

# Impact of War on Growth Patterns in School Children in Croatia

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## ABSTRACT

*The objective of this paper is to present the growth patterns of school children in Osijek – the city which was exposed to severe attacks during the aggression on Croatia. The mean height and weight of Osijek schoolchildren aged 7 to 18 and the menarcheal age in girls in academic year 1995/96 were compared to the analogous data collected in 1980/81. The secular changes in height were heterogeneous. In older age groups from 12 in girls and 13 in boys, the mean height in 1995/96 increased markedly, whereas from 9 to 11 or 12, changes were undulating. In the youngest groups – at the age of 7 in both genders, and at 8 in boys, negative changes were observed. Markedly smaller height in this cohort was still pronounced in 1999/2000 when these children reached the age of 11. However, one year later (2000/01), at the age of 12, boys and girls caught up with their peers in the previous generations. These children during the war were approximately at the age of 2.5 to 4, a period when growth patterns are highly sensitive to adverse environmental influences. It might be possible that the emotional stress caused by a change of environment and separation from home, contributed to the deceleration of growth rate, i.e. the smaller height in a large part of childhood.*

**Key words:** child growth, secular changes, impact of war

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## Subjects and Methods

Secular changes in the growth and development of children and adolescents in Croatia have been very heterogeneous in the last decades. In some parts, changes

in both adult height and maturation are still positive, in others they both have stopped. In some, changes became divergent, i.e. the height is still increasing,

while the decreasing trend of mean menarcheal age has stopped or even shows a shift towards an older age<sup>1-3</sup>.

We were eager to find out the dynamics of growth changes in children in the areas, which were directly exposed to war.

The objective of this paper is to present growth patterns of school children in Osijek – the northeastern Croatian city that was exposed to severe attacks during the aggression on Croatia, being almost on the front-line for 8 months (from September 1991 to May 1992).

The project described in this paper consists of two different types of research, which became interrelated to each other. The first one presents the secular changes in height, weight, and menarcheal age in Osijek school children as a result of two cross-sectional studies performed in 1980/81 and 1995/96. Both surveys were based on a random stratified sample amounting to about 15% of the school population. In the second study, in 1995/96, about 25% of boys and girls enrolled in randomized schools were displaced or refugee children. They were surveyed too, but their data were not included into the results. (Their data were processed separately since these children originated from different regions. Moreover, they experienced a great deal of emotional stress, which could bias the results). So, the study in 1995 embraced 1,993 examinees: 895 girls and 1,098 boys. The 1980 sample was somewhat larger: 2,365 examinees – 1,244 boys and 1,121 girls.

However, the height and weight of the youngest age groups, 7-year-olds, were surveyed again in 1999/2000 and 2000/01 when they reached the age of 11 and 12. The 8-year-olds in 1995/96 were measured again also, but only in 1999/2000 at the age of 12. The measurements were performed in the same period of the year as on the first occasion (in 1995/96). This part has a feature of follow-up approach.

All measurements were performed by two of the authors (H.J. and I.S.) who work as school doctors in Osijek.

The data were processed at the School of Public Health »Andrija Štampar« computing center. The height and weight of boys and girls were grouped in 1-year age groups according to the nearest birthday; the values used in the text thus refer to the median values (e.g. »7 years« means all children in the group aged from 6.50 to 7.49).

The differences between the mean heights were estimated by t-test and the mean menarcheal ages by the status quo method by the application of probity analysis.

## Results

The changes in height observed in 1995/96 were heterogeneous over the age groups (Table 1). In 1995, in the youngest age groups of both genders negative changes were noticed: 7- and 8-year old boys were 2.33 cm and 1.47 cm respectively shorter than their peers in 1980. The difference in 7-year-olds is significant,  $t=2.79$ .

In girls, the decreased mean height (by 1.57 cm) was noticed only at the age of 7, but it is slightly below the significance limit ( $t=1.91$ ). From the age of 8 onwards in girls, and from 9 onwards in boys, changes were slightly positive or undulating, whereas in older age groups, from 12 in girls and from 13 in boys, the mean height in the majority of the age groups increased markedly. In boys, the maximal increase was at 15 and 16, reaching 4 cm, which suggests an earlier end of the adolescent spurt for the whole group. Boys approached their final height already at 16. In girls, the secular increase seems to be more homogeneous, peaking at 15 – 3.25 cm (Table 1), when the girls approach their adult mean height.

Changes in weight more or less followed the height changes, although a slight tendency towards higher weight was noticed.

The mean menarcheal age in Osijek girls did not change at all. It was exactly the same as in the generation surveyed 15 years earlier ( $X=12.89$ ,  $SD=1.15$  in 1980, and  $X=12.88$ ,  $SD=1.14$  in 1995).

The question arose: What was the reason of the negative height trend in the youngest age groups in generation 1995? Would these children, in the course of their growth, catch up with their peers, or

would the difference persist until adult age?

That is why height and weight measurements were repeated in the same children four and five years later, in academic year 1999/2000 and 2000/2001, when they reached the age of 11 and 12 respectively. Unfortunately, the age groups were smaller as some children were unavailable. They moved from Osijek or changed the school and the address.

The results showed (Table 2) that at the age of 11 neither the boys nor the girls had caught up with their peers.

**TABLE 1**  
MEAN HEIGHT OF OSIJEK SCHOOL CHILDREN IN THE ACADEMIC YEARS 1980/81 AND 1995/96

Age (years)	1980/81			1995/96		
	N	X	SD	N	X	SD
<b>Boys</b>						
7	99	125.90	5.01	83	123.57	6.06
8	115	131.90	7.36	79	130.43	6.22
9	128	136.60	6.78	65	135.81	6.11
10	111	142.00	6.84	86	142.23	6.85
11	107	146.50	6.73	94	147.33	8.20
12	126	152.50	7.54	94	152.39	7.53
13	121	158.40	8.48	91	160.28	8.70
14	114	166.30	9.65	105	166.76	8.18
15	81	169.80	8.01	119	173.88	8.58
16	84	174.10	6.71	117	178.25	6.56
17	76	178.30	6.27	106	178.95	5.97
18	82	176.90	6,67	59	178.17	6.66
<b>Girls</b>						
7	90	124.80	5.64	75	123.23	4.90
8	97	129.60	6.33	79	130.61	6.49
9	99	134.80	6.00	59	134.68	6.08
10	99	139.42	6.92	67	140.66	5.80
11	109	148.30	7.93	87	148.33	7.34
12	120	152.50	7.84	102	155.00	7.62
13	124	157.80	7.90	102	159.64	7.09
14	98	162.20	5.43	98	163.95	5.90
15	67	162.00	5.62	72	165.25	6.35
16	64	164.20	6.35	70	166.02	6.33
17	72	163.40	6.06	50	166.08	6.54
18	82	162.90	7.69	34	165.44	6.56

**TABLE 2**  
 MEAN HEIGHT IN 7- AND 8-YEAR-OLD OSIJEK SCHOOLBOYS AND SCHOOLGIRLS MEASURED IN THE ACADEMIC YEAR 1995/1996 AND AGAIN IN 1999/2000 AND 2000/2001 (WHEN THEY WERE AT THE AGE OF 11 OR 12)

Age (years)	1995/96			1999/2000			2000/01		
	N	X	SD	N	X	SD	N	X	SD
<b>Boys</b>									
7	**83	**123.57	**6.06						
8	79	130.43	6.22						
11	94	147.33	8.20	**72	**144.84	**7.61			
12	94	152.39	7.53	*57	*152.97	*8.17	**59	**153.05	**2.2
<b>Girls</b>									
7	**75	**123.23	4.90						
8	*79	*130.61	6.49						
11	87	148.33	7.34	**54	**145.9	****7.20			
12	112	155.00	7.62	*71	*154.82	*6.20	*49	**154.93	8.17

\*\* The cohort of children measured 3 times (at the age of 7, 11, and 12);

\* The cohort of children measured 2 times (at the age of 8 and 12)

They were on average shorter than their peers of the same gender in 1995 and even in 1980. In girls, the mean difference even increased, from 1.57 cm at the age of 7 in 1995 to 2.43 cm at 11 in 1999/2000. The difference almost reached the level of significance ( $t=1.94$ ). In contrast, 12-year-old boys, who in 1995 at the age of 8 were shorter than their peers in 1980, had caught up with their peers in generation 1995 and 1980. However, one year later – in 2000/2001 the »school-beginners« in 1995/1996 reaching 12 years in both genders had caught up and even surpassed their peers from 1995 and 1980. They reached the same mean height, as did the 12-year-old children one year earlier. The average increment of 8.2 cm in boys and 8.9 cm in girls from 11 to 12 suggests the start or even the peak of the pubertal spurt in the majority of examinees.

The mean weight in 1999/2000 in girls at the age of 11 (40.11 kg) was somewhat lower than in 1995/1996 (41.13 kg). However, due to the smaller stature, the value of BMI slightly increased – from 18.53 to 18.77. The 11-year-old boys in 1999/2000

had about the same mean weight (40.10 kg) as their peers in 1995/96 (39.84 kg) resulting in marked increase of BMI – from 18.12 in 1995 to 18.92 in 1999 (Table 3).

## Discussion

In the early 1980s, both genders of Osijek school children in almost all age groups had about the same mean height as their peers in another three big Croatian cities-Zagreb-the capital, Split-the second largest town situated in the middle of Dalmatia and Rijeka-a city at the northwestern part of the Croatian coast<sup>4</sup>. Only at the age of 18 did Split boys and girls exceed their coevals reaching mean height of 181 cm and 167 cm respectively. In the other 3 cities, the mean height of 18-year-olds varied from about 177 to 178 cm in boys, and from 163 to 165 cm in girls. So, Osijek schoolboys and schoolgirls were among the tallest in Croatia.

However, in the following period of 10 to 15 years, secular changes in height in dwellers of four respective cities were different. In Rijeka, the mean male height

**TABLE 3**  
 MEAN VALUES OF BMI IN OSIJEK SCHOOL CHILDREN IN ACADEMIC YEAR 1995/1996, AND IN THE SAME CHILDREN IN 1999/2000 AND 2000/2001 WHEN THEY WERE AT THE AGE OF 11 OR 12

Age (years)	1995/96			1999/2000			2000/01		
	N	X	SD	N	X	SD	N	X	SD
<b>Boys</b>									
7	**83	**16.10	2.28						
8	79	16.32	1.95						
11	94	18.12	3.23	**72	**18.92	3.74			
12	94	18.57	3.26	*57	*18.93	3.35	**59	**19.53	3.69
<b>Girls</b>									
7	**75	**15.93	2.63						
8	79	16.50	2.88						
11	87	18.53	3.41	**54	**18.77	3.66			
12	112	18.95	3.76	*71	*19.56	3.57	**49	**19.05	2.92

\*\* Cohort of children measured 3 times (at the age of 7, 11, and 12);

\* Cohort of children measured 2 times (at the age of 8 and 12)

increased on average by 1–3 cm between 1981 and 1992, with the largest difference from 10 to 15. The girls displayed no change up to the age of 10, a moderate increase between 11 and 14, but a very steep one (4 cm) from 15 onwards. At 15–18 years, the girls reached a stature of 167–167.5 cm<sup>1,2</sup>. In Split, the average height increased in all observed age groups by 2–4.5 cm in girls, and by 3–5 cm in boys. In 1992 at the age of 18, the girls' mean height was 170 cm and the boys' 182.5 cm, exceeding the tallest European populations<sup>5</sup>.

In Zagreb, in the period 1982–1991, changes were small—in boys practically nonexistent until the age of 13. After 14 years, a positive trend was observed, averaging from 0.4 to 1.2 cm. In almost all the female groups, changes towards a taller height varied from 0.1 to 1.2 cm<sup>6</sup>.

In all surveyed groups, changes in mean male weight corresponded to changes in height. In general, girls showed a smaller increase in weight than in height, this being more marked in older age groups.

It is difficult to explain the diversity of growth changes in Osijek.

It cannot be ruled out that compared to their peers in 1980/81, height in the 7-year-old Osijek school children in 1995/96, i.e. the 11-year-olds in 1999/2000, was the consequence of war conditions. Of course, there are factors, which might bias such a conclusion, including in first place the incomplete involvement of examinees by measurements in 1999/2000 and 2000/2001. In the postwar period, there were quite intensive migration movements in this region.

On the other hand, it is difficult to explain why the negative changes would be pronounced only in this cohort.

It is well known that war conditions include many factors which might slow down the maturational rate of children – insufficient nutrition, poor hygienic conditions, increased prevalence of diseases, emotional stressors such as fear and anxiety, loss of a beloved person, loss or damage of home, etc. However, it should be mentioned that food shortage did not appear in Osijek. Neither did the incidence of diseases, especially infectious diseases, increase. Health care as well as food and water supply were functioning properly.

Moreover, children were evacuated from Osijek during the most dangerous period. In this way they were spared the deleterious effects of fear and anxiety. However, the stressful atmosphere of the sudden change of environment and separation from home caused a great deal of emotional disturbances, which had been manifested for years – emotional disorders, school failure, maladaptation, a variety of neurotic symptoms, etc.

Boys and girls in our observed cohort (7-year-olds in the survey in 1995/96, i.e. 11 in 1999/2000) were between the age of 2.5 and 4 years during the war in the Osijek region. This is a period when according to Tanner<sup>7</sup> the secular trend and social class difference is established. This has been documented by many classical growth studies<sup>8–10</sup>. It seems that in this period susceptible for environmental influences, growth is sensitive to adverse emotional factors as well. That might explain the isolated negative changes in both genders of the youngest age group in 1995. The smaller height only in boys at the age of 8 in 1995/96 compared to their peers in 1980/81 speaks in favor of that assumption as boys are more susceptible to changing conditions than girls with respect to height<sup>6,7</sup>.

On the other hand, slightly greater positive changes in body weight compared to changes in height, i.e. the increase in BMI, suggest a worsening in the quality of nutrition, i.e. in eating habits, which might also have contributed to the smaller height in the most sensitive groups. However, variations in the body mass index during childhood and adolescence reflect the developmental changes,

e.g. the mid spurt and pubertal spurt in height and not only being over- or underweight<sup>11</sup>. It is difficult to explain why these children did not catch up with their peers from previous generations in the period of 4 years (up to the age of 11). We may speculate that there is the mutual influence of growth patterns in the different growth phases, i.e. between the growth pattern in the early childhood and the prepubertal phase. As Sheehy et al.<sup>12</sup> have recently published, there is a correlation between increments in the leg length in those two phases.

We tend to believe that negative changes in the observed cohort of Osijek school children are the effect of war conditions, i.e. the adverse emotional influences in early childhood. Our previous investigations in Šibenik, a town in Dalmatia, which was in war for more than 3 years, suggest this explanation. The mean age of menarche in girls who were exposed to prolonged emotional stressors shifted towards an older age for 3 months<sup>13</sup>.

It is difficult to prove our hypothesis. As Rona pointed out recently the level of causality is impossible to establish in a retrospective study<sup>14</sup>. Nevertheless, a rather short follow-up of our »war cohort« speaks in favor of the adolescent growth spurt as a potential regulating factor which might make up for the growth delay in childhood.

It might be possible that the events related to war and its consequences will still be influencing the patterns of growth and maturation of children and adolescents in the first decade of the new millennium.

## REFERENCES

1. PREBEG, Ž., N. SLUGAN, L. REIĆ, N. STIPIĆ, M. FERI-MATIĆ, S. TREBER-ČULUMOVIĆ, M. DRINKOVIĆ, *Coll. Antropol.*, 18 (1994) 309. — 2.

PREBEG, Ž., Variations in growth patterns of school children in Croatia over the last decade. In: ROBERTS, D. F., P. RUDAN, T. ŠKARIĆ-JURIĆ (Eds.):

Growth and development in the changing world. (Croatian Anthropological Society, Zagreb, 1997). — 3. PREBEG, Ž., Secular growth changes in Croatia over the twentieth century. In: BODSZAR, B. E., C. SUSANNE (Eds.): Secular growth changes in Europe. (Eotvos University Press, Budapest, 1998). — 4. PREBEG, Ž., Coll. Antropol., 12 (1988) 259. — 5. EVELETH, P. B., J. M. TANNER, Worldwide variations in human growth. (Cambridge, University Press, Cambridge 1990). — 6. PREBEG, Ž., V. JUREŠA, M. KUJUNDŽIĆ, Ann. Hum. Biol., 22 (1995) 99. — 7. TANNER, J. M., Growth as a mirror

of the condition of society: Secular trend and class distinctions. In: DEMIRJIAN, A. (Ed.): Human growth: A multidisciplinary review. (Taylor and Francis, London, 1986). — 8. BRUNDLAND, G. H., K. LIESTOL, L. WALLOE, Ann. Hum. Biol., 7 (1980) 307. — 9. SMITH, A. M., S. CHINN, R. J. RONA, Ann. Hum. Biol., 7 (1980) 115 — 10. BILLEWITZ, W. Z., A. M. THOMSON, H. M. FELLOWES, Ann. Hum. Biol., 10 (1983) 125. — 11. PREBEG, Ž., N. SLUGAN, I. STANIĆ, Coll. Antropol., 23 (1999) 69. — 14. RONA, R. J., Ann. Hum. Biol., 27 (2000) 111.

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## UTJECAJ RATA NA TIJEK RASTA ŠKOLSKE DJECE U HRVATSKOJ

### SAŽETAK

Cilj je rada prikazati tijek rasta školske djece i mladeži u Osijeku, gradu koji je bio izložen teškim stradanjima za vrijeme agresije na Hrvatsku. Srednja visina učenica i učenika od 7 do 18 godina, te dob menarhe u djevojčica školske godine 1995/96 uspořeđena je s istovrsnim podacima prikupljenim 1980/81. Sekularne promjene visine su različite. U starijim dobnim skupinama počevši od 12 ili 13 godina, srednja visina je 1995/96 znatno porasla, dok su u dobi od 9 do 11 ili 12 godina razlike beznačajne i promjenljivog smjera. U najmlađim skupinama-sa 7 godina u oba spola, a s 8 samo u dječaka, opažene su negativne promjene tj. manja srednja visina.. Znatno manja visina u tim skupinama djece izražena je i 1999/2000 kada su već bila u dobi od 11 godina. Međutim, jednu godinu kasnije (2000/2001) s 12 godina, dječaci i djevojčice dostigli su svoje vršnjake iz ranijih generacija. Ta djeca za vrijeme rata, bila su u dobi od oko 2,5 do 4 godine, razdoblju kada su tempo i tijek rasta vrlo osjetljivi na nepovoljne okolinske čimbenike. Moglo bi se pretpostaviti da je emocionalni stres izazvan promjenom okoline i odlaskom iz vlastitog doma doprinjeo usporavanju tempa rasta tj. manjoj visini u velikom djelu djetinjstva.