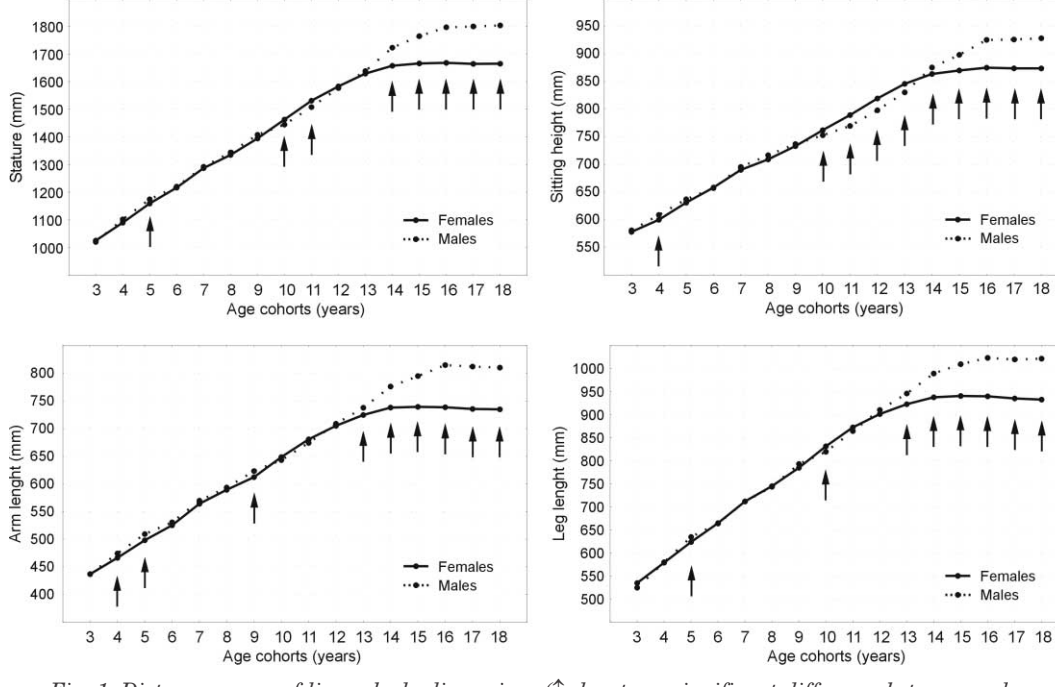

Fig. 1. Distance curves of linear body dimensions (↑ denotes a significant difference between males and females. See Tables 1 to 4).

Results

Descriptive statistics of stature, sitting height, arm and leg lengths are shown by age cohorts in Tables 1 to 4. Sample sizes (N), means ($\bar{X}$), standard deviation (SD), standard errors of means (SE), 95% confidence intervals for means (95% CI), minimal (Min) and maximal (Max) values and coefficients of variation (CV) are given. Plots of the means by age and sex are shown in Figure 1. Statistically significant differences between male and female means obtained using ANOVA are marked by asterisks in tables and by arrows in Figure 1.

TABLE 1
STATURE (IN MM) BY SEX AND AGE

Age cohort (years)	N	$\bar{X}$	SD	SE	95% CI		Min	Max	CV
					L Bound	U Bound			
Females	2,591								
3	39	1025	41.3	6.6	1012	1038	926	1097	4.03
4	62	1090	40.0	5.1	1080	1100	982	1178	3.67
5	97	1159*	53.6	5.4	1148	1170	1005	1325	4.62
6	114	1217	50.3	4.7	1207	1226	1076	1334	4.14
7	175	1287	58.6	4.4	1279	1296	1155	1452	4.55
8	143	1335	63.2	5.3	1325	1345	1153	1513	4.73
9	179	1395	69.1	5.2	1385	1405	1215	1560	4.95
10	161	1463*	68.2	5.4	1452	1474	1320	1690	4.66
11	208	1531***	71.6	5.0	1521	1541	1342	1703	4.68
12	181	1583	74.7	5.6	1572	1594	1398	1781	4.72
13	189	1629	66.0	4.8	1620	1639	1446	1790	4.05
14	209	1658***	61.5	4.3	1649	1666	1502	1844	3.71
15	259	1666***	60.0	3.7	1659	1673	1544	1880	3.60
16	227	1668***	62.5	4.2	1660	1676	1483	1840	3.75
17	183	1664***	58.5	4.3	1656	1673	1540	1826	3.51
18	165	1665***	64.4	5.0	1655	1675	1511	1841	3.87
Males	2,564								
3	47	1020	44.3	6.5	1007	1033	939	1142	4.34
4	90	1102	40.2	4.2	1094	1110	1023	1188	3.65
5	119	1175	49.3	4.5	1166	1183	1023	1285	4.19
6	112	1220	50.5	4.8	1211	1230	1090	1367	4.14
7	191	1292	57.5	4.2	1284	1300	1170	1455	4.45
8	153	1344	66.1	5.3	1333	1355	1201	1517	4.92
9	177	1408	61.7	4.6	1399	1417	1179	1561	4.38
10	182	1445	61.0	4.5	1436	1454	1277	1602	4.22
11	225	1508	72.5	4.8	1499	1518	1320	1683	4.81
12	213	1577	89.0	6.1	1565	1589	1352	1824	5.65
13	217	1639	85.7	5.8	1627	1650	1460	1936	5.23
14	225	1723	74.8	5.0	1713	1733	1534	1907	4.34
15	198	1765	69.7	5.0	1755	1775	1576	1952	3.95
16	145	1797	66.0	5.5	1786	1808	1635	2015	3.67
17	155	1800	71.4	5.7	1789	1811	1642	2010	3.96
18	115	1804	65.8	6.1	1792	1816	1672	1990	3.65

Significant difference between males and females obtained using ANOVA:
* $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$

Stature

The annual increase in stature was significant from early childhood to 14 years of age in girls and to 16 years in boys (post hoc LSD procedure: $p<0.05$). Both sexes experienced similar increase until 9 years. Boys were slightly taller in this period, but gender difference was significant only in the age of 5 years, when they were 15 mm taller than girls (Table 1, Figure 1). The earlier beginning of pubertal spurt in girls resulted in their statural advantage from 10 to 12 years of age. The differences were significant in the ages of 10 and 11. A larger annual increase in boys starting at the age of 12 is illustrated in Figure 2 by an intersection of the two lines. Consequently, boys were significantly taller from 14 years of age to adult stature. As shown in Figure 3, gender difference increased sequentially from 65 mm in the age of 14 to 139 mm in the age of 18. The coefficients of variation were the highest slightly before the maximal pubertal growth gain.

Sitting height

The annual gain in sitting height was significant until the age of 15 years in girls and 16 years in boys (post hoc LSD procedure: $p<0.05$). The annual increments were similar in both genders until the age of 9 (Table 2, Figures 1 and 2). In the age of 7 to 11 years, the growth velocity increased in girls and decreased in boys resulting in their longer trunks at that period. Boys experienced rapid growth of sitting height in the period of 11 to 13 years of age. Consequently, boys had significantly longer sitting height from the age of 14 to adulthood. The difference between genders increased from 12 mm in the age of 14 to 55 mm in the age of 18 (Figure 3). The greatest dispersion of data

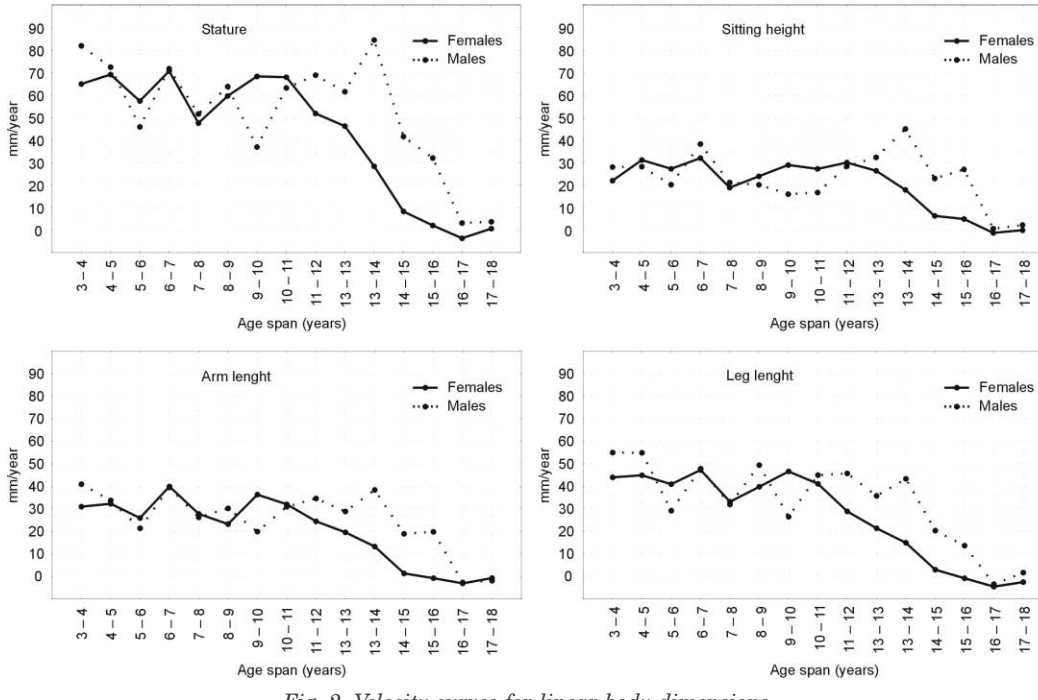

Fig. 2. Velocity curves for linear body dimensions.

TABLE 2
SITTING HEIGHT (IN MM) BY SEX AND AGE

Age cohort (years)	N	$\bar{X}$	SD	SE	95% CI		Min	Max	CV
					L Bound	U Bound			
Females	2,591								
3	39	578	23.5	3.8	571	586	537	626	4.07
4	62	600*	23.0	2.9	594	607	544	651	3.83
5	97	631	30.1	3.1	625	637	559	718	4.77
6	114	658	30.6	2.9	653	664	585	738	4.64
7	175	690	29.6	2.2	686	695	606	765	4.29
8	143	709	33.3	2.8	704	715	600	794	4.70
9	179	733	36.3	2.7	728	739	649	818	4.95
10	161	762*	36.8	2.9	757	768	679	883	4.82
11	208	790***	41.5	2.9	784	795	695	925	5.25
12	181	820***	42.7	3.2	813	826	702	930	5.22
13	189	846***	37.3	2.7	841	851	751	937	4.41
14	209	864**	32.3	2.2	860	868	773	968	3.74
15	259	870***	30.4	1.9	867	874	796	969	3.50
16	227	875***	34.5	2.3	871	880	790	966	3.94
17	183	874***	29.6	2.2	870	878	795	954	3.38
18	165	874***	34.1	2.7	869	879	770	958	3.90
Males	2,564								
3	47	581	20.6	3.0	575	587	543	642	3.55
4	90	609	24.8	2.6	604	614	557	669	4.07
5	119	637	27.2	2.5	632	642	573	707	4.26
6	112	658	29.4	2.8	652	663	584	743	4.47
stright 7	191	696	29.7	2.2	692	700	625	766	4.27
8	153	717	34.6	2.8	711	723	628	823	4.82
9	177	737	30.9	2.3	733	742	627	806	4.19
10	182	753	30.3	2.2	749	758	667	828	4.02
11	225	770	38.1	2.5	765	775	678	881	4.94
12	213	798	45.1	3.1	792	804	691	933	5.65
13	217	831	50.6	3.4	824	837	710	975	6.09
14	225	876	44.5	3.0	870	882	770	984	5.08
15	198	899	39.5	2.8	893	904	786	990	4.39
16	145	926	37.2	3.1	920	932	810	1032	4.02
17	155	926	40.5	3.2	920	933	840	1060	4.37
18	115	929	36.7	3.4	922	935	853	1010	3.95

Significant difference between males and females obtained using ANOVA:
* $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$

was observed in both genders in the period of maximal annual change which was earlier in girls (11 to 12 years) than in boys (12 to 14 years) (Table 2).

Arm length

Arm increased in length significantly up to the age of 14 years in females and 16 years for males (post hoc LSD procedure: $p<0.05$). In the prepubertal period, boys had longer arms than girls (significant in the ages of 5, 7 and 9 years) (Table 3, Figure 1). The annual gain in arm length was very similar in both genders leading to nearly equal increase in arm length in the period from 4 to 9 years. Female advantage existed only at the age of 10 and 11 but the difference was negligi-

TABLE 3
ARM LENGTH (IN MM) BY SEX AND AGE

Age cohort (years)	N	$\bar{X}$	SD	SE	95% CI		Min	Max	CV
					L Bound	U Bound			
Females	2,591								
3	39	432	21.2	3.5	425	439	376	468	4.91
4	62	463*	21.8	2.8	458	470	411	526	4.71
5	97	495**	25.6	2.6	490	500	430	567	5.17
6	114	521	26.5	2.5	516	526	445	587	5.07
7	175	561	29.6	2.2	557	566	496	641	5.27
8	143	589	33.3	2.8	583	595	495	690	5.66
9	179	612**	33.3	2.5	607	617	524	717	5.45
10	161	649	34.5	2.7	643	654	557	761	5.32
11	208	681	37.1	2.6	676	686	580	763	5.45
12	181	705	36.8	2.7	700	711	614	817	5.23
13	189	725***	33.8	2.5	720	730	642	808	4.67
14	209	738***	29.6	2.1	734	742	668	827	4.02
15	259	739***	34.2	2.1	735	744	638	852	4.63
16	227	739***	33.0	2.2	734	743	634	839	4.46
17	183	736***	31.2	2.3	731	740	632	800	4.25
18	165	735***	34.7	2.7	730	740	640	828	4.72
Males	2,564								
3	47	431	23.1	3.4	425	438	381	484	5.36
4	90	472	20.6	2.2	468	476	425	523	4.36
5	119	506	24.9	2.3	501	510	438	557	4.93
6	112	527	25.6	2.4	522	532	459	613	4.85
7	191	567	29.8	2.2	562	571	500	658	5.26
8	153	593	32.6	2.6	588	598	504	698	5.49
9	177	623	32.6	2.4	618	628	502	722	5.23
10	182	643	30.4	2.3	639	648	580	748	4.73
11	225	674	36.9	2.5	669	679	586	772	5.47
12	213	709	45.3	3.1	703	715	606	849	6.40
13	217	738	42.3	2.9	732	743	646	885	5.73
14	225	776	37.4	2.5	771	781	687	869	4.82
15	198	795	34.0	2.4	790	800	702	894	4.28
16	145	815	39.6	3.3	808	821	718	944	4.85
17	155	812	35.1	2.8	807	818	717	903	4.32
18	115	810	33.8	3.2	804	817	735	909	4.17

Significant difference between males and females obtained using ANOVA:
* $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$

ble. From the age of 11, arm grew more rapidly in boys (Figure 2) which resulted in their significantly longer arms from the age of 13 on. Figure 3 demonstrates that gender difference increased from 13 mm in the age of 13 to 76 mm in the age of 18. The greatest variation in arm length as shown by the coefficient of variation, existed slightly before the maximal pubertal spurt in stature (Table 3).

Leg length

A consecutive significant increase of leg length has been documented until the age of 15 years in girls and 16 years in boys (post hoc LSD procedure: $p<0.05$).

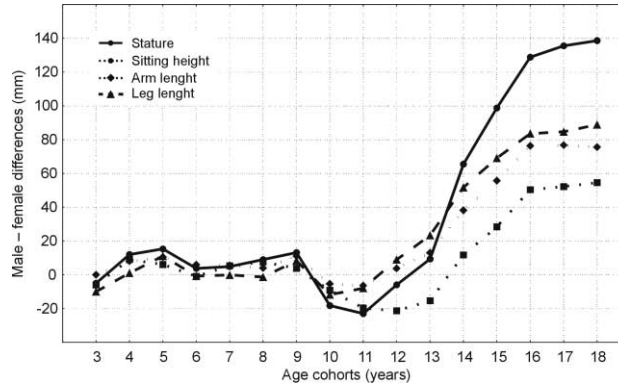

Fig. 3. Gender differences in linear body dimensions by age.

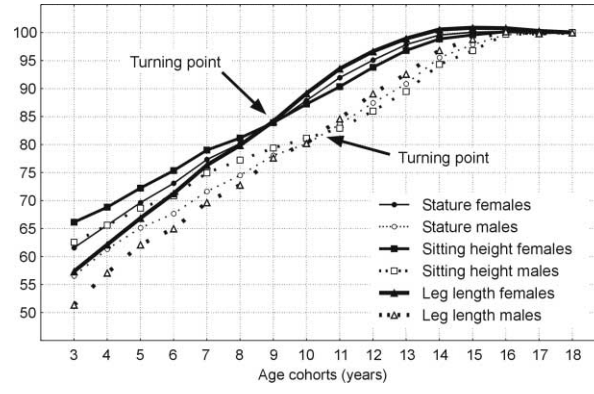

Fig. 4. Percentages of final size achieved during the period of growth.

During the prepubertal period legs grew similarly in both sexes (Table 4, Figure 1). Similarity of boys and girls was maximal in the ages of 6 to 8 years when gender differences did not exceed 1 mm. Due to an increase in leg growth velocity in girls that took place between 8 and 10 years, girls were longer-legged than boys at 10 and 11 years of age (Figures 2 and 3). From the age of 12 on, legs grew more rapidly in boys. Consequently, boys had significantly longer legs from 13 years on. The difference increased from 23 mm in the age of 13 to 89 mm in the age of 18 years (Figure 3). The coefficients of variation were on the average higher in girls (Table 4). The homogeneity of data was generally marked in childhood and in late adolescence. The greatest variation was observed between mid- and pubertal growth spurts in girls (7 to 9 years) and at 12 years of age in boys (Table 4).

Differing rates of growth in linear body segments can be viewed through the amounts of their final size that are achieved at a given age. Figure 4 illustrates the percentages of final size that were achieved by each linear dimension during growth. The percentages equalled 100% at the age of 18 years. Sexual di-

TABLE 4
LEG LENGTH (IN MM) BY SEX AND AGE

Age cohort (years)	N	$\overline{X}$	SD	SE	95% CI		Min	Max	CV
					L Bound	U Bound			
Females	2,591								
3	39	535	31.7	5.1	524	545	456	605	5.93
4	62	579	24.8	3.2	573	585	508	641	4.28
5	97	624*	35.4	3.6	617	631	524	726	5.67
6	114	665	34.2	3.2	658	671	572	734	5.15
7	175	712	40.3	3.0	706	718	637	830	5.66
8	143	745	41.2	3.4	738	752	625	852	5.53
9	179	785	45.5	3.4	778	792	653	906	5.80
10	161	832*	45.6	3.6	825	839	727	968	5.48
11	208	873	47.2	3.3	866	879	756	980	5.41
12	181	902	50.2	3.7	894	909	783	1047	5.57
13	189	923***	45.3	3.3	917	930	799	1052	4.91
14	209	938***	46.1	3.2	932	944	819	1098	4.92
15	259	941***	45.6	2.8	935	947	827	1113	4.84
16	227	940***	44.9	3.0	934	946	817	1052	4.77
17	183	936***	46.2	3.4	929	942	820	1056	4.93
18	165	933***	45.2	3.5	926	940	822	1068	4.85
Males	2,564								
3	47	525	30.8	4.5	516	634	470	602	5.87
4	90	580	28.5	3.0	574	586	517	644	4.91
5	119	635	32.8	3.0	629	641	532	705	5.17
6	112	664	35.1	3.3	658	671	570	770	5.29
7	191	712	39.7	2.9	706	718	620	843	5.58
8	153	744	44.1	3.6	737	751	636	845	5.92
9	177	793	45.3	3.4	787	800	647	928	5.71
10	182	820	39.8	3.0	814	826	715	924	4.86
11	225	865	50.5	3.4	858	871	756	1015	5.84
12	213	911	58.7	4.0	903	918	773	1065	6.44
13	217	946	53.4	3.6	939	953	833	1150	5.65
14	225	990	48.8	3.3	983	996	865	1115	4.93
15	198	1010	47.8	3.4	1003	1017	902	1138	4.73
16	145	1024	51.7	4.3	1015	1032	875	1217	5.05
17	155	1020	54.5	4.4	1012	1029	880	1162	5.34
18	115	1022	48.7	4.5	1013	1031	902	1136	4.76

Significant difference between males and females obtained using ANOVA:
* $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$

morphism emerged already at the age of 3. At that time, girls achieved 57.3% of the final leg length and 66.1% of the final sitting height. Boys in this age group achieved lower amounts of final sizes (51.4% and 62.6%, respectively). The female advantage remained throughout the growing period until the age of 16. Rates of growth of different body segments changed at the time of onset of pubertal growth spurt. Until then, sitting height achieved larger percentages of its final size than did extremities. At the time of onset of the pubertal spurt, the percentages equalised to about 85%. The turning point emerged at the age of 9 in girls and between 10 and 11 years in boys when growth rates of body segments

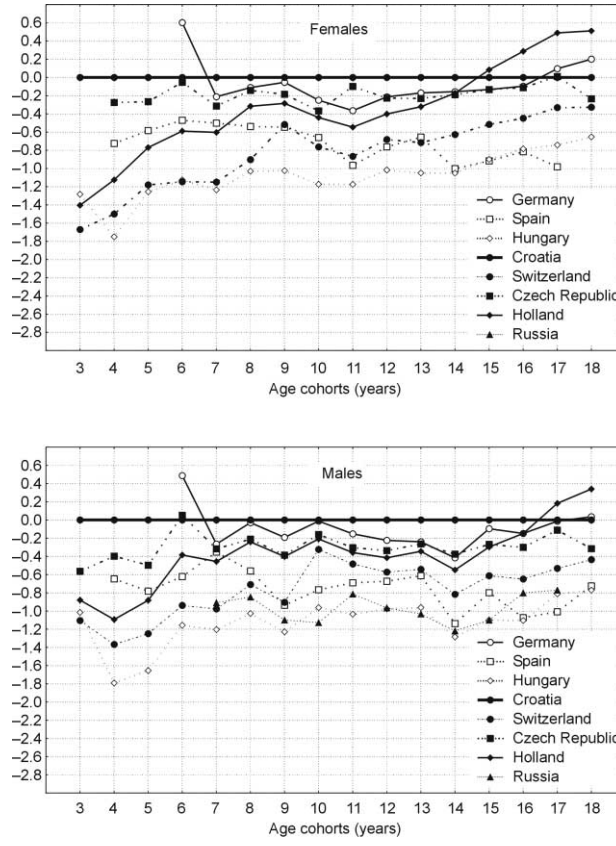

Fig. 5. Stature of Croatian children compared with that of other European populations (SDS values are Z-scores related to the Croatian data).

switched and resulted in changes of body proportions.

The results obtained in all four linear dimensions can be summarized as follows:

- In the prepubertal period, there is an overall similarity in linear dimensions among males and females;
- At the age of 10, boys were overgrown by girls in all parameters. The female growth advantage remained in a two year period for the extremities length, but in a three year period for stature and a four year period for sitting height;
- During adolescence, differing growth rates of body segments resulted in differential emergence of sexual dimorphism in the studied linear dimensions: at the age of 13 for the extremities, and at the age of 14 for sitting height and stature;
- Growth had longer duration in males than in females: in males, generally until the age of 16, while in females stature and arm length grew until 14

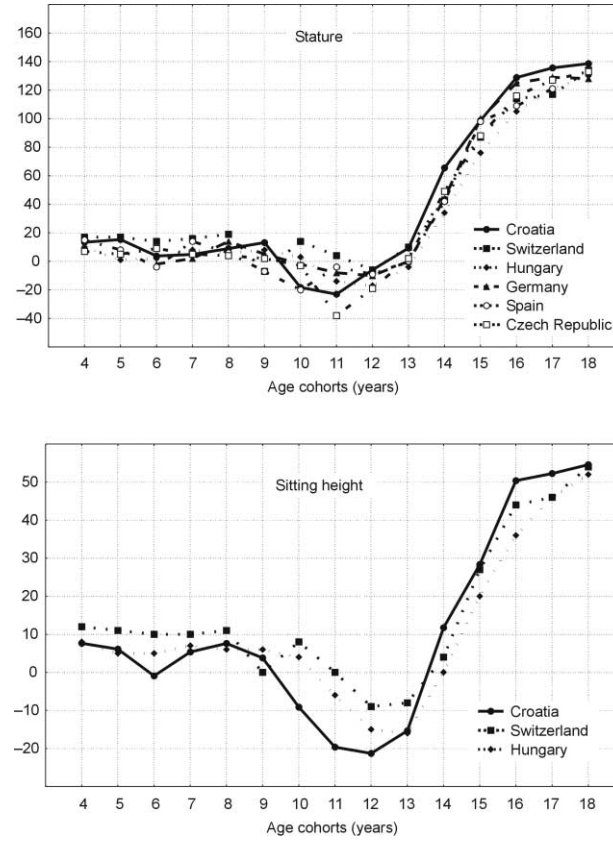

Fig. 6. Gender differences in stature and sitting height for Croatian children compared with other European populations.

years and sitting height and leg length until 15 years age.

Discussion

This paper contains contemporary cross-sectional data describing the stature, sitting height, arm and leg lengths of children living in the town of Zagreb, Croatia. With the exception of stature, there is generally a lack of referential data on linear body dimensions in healthy children and youth. Even well known studies as the Zürich Longitudinal Growth Study[23], the Osterwolde Study[24], the Czech Nationwide Anthropological Survey[25] or the Hungarian National Growth Study[26] did not include all presently studied characteristics of linear dimensionality. Leg length, if presented, was mostly estimated as a difference of height and sitting height (subischial length), e.g. in the Zürich study[23]. Therefore, the lack of referential data on length of extremities and different measuring techniques restricted comparisons of our data with other studies to stature and sitting height. Standardised values of stature shown in Figure 5 indicate considerable variation in growth among recent European popu-

lations (German[27], Spanish[28], Hungarian[26], Russian[29], Swiss[23], Czech[25] and Dutch[30]). They also support Prebeg's[9] view that growth potential of the Croatian population is very similar to that of the tallest European populations. Growth pattern of Zagreb children and youth is most similar to growth of their German and Czech peers.

Measurements of stature and sitting height generally show a similar pattern of sexual dimorphism among populations during the growth period. Gender differences presented in Figure 6 for the Croatian and several other European populations point to the following:

- In prepuberty, until the age of 8 to 9 years, sexual dimorphism in stature and sitting height is negligible in all presented populations. This pattern was noted in the Harpenden study[18] and the Zürich Longitudinal Growth Study[23], both starting from 3 years of age. Similar effects in statural growth were recognised in other European studies as well, e.g. Slovenian[31], German[27], Spainish[28], Hungarian[26] and Czech[25];
- In puberty, sexual dimorphism in stature and sitting height markedly differs among populations due to the variation in timing and intensity of the morphological changes;
- In late adolescence, when linear growth is almost completed, there is again a considerable interpopulational similarity in sexual dimorphism despite the fact that its extent is maximal at that period (e.g., for stature: 138 mm in our sample, 128 mm in German[27], 130 mm in Spanish[28], 130 mm in Hungarian[26], 134 mm in the Swiss[23] and Dutch[30], and 133 mm in Czech[25]).

Throughout the growth period girls achieved larger amounts of final linear size for age (Figure 4) which suggests their earlier bone maturation. This was documented by the Zürich Study as well[32].

Although it is impossible to derive the exact dynamics of the growth pattern from cross-sectionally obtained mean growth curves, it is obvious that the adolescent growth spurt has different timings in different parts of the body. The data show that acceleration in leg growth in the late prepubertal and early pubertal periods precede the trunk in both genders (Figures 2 and 4). This is in accordance with the general biological phenomenon that leg length is reaching its peak growth velocity earlier than the trunk[33]. The kinetics of these changes has been described by Gasser et al.[32], who noted that the pubertal spurt occurred earlier in the legs than in the trunk. Bass et al.[34] confirmed this finding with the statement that appendicular growth was more rapid than axilar growth before puberty in girls. Dasguapta and Das[35] also noted in a cross-sectional growth study of the Calcutta boys that in the age of 16 years legs have almost reached the final size while the trunk is still growing.

The differential growth dynamics of body segments greatly influences changes of body proportions. Legs and stature have similar patterns of growth (especially in the prepubertal period) in both genders stressing stronger dependence of stature on leg length than on sitting height (Figure 2). Recent studies of the effects of quality of life and environmental factors on human growth hypothesised higher plasticity of leg length relative to sitting height. Namely, secular trend toward increased stature observed in numerous populations was found to be almost entirely due to the increase in leg length[36–38]. The trend was associated with better nutritional and health status. It exists in both genders and confirms that environmental factors powerfully influence body shape as well as body size.

Thus, the present observations further illustrate different timing and intensity of change in linear body segments during the growth period. The patterns are gender-specific and result in prominent sexual dimorphism in size and shape of the body in adulthood. The observed changes of body proportions may be a reflection of functional necessity of the organism to achieve skeletal stability and muscle strength in the years of growth. Therefore, growth kinetics of linear body dimensionality has to be studied using different linear traits paralelly. Our study is a contribution in that direction.

Acknowledgment

This study would not have been possible without the help given generously in the participating kindergartens, primary and secondary schools. We are indebted to all children and youth, their teachers, pedagogues, psychologists and directors of the institutions. Our heartfelt gratitude is due to Milena Haller, psychologist and Branka Zeljković – Smrzlić, pedagogue who helped us organising the measurements in kindergartens. The study was supported by the Ministry of Science and Technology of the Republic of Croatia by grants 0196001 and 0196003.

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OBRASCI RASTA VISINE, SJEDEĆE VISINE I DULJINE UDOVA DJECE I MLADEŽI U HRVATSKOJ (OD 3. DO 18. GODINE ŽIVOTA)

S A Ž E T A K

U okviru transverzalnog istraživanja rasta djece i mladeži ispitano je 5155 predškolske djece i učenika (2591 djevojčica i 2564 dječaka) grada Zagreba. Analizirana su četiri pokazatelja linearne dimenzionalnosti tijela (visina, sjedeća visina, duljine ruke i noge) u dobi od 3 do 18 godina života. Mjere tih pokazatelja povećavaju se do 14. i 15. godine u djevojčica te do 16. godine u dječaka što potvrđuje da djevojčice ranije završavaju s rastom. Razlike među spolovima neznatne su u prepubertetskom razdoblju do 9. godine života. Djevojčice ranije ulaze u pubertet i s 10 godina prerastaju dječake. Obrazac rasta pojedinih linearnih dimenzija razlikuje se među spolovima. Prednost djevojčica zadržava se dvije godine za duljine udova, tri godine za visinu i 4 godine za sjedeću visinu. Dječaci prerastaju djevojčice u duljini udova s 13 godina, a u visini i sjedećoj visini s 14 godina. Spolni dimorfizam u razdoblju rasta slijedi obrasce uočene u drugim europskim populacijama. Rast djece i mladeži u Hrvatskoj sličan je onome zabilježenom u najvišim populacijama Europe.