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Changes in body proportions of children and adolescents from Rzeszów during a 35-year period from 1978/79–2013/14

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Abstract

Introduction. Environmental conditions have been changing over the years and the body's capacity to adapt affects human development, its growth and typogenesis.

Aim. To confirm the secular trend in the population of children and adolescents aged 4 to 18 from Rzeszów in the last 35 years in terms of growing and differentiating body proportions.

Materials and methods. In 2013/2014, a total of 1,563 children from Rzeszów were examined. The length of the trunk, the upper limb, the lower limb, the width of the shoulders and the width of the hips were measured and the following indices were calculated: trunk length, upper limb length, lower limb length, inter-limb, hip-shoulder and shoulder width. The data was subjected to statistical analysis and compared to the data collected in 1978/79, 1993/1994 and 2003/2004.

Results. During the 35-year period, the following symptoms were observed: elongation of upper and lower limbs in both sexes, increase in shoulder width in boys from 15-18 years of age, and in girls generally in the entire examined age, tendency to decrease in hip width in both sexes in most age classes.

Conclusions. The secular trend in the population of children and adolescents aged 4 to 18 from Rzeszów in the last 35 years regarding growth process and differentiating body proportions was confirmed.

Keywords. anthropometry, growth, proportion, secular trend

Introduction

The somatic (morphological) development of a human is often associated with an increase in the size of the body – called the process of growing.¹ The popular rule is that until the end of the process of growing the length of individual parts is greater: the trunk – three times, the upper limbs – four times, the lower limbs – five times.² The most popular anthropometric parameters that charac-

terize the growing process are body height, body mass, head circumference, chest circumference and waist circumference.³ These data are entered into the health book at birth and after the health balance at a given age.⁴ During the health balance, a further evaluation of the chest circumference is not recommended, evaluation of the head circumference is recommended until the third year of life, and the assessment of body height and

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weight is carried out until adulthood and longer.^{2,5-11} An important material aspect of human somatic development, apart from growing, is differentiation - perfecting the structure. Among other things, it includes changes in body composition (fat mass and fat free mass), the formation of typical body proportions (typogenesis) or gender-related differences (sexual dimorphism).¹ In anthropometry, the parameters describing the process of differentiation are proportion ratios. In the literature on the subject, Quetelet's index WQ2 (Body Mass Index, BMI) is most commonly used.^{2,3} It is used to assess the nutritional status.¹² The quotient of waist circumference and body height serves to differentiate obesity types in children and adolescents starting from the pre-school age.¹³ Research with other anthropometric parameters is rarely carried out.¹⁴

An important direction of anthropometric research is the study of the secular trend, understood as changes in somatic development occurring between generations, recognized as a non-evolutionary phenomenon, having an adaptive character, under the influence of changes in civilization development.^{15,16} Changes in body structure reflect the condition of the natural and social environment.¹⁷ In addition, subsequent generations differ in the frequency of individual genes.¹⁷ The secular trend is expressed by the acceleration (acceleration of development) of some and the deceleration (slowdown of development) of other developmental parameters.² An example of the phenomenon of acceleration is the increase in mean body height in subsequent generations, the occurrence of post-puberty height increase at an earlier age, changes in body proportions - within the lower limbs with the tendency to having long limbs.² These changes are a sensitive marker of the biological condition of a given population.¹⁷ Studies on the secular trend are most often carried out on the basis of the previously mentioned body weight as well as body height and BMI. The present study, however, presents the data from a different perspective.

Aim of the study

To confirm the secular trend in the population of children and adolescents aged 4 to 18 from Rzeszów in the last 35 years in terms of: 1. growing - characterized on the basis of such anthropometric features as: trunk length (sst-s), the upper limb length (a-daIII), the lower limb length (B-sy), shoulder width (aa), hip width (c-ic) and 2. differentiation the proportions of body structure - using selected coefficients formed from the above-mentioned features: trunk length index, upper limb length index, lower limb length index, inter-limb, hip-shoulder ratio and shoulder width.

Materials and methods

Assessments of changes in morphological development of children and adolescents from Rzeszów were made

in 1978/79, 1993/94, 2003/04 and 2013/14. During all these years, the research methodology was conducted according to the same principles.¹⁸⁻²⁴ Anthropometric research covered 2,378 persons in 1978/79 (1,176 boys and 1,056 girls), 1993/94 - 2586 (1,300 boys and 1,286 girls), while in the 2003/04 2,560 people (1,280 boys and 1,280 girls). A random sample of children and adolescents was taken in all three series in order to be representative. In the years 1978/79 - 2003/04, a mean of 80 boys and 80 girls were examined in each age group.¹⁹ Samples for testing were randomly drawn without repetition. A written consent for the tests was obtained from the Education Office, the President of Rzeszów, the directors of individual schools and parents, whereas the oral consent was expressed individually by every child before the start of the measurements. In 2013/14, the respondents were selected in the same way as in the previous series, trying to keep similar numbers of boys and girls in particular age classes, but difficulties occurred. They concerned the consent of parents and the respondents themselves to carry out measurements, which, as is known, are not invasive, and therefore they pose no threat to health and life. Finally, over 5% of the population of children and adolescents from Rzeszów was examined, taking into account the sex from 4 to 18 years of age in each age class. Data on the number of live-born boys and girls in the examined age classes were obtained from the Central Statistical Office in Rzeszów. In total, 1,563 people were examined, including 779 boys and 784 girls. We also observed that the basic group of both boys and girls in each age class was not less than 50 people. The examined children were healthy and did not have a disability certificate. It was not possible to gather a sufficiently large group of 3-year-old boys and girls due to the lack of consent of parents and guardians. The examinations of 3-year-olds were also disproportionately prolonged in time.^{19,21-23} For all of the above series, anthropometric measurements were made based on the technique by Martin and Saller.²⁰ In anthropometric studies, the following features were taken into account: trunk length (sst-s), length of the upper limb (a-daIII), length of the lower limb (B-sy), shoulder width (a-a) and hip width (ic-ic). Based on the collected data, the ratios of body structure were calculated: length of trunk, length of upper limb, length of lower limb, inter-limb, hip-shoulder and shoulder width.^{18,20} As in previous studies, the collected data was statistically developed. Selected numerical characteristics of the tested parameters were determined: the arithmetic mean (\bar{x}) - in all discussed series, median (Me), standard deviation (s) in all discussed series, 25th and 75th percentile (C25, C75). The analysis of variance (ANOVA) was used for statistical calculations.²¹⁻²³ To answer the question of whether the population of children and adolescents from Rzeszów continues to exhibit the phe-

nomenon of secular trend, a comparative analysis of statistical characteristics of selected anthropometric features and ratios from the series 1978/79, 1993/94, 2003/04 and 2013/14 was made.²⁴

Results

Intergenerational variability of height and body mass of Rzeszów children and adolescents examined in the time interval 1978/79 - 2013/14 was presented in an earlier publication.²² The tendency of changes and diversity in the morphological structure of the body over generations can be illustrated by comparing particular dimensions with each other (Tables 1-10). It seems, however, that the best time variation of the body shape describes the proportions between dimensions expressed in the form of ratios of proportions (Tables 13-24). At the same time, data for the 2013/14 series contained in Tables 1-10 may serve as a development standard for children and adolescents from Rzeszów aged 4 to 18 in the terms of parameters studied.

On the basis of a comparative analysis during the 35-year period of 1978/79-2013/14 and 10-year period of 2003/04-2013/14 some changes in the development of selected somatic features were observed. After 35 years, the trunk of Rzeszów boys is extending at the age of 5 up to 9, at the age of 11, from 13 to 16 years of age and at the age of 18 (Tables 1, 11). In girls examined in the same time interval, the trunk is also extending from 8 to 10 years of age. In the remaining age classes, mean trunk lengths are lower (between 4-5 and 12-15 years) or close (6, 7, 11 and 16-18) (Tables 2,12). During the 10-year period of 2003/04-2013/14, the trunks in boys are getting longer only in the age range from 14-16 years. In the remaining age classes, mean trunk lengths are lower (between 4-5, 7, 9-12 and 17 years) or close (6, 8, 13 and 18) (Tables 1-11). In girls in the same age group, the

tendency to shorten the trunk dominates, except for the ages 8, 9, 16 and 17, where the average values are similar (Tables 2,12).

In both boys and girls, the upper limb are getting longer. This process is also strongly marked in the 10-year period of 2003/04-2013/14 (Tables 3,4,11-12).

In boys after 35-year period, also the lower limb lengthening is observed. During the 10-year period of 2003/04-2013/14, this process did not take place, except for 18-year-olds, in whom the average length of the lower limb was higher by 0.8 cm (Tables 5,11). In girls during the 35-year period, the lower limbs became much longer. A comparative analysis of the mean length values of the lower limbs in the time interval 2003/04-2013/14 showed the presence of the process of elongation of the lower limbs only at the age of 17 and 18. In the remaining age classes, the absolute differences between the mean values of the discussed parameter assume lower or similar values (Tables 6, 12).

In the course of the 35-year period and the 10-year period in boys, the phenomenon of shoulder widening between 15-18 years of age has been noticed. After 10 years, the shoulders are also getting wider at the age of 9, 10 and 12-13 years (Tables 7, 11).

In turn, in girls a tendency of shoulders narrowing occurs (Table 8,12). Both in boys and girls in the compared series, the hips are getting narrower (Tables 9-12).

The intergenerational phenotypic variation described is also noted in the proportions of the body structure of children and adolescents from Rzeszów. According to Wanke's classification, the examined boys from the series 1978/79 are characterized by a medium trunk from 3-5 years of age, 1993/94 – at the age of 3-4 years, 2003/04 – between 3 and 6 years and from 2013/14 – at 5 and 6 years of age.²⁰ In the other age classes, boys have short trunk in all compared series

Table 1. Mean values of trunk length (sst-sy) in boys (cm)

Age	(sst-sy)										
	Boys										
	1978/79		1993/94		2003/04		2013/14				
	\bar{x}	<i>s</i>	\bar{x}	<i>s</i>	\bar{x}	<i>S</i>	\bar{x}	<i>Me</i>	<i>s</i>	<i>C</i> ₂₅	<i>C</i> ₇₅
3	29.9	2.8	28.9	1.6	31.9	4.1	-	-	-	-	-
4	31.0	2.4	30.3	1.9	32.7	3.5	29.8	29.1	2.7	27.9	31.5
5	32.3	2.1	32.5	2.0	34.1	3.3	33.1	32.6	3.3	30.9	34.7
6	33.7	2.2	34.2	1.6	35.5	3.1	35.3	35.1	2.1	33.6	36.8
7	35.6	2.2	35.0	1.7	36.9	3.0	36.2	36.5	3.8	31.3	38.3
8	36.9	2.1	36.0	2.0	37.9	2.7	38.1	38.5	3.3	35.0	41.2
9	37.8	1.9	37.2	2.4	39.6	3.4	38.4	38.5	2.4	37.5	39.1
10	38.8	2.0	38.0	2.0	40.9	3.3	38.9	39.0	3.0	37.6	40.8
11	40.1	2.2	39.4	2.4	42.0	3.4	41.1	40.3	4.7	39.1	41.3
12	41.8	2.3	40.4	2.2	43.0	4.3	41.4	40.0	3.4	38.7	44.3
13	43.7	2.9	42.0	2.4	44.7	3.7	44.6	45.2	2.9	41.9	47.0
14	45.5	3.4	44.5	2.9	45.9	4.0	47.6	46.0	5.0	42.8	50.8
15	47.1	3.1	46.8	2.5	47.3	4.1	48.6	47.4	3.5	45.8	51.7
16	48.7	2.6	48.5	2.9	49.0	4.1	50.9	49.4	5.5	47.4	53.0
17	49.8	2.3	49.4	2.8	50.1	3.9	49.6	51.8	5.5	45.3	53.9
18	50.4	2.2	50.0	2.6	51.3	4.1	51.2	51.1	3.2	48.9	53.5

Table 2. Mean values of trunk length (sst-sy) in girls (cm)

Age	(sst-sy)											
	Girls											
	1978/79		1993/94		2003/04		2013/14					
	\bar{x}	s	\bar{x}	s	\bar{x}	S	\bar{x}	Me	s	C ₂₅	C ₇₅	
3	29.4	2.3	28.0	1.8	32.5	4.3	-	-	-	-	-	
4	30.8	2.2	30.2	1.7	33.3	3.2	30.3	30.4	2.1	29.4	31.7	
5	32.2	2.4	32.0	1.9	34.8	2.9	31.8	31.8	2.0	30.4	33.0	
6	33.8	2.3	33.6	2.2	35.9	2.9	34.1	34.5	1.9	33.2	35.0	
7	35.3	1.9	35.3	2.0	36.4	3.3	35.0	34.3	2.7	33.3	36.5	
8	36.1	1.9	36.2	2.0	37.1	3.1	37.1	35.4	4.6	34.0	38.8	
9	37.0	2.0	37.2	2.1	38.4	4.6	38.6	38.0	3.7	37.0	40.1	
10	38.4	2.1	38.3	2.2	40.3	3.0	39.2	39.5	3.2	38.0	41.8	
11	40.2	2.5	39.6	2.4	41.3	4.6	40.6	37.8	7.7	34.2	50.4	
12	42.1	2.5	41.2	2.4	42.8	3.5	41.2	39.6	2.6	38.9	41.4	
13	44.1	2.1	43.0	2.4	44.1	3.0	42.3	42.5	3.8	40.0	44.6	
14	45.4	2.1	44.6	3.0	44.6	2.7	43.2	43.1	2.0	41.8	44.9	
15	45.8	2.3	45.4	2.5	45.6	3.3	45.2	45.3	4.3	42.3	49.3	
16	46.3	2.3	45.9	2.6	46.2	2.9	46.4	47.0	3.3	44.1	48.4	
17	46.8	2.1	46.5	2.6	46.7	2.7	46.8	45.4	4.8	44.2	49.2	
18	47.1	2.1	47.0	2.3	47.4	2.7	46.9	46.9	2.8	46.3	49.9	

Table 3. Mean values of upper extremity length (a-da_{III}) in boys (cm)

Age	(a-da _{III})											
	Boys											
	1978/79		1993/94		2003/04		2013/14					
	\bar{x}	s	\bar{x}	s	\bar{x}	S	\bar{x}	Me	s	C ₂₅	C ₇₅	
3	41.8	2.1	40.5	2.3	41.7	3.4	-	-	-	-	-	
4	44.1	2.4	43.5	2.0	44.5	2.9	44.6	44.0	2.9	42.0	45.5	
5	46.4	2.7	47.4	2.2	48.8	2.9	49.0	49.0	3.0	46.6	50.1	
6	49.6	2.7	50.3	2.2	51.0	2.7	53.4	53.0	4.3	51.0	58.0	
7	53.3	2.7	52.6	2.5	54.6	4.9	57.1	57.0	3.0	54.8	59.0	
8	56.5	2.8	55.1	3.2	57.0	3.3	59.1	59.2	2.5	58.0	61.2	
9	58.9	2.9	57.5	2.8	60.2	3.8	62.4	63.0	3.6	59.5	64.0	
10	60.9	3.2	59.4	3.0	61.8	3.3	64.4	64.0	3.2	62.3	67.0	
11	63.0	3.2	62.2	2.9	64.5	3.0	66.0	66.0	3.3	65.0	67.0	
12	65.8	3.6	65.3	3.7	67.5	5.5	70.4	70.0	4.4	67.0	73.5	
13	69.2	4.2	67.8	3.5	70.1	3.9	72.4	72.5	2.1	69.7	75.3	
14	71.9	4.2	72.2	3.5	73.5	4.5	79.0	79.5	4.7	75.2	83.5	
15	74.2	3.9	74.9	3.5	75.6	4.8	81.0	80.0	3.0	79.6	81.0	
16	76.2	3.5	75.7	3.3	78.5	4.5	82.1	81.4	2.9	80.2	83.6	
17	77.1	3.2	76.3	3.8	78.9	3.9	84.0	83.0	3.4	81.6	85.8	
18	78.1	3.6	76.8	3.6	79.9	3.7	84.1	84.4	2.1	82.2	85.8	

Table 4. Mean values of upper extremity length (a-da_{III}) in girls (cm)

Age	(a-da _{III})											
	Girls											
	1978/79		1993/94		2003/04		2013/14					
	\bar{x}	s	\bar{x}	s	\bar{x}	S	\bar{x}	Me	s	C ₂₅	C ₇₅	
3	40.8	2.0	39.4	2.0	41.1	2.9	-	-	-	-	-	
4	43.5	2.2	43.1	2.0	43.5	2.5	45.5	46.1	2.0	43.0	47.0	
5	46.2	2.6	46.6	2.0	46.7	3.0	48.2	48.0	1.9	47.0	49.4	
6	49.3	3.0	49.2	2.7	50.2	2.9	49.9	50.3	3.5	47.0	52.0	
7	52.2	2.9	52.1	2.3	54.0	3.1	55.5	56.0	4.3	52.9	58.1	
8	54.7	3.0	53.8	2.6	56.2	2.9	58.3	58.0	3.3	56.0	61.0	
9	57.1	3.0	56.1	2.8	58.3	5.6	62.6	63.3	3.8	61.1	65.3	
10	59.8	3.0	59.1	2.6	60.7	4.5	65.3	66.0	3.4	62.5	67.8	
11	63.0	3.5	61.5	3.7	64.2	4.9	67.1	66.3	4.4	63.4	69.7	
12	65.7	3.6	64.9	3.3	68.5	3.9	70.3	70.0	3.4	68.8	73.0	
13	68.1	3.3	67.5	3.6	70.0	3.8	71.2	71.0	1.2	70.0	72.0	
14	69.3	3.0	69.2	3.4	70.8	3.5	73.5	73.8	1.9	72.4	74.7	
15	69.7	3.0	69.3	3.3	71.2	3.9	74.0	73.7	3.1	73.0	76.0	
16	69.9	3.2	69.4	3.5	71.8	3.7	75.4	75.3	1.5	74.5	76.5	
17	70.0	3.2	69.4	3.9	72.5	5.0	76.7	76.4	1.9	75.4	77.0	
18	70.1	3.5	69.5	3.3	72.5	3.5	76.9	76.4	2.2	75.8	77.9	

Table 5. Mean values of lower extremity length (B-sy) in boys (cm)

Age	(B-sy)										
	Boys										
	1978/79		1993/94		2003/04		2013/14				
	\bar{x}	s	\bar{x}	s	\bar{x}	s	\bar{x}	Me	s	C ₂₅	C ₇₅
3	43.8	2.8	43.6	2.6	46.9	3.5	-	-	-	-	-
4	47.7	2.8	48.5	2.6	49.7	3.1	49.0	49.1	3.5	46.5	51.5
5	52.3	3.3	53.0	2.7	55.0	3.9	51.3	51.3	2.9	49.5	53.2
6	56.1	3.3	57.1	2.5	58.3	3.3	56.4	56.7	3.9	53.7	59.0
7	60.4	3.1	60.4	2.9	65.0	4.0	64.9	63.7	5.7	61.6	69.6
8	65.4	3.7	64.5	3.9	68.8	3.9	66.9	67.3	4.0	65.4	68.5
9	68.8	4.1	68.2	3.1	72.1	4.3	70.7	71.1	3.9	69.2	72.3
10	71.5	3.9	71.3	3.7	76.9	4.6	75.7	75.1	3.9	73.3	78.2
11	74.2	3.7	75.8	3.7	79.2	5.1	76.8	75.9	3.4	74.0	79.5
12	78.0	4.4	79.3	4.8	83.3	7.7	80.4	79.3	2.0	78.9	82.5
13	81.3	5.2	83.3	4.1	86.6	4.9	82.1	80.5	4.6	79.0	85.5
14	85.0	5.1	88.0	4.7	91.2	5.3	88.9	89.0	4.8	86.0	92.0
15	89.1	4.7	91.0	4.0	94.5	7.6	93.2	92.9	2.0	91.7	94.8
16	91.1	4.5	92.2	4.0	95.5	6.7	95.5	95.8	2.6	94.6	97.2
17	91.7	4.1	92.4	4.0	95.9	3.8	95.6	96.0	3.3	92.9	97.8
18	91.9	4.7	92.7	4.2	96.5	4.0	97.3	96.1	3.9	94.2	100.6

Table 6. Mean values of lower extremity length (B-sy) in girls (cm)

Age	(B-sy)										
	Girls										
	1978/79		1993/94		2003/04		2013/14				
	\bar{x}	s	\bar{x}	s	\bar{x}	s	\bar{x}	Me	s	C ₂₅	C ₇₅
3	43.6	2.5	43.8	2.7	47.1	3.5	-	-	-	-	-
4	47.9	2.9	48.6	2.5	48.7	3.0	47.4	47.3	1.4	46.3	48.4
5	52.1	3.4	52.4	2.4	53.9	3.1	52.5	52.9	2.5	50.9	54.4
6	55.9	3.4	56.4	3.3	58.0	3.7	55.2	54.5	4.3	51.5	58.5
7	59.9	3.5	60.4	2.9	64.9	4.3	63.7	64.8	6.4	59.1	67.6
8	63.7	3.9	64.0	3.2	69.5	4.3	66.3	67.7	3.9	64.0	69.0
9	67.3	3.7	67.8	3.3	71.8	5.0	69.7	71.1	5.5	65.1	74.5
10	71.1	4.2	71.9	3.7	74.3	4.7	74.7	77.0	7.0	71.0	79.9
11	74.7	4.5	75.6	4.1	79.5	5.2	76.4	77.1	3.6	73.5	80.0
12	78.6	4.2	80.2	3.8	84.6	5.8	84.5	84.8	4.4	82.5	88.5
13	81.9	4.2	83.8	4.2	86.3	4.5	86.6	86.4	4.2	85.4	90.0
14	83.0	3.6	84.4	4.2	87.8	4.5	87.0	86.9	2.5	85.4	88.0
15	83.0	4.0	84.4	3.8	87.7	5.2	87.9	88.4	4.4	85.5	88.6
16	83.0	4.3	84.4	4.8	88.7	5.0	88.9	89.7	3.7	88.7	90.2
17	83.2	3.7	84.4	4.3	88.7	4.7	92.7	90.8	5.6	88.8	96.3
18	83.3	4.1	84.4	3.7	88.8	3.9	93.7	94.0	5.2	91.2	96.0

Table 7. Mean values of shoulder width (a-a) in boys (cm)

Age	(a-a)										
	Boys										
	1978/79		1993/94		2003/04		2013/14				
	\bar{x}	s	\bar{x}	s	\bar{x}	s	\bar{x}	Me	s	C ₂₅	C ₇₅
3	21.6	1.3	21.6	1.1	22.2	1.5	-	-	-	-	-
4	22.4	1.9	22.9	1.5	23.4	1.5	22.0	21.5	1.5	20.5	23.0
5	23.6	1.6	24.2	1.1	24.5	1.8	23.0	23.0	1.5	22.0	24.0
6	25.2	1.3	25.5	1.3	25.6	2.9	25.1	25.0	1.4	24.5	26.5
7	26.6	1.3	26.6	1.8	26.8	1.9	25.9	25.8	1.9	25.0	27.0
8	27.7	1.3	28.0	1.3	27.1	1.4	26.9	26.8	1.8	26.0	28.0
9	28.7	1.3	29.0	1.3	28.1	1.9	28.8	28.0	1.8	27.5	30.0
10	29.5	1.3	29.6	1.6	28.5	2.8	29.0	29.3	1.7	27.3	30.1
11	30.4	1.4	31.0	1.4	29.1	1.9	29.2	29.0	1.9	28.0	30.0
12	31.5	1.6	32.1	1.7	30.0	2.9	31.4	31.5	2.0	30.0	33.0
13	32.9	2.0	33.4	1.6	31.7	2.8	32.8	32.5	1.8	32.0	34.5
14	34.5	2.3	35.0	1.8	33.9	2.7	34.0	33.5	1.4	33.0	35.0
15	35.9	2.2	36.4	2.3	35.5	2.1	37.2	37.0	1.8	35.5	38.0
16	37.0	1.9	37.6	2.1	36.7	2.0	38.3	38.0	1.9	37.0	39.5
17	37.8	1.6	38.5	2.4	37.5	2.0	38.5	39.0	1.8	36.8	40.0
18	38.4	1.6	38.9	2.3	37.9	2.1	39.4	39.5	0.9	38.5	40.3

Table 8. Mean values of shoulder width (a-a) in girls (cm)

Age	(a-a)											
	Girls											
	1978/79		1993/94		2003/04		2013/14					
	\bar{x}	s	\bar{x}	s	\bar{x}	s	\bar{x}	Me	s	C ₂₅	C ₇₅	
3	21.6	1.2	21.3	1.0	22.2	1.5	-	-	-	-	-	
4	22.6	1.3	22.9	1.4	23.4	1.7	21.5	21.3	0.9	21.0	22.0	
5	23.7	1.3	24.0	1.1	24.2	1.5	22.7	22.5	0.9	22.0	23.0	
6	25.3	1.2	25.1	1.8	25.7	1.2	23.6	23.3	1.6	22.0	25.0	
7	26.4	1.3	26.3	1.2	26.6	1.9	25.6	25.0	1.9	25.0	27.0	
8	27.2	1.3	27.4	1.3	26.9	1.5	26.7	27.0	1.7	26.0	28.5	
9	28.2	1.3	28.6	1.9	27.9	1.5	27.0	27.3	1.3	26.0	28.0	
10	29.1	1.5	29.9	1.7	28.7	1.6	27.6	27.5	1.3	26.5	28.5	
11	30.3	1.7	31.4	1.7	29.3	2.2	27.9	28.0	1.6	26.5	29.0	
12	31.7	1.8	32.4	1.3	30.3	2.2	30.8	31.0	0.8	30.1	31.2	
13	33.0	1.8	33.6	1.5	32.0	2.0	31.0	31.1	0.8	30.2	31.4	
14	33.7	1.6	34.0	1.6	33.0	2.3	31.0	30.0	1.5	30.0	31.8	
15	34.1	1.4	34.2	1.8	33.4	1.9	31.5	31.2	1.5	31.0	32.0	
16	34.4	1.5	34.8	1.7	33.5	1.8	32.1	32.0	0.6	32.0	32.5	
17	34.6	1.6	35.1	2.0	34.0	2.0	33.2	33.2	1.0	32.5	34.0	
18	34.7	1.6	35.1	1.6	34.0	2.2	33.6	34.0	1.1	33.0	34.5	

Table 9. Mean values of hip width (ic-ic) in boys (cm)

Age	(ic-ic)											
	Boys											
	1978/79		1993/94		2003/04		2013/14					
	\bar{x}	s	\bar{x}	s	\bar{x}	s	\bar{x}	Me	s	C ₂₅	C ₇₅	
3	16.3	0.9	15.8	0.8	17.2	1.6	-	-	-	-	-	
4	17.2	1.0	16.4	0.9	17.8	1.1	16.1	16.4	0.9	15.5	17.0	
5	17.9	1.1	17.2	0.7	18.5	1.5	16.5	16.5	1.0	16.0	17.0	
6	18.5	1.0	18.4	1.0	18.8	1.3	18.1	17.5	2.0	16.5	20.0	
7	19.3	1.1	18.8	1.6	20.0	2.5	19.1	19.8	1.8	18.0	20.0	
8	20.1	1.1	19.8	1.5	20.5	2.0	19.2	18.5	1.5	18.0	20.0	
9	20.8	1.1	20.6	1.1	21.4	2.3	21.2	20.0	3.1	19.0	21.8	
10	21.4	1.2	21.1	1.2	21.8	3.0	21.1	20.5	2.0	20.0	22.0	
11	22.0	1.2	22.0	1.4	21.9	2.5	21.1	21.0	1.4	20.5	21.5	
12	22.7	1.4	22.8	1.7	22.5	2.9	22.5	22.0	1.3	21.5	22.5	
13	23.7	1.6	23.5	1.2	24.0	2.0	22.7	22.5	2.2	21.0	24.0	
14	24.8	1.7	25.0	1.7	25.3	2.1	25.1	25.4	1.6	24.0	26.0	
15	25.9	1.5	26.0	1.6	26.7	2.2	25.9	26.0	0.6	25.6	26.5	
16	26.7	1.4	26.6	1.4	27.1	2.4	26.3	26.8	1.1	25.0	27.0	
17	27.3	1.4	27.3	1.8	27.5	2.0	26.7	26.3	1.6	25.5	28.1	
18	27.8	1.4	27.3	2.1	27.7	2.0	27.2	27.5	0.5	27.0	27.5	

Table 10. Mean values of hip width (ic-ic) in girls (cm)

Age	(ic-ic)											
	Girls											
	1978/79		1993/94		2003/04		2013/14					
	\bar{x}	s	\bar{x}	s	\bar{x}	s	\bar{x}	Me	s	C ₂₅	C ₇₅	
3	16.3	0.8	15.3	0.8	16.9	1.8	-	-	-	-	-	
4	17.0	0.8	16.4	1.0	17.4	1.5	15.2	15.3	0.9	14.5	16.0	
5	17.8	1.0	17.2	1.1	18.0	1.5	16.4	16.5	0.9	15.5	17.0	
6	18.6	1.1	17.9	1.4	18.9	1.7	17.0	17.0	1.0	16.0	17.5	
7	19.2	1.2	18.7	1.4	19.2	2.0	18.9	18.0	2.2	17.0	20.0	
8	19.8	1.2	19.5	1.2	19.6	1.8	19.4	19.5	1.8	18.0	20.0	
9	20.5	1.2	20.4	1.3	20.5	2.1	20.0	20.0	1.1	19.0	21.0	
10	21.3	1.4	21.4	1.3	20.9	1.9	20.8	20.1	1.6	20.0	21.0	
11	22.5	1.7	22.3	1.6	22.0	2.0	21.1	21.8	1.6	19.8	22.3	
12	23.5	1.7	23.5	1.4	23.1	2.4	22.9	23.5	1.1	22.0	24.0	
13	24.3	1.5	24.8	1.8	24.5	2.5	23.0	23.0	1.0	22.5	24.0	
14	25.1	1.4	25.8	1.8	26.0	2.1	23.2	23.0	1.6	21.5	25.0	
15	25.6	1.4	26.0	1.9	26.5	2.1	23.5	23.5	0.7	23.0	24.0	
16	26.0	1.4	26.4	1.5	26.7	2.0	24.0	23.6	1.7	23.0	24.5	
17	26.3	1.5	26.4	1.5	26.7	1.8	25.6	25.4	0.6	25.0	26.0	
18	26.4	1.6	26.4	1.3	26.7	1.7	26.2	26.3	1.6	25.0	27.3	

Tabela 11. Absolute differences between mean values of trunk length, upper and lower extremity length, shoulder and hip width in boys from the series 1978/79-2013/14 and 2003/2004-2013/14

1978/79 – 2013/14					Age	2003/04 – 2013/14				
sst-sy	a-da	B-sy	a-a	ic-ic		sst-sy	a-da	B-sy	a-a	ic-ic
-1.2	0.5	1.3	-0.4	-1.1	4	-2.9	0.1	-0.7	-1.4	-1.7
0.8	2.6	-1.0	-0.6	-1.4	5	-1.0	0.2	-3.7	-1.5	-2.0
1.6	3.8	0.3	-0.1	-0.4	6	-0.2	2.4	-1.9	-0.5	-0.7
0.6	3.8	4.5	-0.7	-0.2	7	-0.7	2.5	-0.1	-0.9	-0.9
1.2	2.6	1.5	-0.8	-0.9	8	0.2	2.1	-1.9	-0.2	-1.3
0.6	3.5	1.9	0.1	0.4	9	-1.2	2.2	-1.4	0.7	-0.2
0.1	3.5	4.2	-0.5	-0.3	10	-2.0	2.6	-1.2	0.5	-0.7
1.0	3.0	2.6	-1.2	-0.9	11	-0.9	1.5	-2.4	0.1	-0.8
-0.4	4.6	2.4	-0.1	-0.2	12	-1.6	2.9	-2.9	1.4	0.0
0.9	3.2	0.8	-0.1	-1.0	13	-0.1	2.3	-4.5	1.1	-1.3
2.1	7.1	3.9	-0.5	0.3	14	1.7	5.5	-2.3	0.1	-0.2
1.5	6.8	4.1	1.3	0.0	15	1.3	5.4	-1.3	1.7	-0.8
2.2	5.9	4.4	1.3	-0.4	16	1.9	3.6	0.0	1.6	-0.8
-0.2	6.9	3.9	0.7	-0.6	17	-0.5	5.1	-0.3	1.0	-0.8
0.8	6.0	5.4	1.0	-0.6	18	-0.1	4.2	0.8	1.5	-0.5

Table 12. Absolute differences between mean values of trunk length, upper and lower extremity length, shoulder and hip width in girls from the series 1978/79-2013/14 and 2003/2004-2013/14

1978/79 – 2013/14					Age	2003/04 – 2013/14				
sst-sy	a-da	B-sy	a-a	ic-ic		sst-sy	a-da	B-sy	a-a	ic-ic
-0.5	2.0	-0.5	-1.1	-1.8	4	-3.0	2.0	-1.3	-1.9	-2.2
-0.4	2.0	0.4	-1.0	-1.4	5	-3.0	1.5	-1.4	-1.5	-1.6
0.3	0.6	-0.7	-1.7	-1.6	6	-1.8	-0.3	-2.8	-2.1	-1.9
-0.3	3.3	3.8	-0.8	-0.3	7	-1.4	1.5	-1.2	-1.0	-0.3
1.0	3.6	2.6	-0.5	-0.4	8	0.0	2.1	-3.2	-0.2	-0.2
1.6	5.5	2.4	-1.2	-0.5	9	0.2	4.3	-2.1	-0.9	-0.5
0.8	5.5	3.6	-1.5	-0.5	10	-1.1	4.6	0.4	-1.1	-0.1
0.4	4.1	1.7	-2.4	-1.4	11	-0.7	2.9	-3.1	-1.4	-0.9
-0.9	4.6	5.9	-0.9	-0.6	12	-1.6	1.8	-0.1	0.5	-0.2
-1.8	3.1	4.7	-2.0	-1.3	13	-1.8	1.2	0.3	-1.0	-1.5
-2.2	4.2	4.0	-2.7	-1.9	14	-1.4	2.7	-0.8	-2.0	-2.8
-0.6	4.3	4.9	-2.6	-2.1	15	-0.4	2.8	0.2	-1.9	-3.0
0.1	5.5	5.9	-2.3	-2.0	16	0.2	3.6	0.2	-1.4	-2.7
0.0	6.7	9.5	-1.4	-0.7	17	0.1	4.2	4.0	-0.8	-1.1
-0.2	6.8	10.4	-1.1	-0.2	18	-0.5	4.4	4.9	-0.4	-0.5

(Tables 13). In girls, on the basis of Kolasa's classification, long-trunk occurs in 3-year-olds from the series of 1978/79 and 2003/04 test between the age of 3-6.²⁰ The medium trunk in the series of 1978/79 appears from 4-6 years of age, 1993/94 - at the age of 3-4 years, 2003/04 - in 7-year-olds, while in the sample of 2013/14 - in 4-6 years of age. For girls from all series, in other age categories, short trunk is characteristic in terms of physical proportions (Table 14).

The mean values of the upper limb index in boys and girls show that the subjects from the series 1978/79, 1993/94 and 2003/04 have shorter limbs in the whole studied ontogenesis section. Their peers from the 2013/14 series have short limbs only at the age of 4, and in the other age classes they have mean length limbs (Table 15-16). In turn, in girls from the 2013/14 series short limbs are observed at the age of 4-7 years of age and at the age of 13-14, and in the remaining age classes, medium length limbs - similar as in boys (Table 16).

Considering the mean values of the lower limb index, it was found that the boys from all discussed series are characterized by short-limbs, with the exception of subjects from the 2003/04 sample aged 13-15, who have medium length limbs (Table 17). In girls, mean values of the lower limb index in the samples 1978/79, 1993/94 and 2003/04 indicate short limbs throughout the entire examined age range. After 35 and 10 years, this feature persists up to 15 years of age. At the age of 16-18, in the 2013/14 sample, medium length limbs appear (Table 18).

The temporal changes described above in the length of lower and upper limbs with age in boys and girls from Rzeszów illustrate the mean values of the inter-limb index in terms of Wolański's classification.²⁰ In boys, the mean values of the inter-limb index indicate the elongation of the lower limbs in the series 1978/79 from 9 years of age, 1993/94 - from the age of 8 years and 2003/04 - from 7 years of age. As a result, as illustrated in Table 19, at the age of 18, the representatives of these series are

Table 13. Mean values of trunk length index in boys

Age	(sst-sy) / (B-v) x 100							
	Boys							
	1978/79	1993/94	2003/04	2013/14				
	\bar{x}	\bar{x}	\bar{x}	\bar{x}	Me	s	C ₂₅	C ₇₅
3	31.0	30.3	31.1	-	-	-	-	-
4	30.1	29.7	31.0	29.0	28.7	2.3	27.4	30.4
5	29.7	29.5	30.4	30.7	30.4	2.3	29.0	31.9
6	29.4	29.2	30.0	29.8	30.5	2.9	28.2	31.6
7	29.4	28.9	29.2	28.6	28.1	2.0	26.9	29.5
8	28.9	28.2	28.9	29.3	29.3	2.5	26.8	31.6
9	28.4	28.0	28.8	28.0	28.3	2.0	27.0	29.5
10	28.2	27.7	28.6	27.4	27.3	1.1	26.7	28.1
11	28.2	27.4	28.7	28.1	27.5	2.1	27.0	28.5
12	28.1	27.1	28.2	27.1	26.9	1.4	26.3	28.5
13	28.1	27.1	28.4	28.9	29.3	1.4	27.5	29.5
14	28.0	27.2	27.7	28.3	27.8	2.3	26.7	29.2
15	28.1	27.6	27.7	27.0	26.5	1.6	26.2	28.3
16	28.3	28.0	27.9	28.7	28.1	2.5	27.0	29.7
17	28.5	28.3	28.3	27.5	28.5	2.6	25.6	29.5
18	28.6	28.5	28.7	28.4	28.0	1.6	27.4	29.6

Table 14. Mean values of trunk length index in girls

Age	(sst-sy) / (B-v) x 100							
	Girls							
	1978/79	1993/94	2003/04	2013/14				
	\bar{x}	\bar{x}	\bar{x}	\bar{x}	Me	s	C ₂₅	C ₇₅
3	30.8	29.7	33.1	-	-	-	-	-
4	30.2	29.6	32.6	29.9	29.6	1.4	28.9	30.6
5	29.7	29.3	31.6	29.5	29.4	1.7	28.7	30.2
6	29.5	29.1	30.8	30.1	30.0	1.6	29.1	31.5
7	29.2	29.0	29.6	28.2	28.0	2.0	27.4	29.5
8	28.7	28.6	28.7	28.7	27.8	2.6	26.9	29.6
9	28.3	28.1	28.5	28.6	27.7	2.3	27.1	29.7
10	28.2	27.7	28.8	27.8	27.5	2.1	27.0	29.5
11	28.0	27.6	28.3	28.4	28.4	1.8	27.5	29.6
12	28.0	27.2	27.7	26.7	26.3	1.4	25.6	27.7
13	28.3	27.5	27.9	25.6	25.5	2.3	24.0	27.3
14	28.5	27.9	27.5	26.3	25.9	1.4	25.2	27.3
15	28.6	28.2	28.1	27.5	27.4	1.7	26.1	29.0
16	28.8	28.4	28.1	28.9	29.0	1.7	28.1	29.6
17	29.0	28.8	28.3	27.8	27.0	3.2	25.7	28.1
18	29.2	29.0	28.8	28.0	27.8	2.0	27.2	29.3

Table 15. Mean values of index of upper extremity length in boys

Age	(a-da _{III}) / (B-v) x 100							
	Boys							
	1978/79	1993/94	2003/04	2013/14				
	\bar{x}	\bar{x}	\bar{x}	\bar{x}	Me	s	C ₂₅	C ₇₅
3	43.4	42.4	40.7	-	-	-	-	-
4	42.8	42.6	42.2	43.4	43.2	1.6	42.7	44.2
5	42.6	43.0	43.4	46.1	45.5	3.2	43.7	47.2
6	43.3	43.0	43.0	45.0	45.0	2.2	43.9	45.9
7	44.0	43.4	43.2	45.2	45.2	1.4	44.6	46.0
8	44.2	43.2	43.5	45.5	45.6	1.8	45.0	46.3
9	44.2	43.3	43.8	45.5	45.7	1.6	44.6	46.4
10	44.3	43.3	43.2	45.4	45.1	1.1	44.6	46.3
11	44.3	43.3	44.1	45.3	45.3	1.4	44.6	46.6
12	44.3	43.8	44.2	46.1	46.3	1.4	45.4	46.9
13	44.5	43.8	44.5	46.9	47.1	1.0	46.3	47.6
14	44.3	44.1	44.3	46.9	46.7	2.1	46.1	47.3
15	44.2	44.2	44.2	45.0	45.1	1.6	43.5	45.9
16	44.2	43.7	44.7	46.4	46.5	0.9	45.7	47.0
17	44.2	43.7	44.5	46.6	46.7	0.9	45.9	47.2
18	44.4	43.8	44.8	46.7	46.8	1.0	46.1	47.4

Table 16. Mean values of index of upper extremity length in girls

Age	$(a-da_{III}) / (B-v) \times 100$							
	Girls							2013/14
	1978/79	1993/94	2003/04	\bar{x}	Me	s	C_{25}	
3	42.8	41.7	41.9	-	-	-	-	-
4	42.6	42.2	42.6	44.8	44.9	0.9	44.4	45.6
5	42.7	42.6	42.4	44.4	44.6	1.2	43.8	45.2
6	43.0	42.6	43.0	44.0	44.3	1.5	42.9	44.8
7	43.2	42.8	43.9	44.6	44.6	1.6	43.5	45.5
8	43.5	42.6	43.5	45.1	45.0	1.2	44.3	45.9
9	43.6	42.4	43.3	46.3	46.4	4.3	43.6	49.5
10	44.0	42.8	43.4	46.3	46.2	2.2	44.6	47.8
11	44.0	42.8	43.9	46.9	46.8	2.2	45.2	48.4
12	43.8	42.8	44.3	45.6	45.7	1.1	44.8	46.5
13	43.7	43.2	44.3	43.1	43.4	1.5	42.0	44.0
14	43.6	43.3	43.7	44.7	44.8	0.9	44.3	45.6
15	43.6	43.0	43.8	45.0	44.7	1.2	44.0	45.6
16	43.5	42.9	43.6	46.9	46.9	2.2	45.3	48.5
17	43.4	42.9	44.0	45.5	45.5	1.1	44.3	46.6
18	43.4	42.9	44.0	46.0	45.9	2.2	44.3	47.5

Table 17. Mean values of index of lower extremity length in boys

Age	$(B-sy) / (B-v) \times 100$							
	Boys							2013/14
	1978/79	1993/94	2003/04	\bar{x}	Me	s	C_{25}	
3	45.4	45.6	45.8	-	-	-	-	-
4	46.3	47.5	47.1	47.6	47.9	2.2	46.8	49.0
5	48.1	48.1	49.0	47.9	47.9	2.7	46.5	48.7
6	49.0	48.8	49.2	47.6	47.2	1.4	46.5	49.0
7	49.9	49.8	51.4	51.3	50.7	2.3	49.6	53.5
8	51.2	50.6	52.6	51.5	51.5	2.5	49.5	53.7
9	51.7	51.3	52.5	51.5	51.1	1.4	50.7	51.9
10	52.0	52.0	53.8	53.3	52.9	1.2	52.3	54.4
11	52.1	52.8	54.1	52.7	53.0	2.1	52.3	54.3
12	52.5	53.2	54.5	52.7	52.9	1.6	51.3	54.0
13	52.2	53.8	55.0	53.2	53.1	1.3	52.0	54.4
14	52.4	53.7	55.0	52.9	52.9	1.9	51.9	54.1
15	53.1	53.6	55.3	51.8	51.4	1.4	51.1	52.2
16	52.9	53.3	54.4	54.0	54.0	1.3	53.6	54.7
17	52.6	52.9	54.1	53.1	53.0	1.3	51.9	54.3
18	52.2	52.9	54.1	54.0	54.0	1.4	53.1	54.5

Table 18. Mean values of index of lower extremity length in girls

Age	$(B-sy) / (B-v) \times 100$							
	Girls							2013/14
	1978/79	1993/94	2003/04	\bar{x}	Me	s	C_{25}	
3	45.7	46.4	48.0	-	-	-	-	-
4	47.0	47.6	47.6	46.8	47.1	1.3	45.4	48.1
5	48.1	47.9	48.9	48.4	48.8	1.7	47.2	49.7
6	48.7	48.8	49.7	48.7	49.0	1.7	47.1	50.7
7	49.6	49.6	52.8	51.1	51.4	2.3	49.1	52.6
8	50.7	50.6	53.7	51.3	52.8	2.8	49.5	53.2
9	51.4	51.2	53.4	51.6	53.5	4.6	46.5	54.9
10	52.3	52.1	53.1	52.9	54.1	2.9	53.0	54.6
11	52.1	52.6	54.4	53.4	53.4	1.6	52.5	54.1
12	52.4	52.9	54.8	54.8	55.1	1.2	53.8	55.5
13	52.6	53.6	54.6	52.4	52.8	1.9	51.1	53.5
14	52.2	52.9	54.2	53.0	53.5	2.9	53.1	54.7
15	51.9	52.4	54.0	53.4	53.4	1.6	52.5	54.1
16	51.6	52.2	53.9	55.4	55.6	2.2	53.9	56.8
17	51.6	52.2	53.8	55.0	55.3	1.2	54.0	56.0
18	51.6	52.1	53.9	55.9	56.1	2.2	54.4	57.3

Table 19. Mean values of index of proportion of upper to lower extremity length in boys

Age	$(a-da_{III}) / (B-sy) \times 100$							
	Boys							
	1978/79	1993/94	2003/04	2013/14				
	\bar{x}	\bar{x}	\bar{x}	\bar{x}	Me	s	C ₂₅	C ₇₅
3	95.4	92.9	88.9	-	-	-	-	-
4	92.4	89.7	89.5	91.4	90.1	5.2	89.2	94.6
5	88.7	89.4	88.7	96.5	95.3	8.4	91.8	99.4
6	88.4	88.1	87.5	94.7	95.9	5.9	90.8	98.3
7	88.2	87.1	84.0	88.4	88.3	4.8	84.7	91.6
8	86.4	85.4	82.8	88.3	89.4	6.1	85.1	93.6
9	85.6	84.3	83.5	88.3	90.0	4.5	87.2	91.6
10	85.2	83.3	80.4	85.1	85.3	2.0	83.5	87.0
11	84.9	82.0	81.4	86.0	85.5	4.0	83.8	88.8
12	84.3	82.3	81.0	87.5	87.2	2.7	85.3	88.2
13	85.1	81.4	80.9	88.2	89.3	6.1	85.0	93.5
14	84.6	82.0	80.6	88.9	89.0	3.9	85.5	90.3
15	83.3	82.3	80.0	86.9	86.5	2.9	84.6	89.3
16	83.6	82.1	82.2	86.0	85.5	4.0	83.8	88.8
17	84.0	82.5	82.3	87.9	87.7	2.5	85.8	89.2
18	85.0	82.8	82.8	86.4	85.9	4.0	84.2	89.2

Table 20. Mean values of index of proportion of upper to lower extremity length in girls

Age	$(a-da_{III}) / (B-sy) \times 100$							
	Girls							
	1978/79	1993/94	2003/04	2013/14				
	\bar{x}	\bar{x}	\bar{x}	\bar{x}	Me	s	C ₂₅	C ₇₅
3	93.6	89.9	87.3	-	-	-	-	-
4	90.8	88.7	89.3	96.0	94.9	3.2	94.6	97.9
5	88.7	88.9	86.6	91.9	90.8	4.1	88.9	94.5
6	88.2	87.2	86.5	90.5	91.3	3.8	89.3	93.3
7	87.1	86.4	83.2	87.4	88.9	4.9	83.3	90.8
8	85.9	84.0	80.9	88.1	87.2	4.6	85.0	89.6
9	84.8	82.7	81.2	89.8	88.9	4.5	86.7	91.3
10	84.1	82.2	81.7	87.4	88.9	4.9	83.3	90.8
11	84.3	81.3	80.7	87.8	89.3	4.9	83.7	91.2
12	83.6	80.9	81.0	83.2	83.7	2.2	81.8	84.9
13	83.1	80.5	81.1	82.2	82.7	2.4	80.7	83.6
14	83.5	82.0	80.6	84.5	84.9	4.0	82.0	88.1
15	84.0	82.1	81.2	84.2	84.6	4.0	81.7	87.8
16	84.2	82.2	80.9	84.8	85.2	4.2	83.5	86.0
17	84.1	82.2	81.7	82.7	82.0	5.7	79.7	86.5
18	84.1	82.3	81.6	82.4	81.7	5.7	79.4	86.2

Table 21. Mean values of hip-to-shoulder index in boys

Age	$(ic-ic) / (a-a) \times 100$							
	Boys							
	1978/79	1993/94	2003/04	2013/14				
	\bar{x}	\bar{x}	\bar{x}	\bar{x}	Me	s	C ₂₅	C ₇₅
3	75.5	73.1	77.5	-	-	-	-	-
4	76.8	71.6	76.1	73.2	73.5	6.7	67.0	75.0
5	75.8	71.1	75.5	71.7	70.0	4.8	68.0	74.1
6	73.4	72.1	73.4	72.1	71.7	4.8	68.6	75.0
7	72.5	70.7	74.6	74.1	73.2	6.7	69.7	78.5
8	72.6	70.7	75.6	71.2	71.4	5.0	67.3	73.8
9	72.5	71.0	76.2	73.6	75.0	4.9	72.2	77.2
10	72.5	71.3	76.5	72.8	73.1	6.7	66.8	74.8
11	72.4	71.0	75.3	72.3	70.6	5.3	70.0	75.0
12	72.1	71.0	75.0	71.7	70.0	4.8	68.0	74.1
13	72.0	70.3	75.7	69.2	70.1	3.4	68.4	71.3
14	71.9	71.4	74.6	73.9	74.2	4.4	70.8	75.8
15	72.1	71.4	75.2	69.6	70.2	3.5	68.8	71.7
16	72.2	70.7	73.8	68.7	69.0	3.4	68.0	71.5
17	72.2	70.9	73.3	69.3	70.1	3.4	68.4	71.3
18	72.4	70.2	73.1	68.7	69.2	3.1	67.3	71.4

Table 22. Mean values of hip-to-shoulder index in girls

Age	(ic-ic) / (a-a) x 100							
	Girls							
	1978/79	1993/94	2003/04	2013/14				
	\bar{x}	\bar{x}	\bar{x}	\bar{x}	Me	s	C ₂₅	C ₇₅
3	75.5	71.8	76.1	-	-	-	-	-
4	75.2	71.6	74.4	71.1	71.5	2.5	69.0	73.2
5	75.1	71.7	74.4	72.1	71.7	3.7	69.7	74.6
6	73.5	71.3	73.5	72.2	71.3	3.9	70.5	72.7
7	72.7	71.1	72.2	73.9	72.3	6.8	68.6	78.4
8	72.8	71.2	72.9	72.7	71.8	3.9	71.0	72.2
9	72.7	71.3	73.5	74.1	72.6	6.8	68.6	78.0
10	73.2	71.6	72.8	75.3	74.7	4.9	71.5	78.5
11	74.2	71.0	75.1	75.6	75.6	5.2	70.1	80.9
12	74.1	72.5	76.2	74.4	76.2	4.1	71.1	77.8
13	73.6	73.8	76.6	74.2	73.8	4.4	70.5	77.8
14	74.5	75.9	78.8	74.8	74.2	5.5	70.1	78.1
15	75.1	76.0	79.3	74.6	74.6	5.0	70.2	77.7
16	75.6	75.9	79.7	74.8	75.0	5.2	70.4	77.2
17	76.0	75.2	78.5	77.1	77.7	2.6	76.1	79.3
18	76.1	75.2	78.5	78.0	78.1	4.5	75.5	82.0

Table 23. Mean values of shoulder width index in boys

Age	(a-a) / (sst-sy) x 100							
	Boys							
	1978/79	1993/94	2003/04	2013/14				
	\bar{x}	\bar{x}	\bar{x}	\bar{x}	Me	s	C ₂₅	C ₇₅
3	72.2	74.7	69.6	-	-	-	-	-
4	72.3	75.6	71.6	73.8	73.9	5.0	70.6	76.8
5	73.1	74.5	71.8	69.8	69.9	5.3	66.6	73.1
6	74.8	74.6	72.1	71.1	71.8	7.8	63.2	76.2
7	74.7	76.0	72.6	71.5	72.2	7.8	63.6	76.6
8	75.1	77.8	71.5	71.3	72.0	7.8	63.4	76.4
9	75.9	78.0	71.0	75.0	73.8	5.1	71.6	78.5
10	76.0	77.9	69.7	74.6	75.0	4.6	72.3	78.4
11	75.8	78.7	69.3	71.1	71.8	7.8	63.4	76.4
12	75.4	79.4	69.8	76.0	76.3	4.8	72.7	79.5
13	75.3	79.5	70.9	73.5	73.5	2.4	71.6	74.5
14	75.8	78.6	73.9	72.0	71.7	6.5	69.9	76.8
15	76.2	77.8	75.0	76.5	76.8	4.8	73.2	79.5
16	76.0	77.5	74.9	75.2	75.3	4.6	72.5	78.6
17	75.9	77.9	74.8	77.6	77.9	4.0	74.3	81.1
18	76.2	77.8	73.9	77.0	77.3	4.8	73.7	80.5

Table 24. Mean values of shoulder width index in girls

Age	(a-a) / (sst-sy) x 100							
	Girls							
	1978/79	1993/94	2003/04	2013/14				
	\bar{x}	\bar{x}	\bar{x}	\bar{x}	Me	s	C ₂₅	C ₇₅
3	73.5	76.1	68.3	-	-	-	-	-
4	73.4	75.8	70.3	70.9	70.1	3.5	69.4	73.0
5	73.6	75.0	69.5	71.7	71.0	5.2	68.7	74.7
6	74.8	74.7	71.6	69.2	69.5	4.6	64.3	73.4
7	74.8	74.5	73.1	73.2	73.7	6.0	69.4	77.7
8	75.3	75.7	72.5	72.0	70.7	4.2	68.5	75.3
9	76.2	76.9	72.7	70.0	68.6	5.5	66.6	73.4
10	75.8	78.1	71.2	70.4	70.1	3.5	68.9	72.5
11	75.4	79.3	70.9	68.7	67.0	6.8	62.9	75.0
12	75.3	78.6	70.8	74.8	74.8	7.2	70.7	80.5
13	74.8	78.1	72.6	73.3	73.3	7.2	69.2	79.3
14	74.2	76.2	74.0	71.8	71.0	5.2	68.7	74.7
15	74.4	75.3	73.2	69.7	70.0	4.6	64.8	73.9
16	74.3	75.8	72.5	69.2	69.5	4.6	64.3	73.4
17	73.9	75.5	72.8	70.9	70.1	3.5	69.4	73.0
18	73.7	74.7	71.7	71.6	70.5	3.4	69.0	72.5

successively long-legged (1978/79) and very long-legged (1993/94 and 2003/04). In the 2013/14 sample, the long-arms feature persists until 9 years of age and reappears at the age of 13-14. For the other age classes, medium limbs are characteristic, which indicates a proportional shortening of the lower limbs in the sample of 2013/14. As a result of this process, 18-year-olds from the 2013/14 series have medium-length limbs (Table 19).

In girls, the long arms feature (from very long arms to long arms) is manifested in various ways: in the 1978/79 sample - up to age of 7, 1993/94 - 6 years, 2003/04 - up to 4 years old, and 2013/14 - up to 11 years of age. Girls from the 1978/79 series are long-legged in the age range of 9 up to 18 years. In girls from the 1993/94 series, long-leggedness appears at the age of 8, and from 9 to 18 years they are characterized by very long legs. Long-leggedness is characteristic from 7 to 18 years of age for subjects from the 2003/04 sample. The greatest variation in the proportions of the upper limbs and lower limbs was observed in them in 2013/14. In this case, up to 6 yrs. they are very long-armed, and then up to the age of 11 years long-armedness persists. 12-year-old and from 14-16-year-old girls are long-legged, while 13, 17- and 18-year-olds are very long-legged. As a result, 18-year-olds of 1978/79 and 2003/04 series are characterized by long legs, and from the 1993/94 and 2013/14 - very long legs (Table 20).

The proportions of body structure in boys can also be demonstrated with the hip-shoulder index, according to Wanke's classification.²⁰ For boys from the 1978/79 series, mean proportions are characteristic, except for 4-year-olds (female proportions). The subjects from the 1993/94 series aged 3-4 and 6 have mean proportions, and in the other age classes - male. Boys from the 2003/04 series are characterized by female proportions at 3, 9 and 10 years of age, and in other age categories - medium ones. In the studied group from 2013/14, the mean proportions are between 4-7, 9-12 years old and 14 years old, while male ones in 8- and 13-year-olds, as well as from 15-18 years of age (Table 21). The mean values of the hip-shoulders index according to Kolas's interpretation, in girls from all compared series indicate male proportions. The exceptions are the examined 16-year-olds from the 2003/04 sample, which have mean proportions (Table 22).

A comparative analysis of the mean values of the shoulder width index showed for boys (according to Wanke's classification) and for girls (according to Kolas's approach) differentiation of the proportion of body structure in the compared series.²⁰ For boys from the 1978/79 trial, medium-sized shoulders are characteristic in the entire examined segment of ontogeny. In the examined subjects from the 1993/94 series, the mean shoulders last from 3 up to 7 years, and from 8-18 years they are already wide. The boys from the 2003/04 series

are characterized by narrow shoulders at the age of 3 years and from 10-12 years of age, and in the age range 4-9 and 13-18 - medium ones. In turn, representatives of the 2013/14 series from 4-16 years of age, with the exception of 5-year-olds (narrow shoulders), are characterized by medium-sized shoulders, and 17-18 years - broad ones (Table 23). Differentiation in the proportions of body structure in relation to the discussed index is also observed in girls in individual series and age classes. Subjects from the 1978/79 sample are characterized by mean shoulders throughout the compared age range. Girls from the 1993/94 series from 3-9 yrs. and at the age of 14-18 are characterized by mean shoulders, while from 10-13 years - broad ones. In the 2003/04 trial, narrow shoulders occur from 3-6 years of age, in 8-year-olds, between 10-13 and 16 and 18 years. In the other age classes, the shoulders are medium. In turn, in the 2013/14 series, narrow shoulders are typical for the respondents from 4-6, 8-11 and 14-18 years. Mean shoulders are characteristic for 7-, 12- and 13-year-olds, so they are relatively rarely represented in the proportions of body structure in this sample (Table 24).

The comparative analysis shows that visible changes in body composition have occurred over the course of 35 years in the population of children and adolescents from Rzeszów. During the 35-year period, the following symptoms were observed: elongation of upper and lower limbs in both sexes, increase in shoulder width in boys from 15-18 years of age, and in girls generally in the entire examined age, tendency to decrease in hip width in both sexes in most age classes. The ongoing developmental processes have manifested in changes in the proportion of body structure. Short-trunk is characteristic for 18-year-olds of both sexes from all compared series, and in boys - short-limbs determined on the basis of the lower limb index.

Discussion

Monitoring the growth processes and differentiation, which is indication of somatic development and the secular trend, causes many difficulties and is not systematic. For example, Argentina lacks systematic assessment of the process of growth and nutritional status in school-aged children.²⁵

The commonly conducted anthropometric studies are not uniform methodologically. In comparison to current and previous surveys, different choice of anthropometric parameters and a different technique of their implementation, as well as with heterogeneous naming are encountered.^{18,20-24} In anthropometric studies, the following features were taken into account: trunk length (sst-s), length of the upper limb (a-daIII), length of the lower limb (B-sy), shoulder width (a-a) and hip width (ic-ic). To compare, the researchers from Lodz used the height of the lower part of the body (B-ic), the width

of the arms (a-a), the intertrochanteric distance (tro-tro).²⁶ The same parameter (B-ic) is referred to as the height of the lower half of the body²⁶ or the height of the spikes.²⁷ The feature (B-ic) can therefore be determined by various measurement methods: in the mid axillary line, from the base to the iliac crest²⁸ or from the base to the anterior iliac spine.^{20,27} Similarly to the study of the proportions between the upper and lower part of the body, various indicators are used: Lower Body - Upper Body Ratio (LUR), or the index of the lower limb length.^{17,20,27} The most frequently and most uniformly collected measurements are body weight, body height (B-v) and BMI.^{2-13,20-25,27-38}

The methods of anthropometric evaluation are used not only to identify disorders of the growth process (short stature), or disturbances of the nutritional status (malnutrition, obesity) but also to differentiate the body proportions.³⁹⁻⁴⁰ For example, the Body Proportion Card (BPC) is published that allows the assessment of body proportions based on measurements of sitting height and length of the lower limb.^{14,41} Chinese researchers have shown that the lower the values of the ratio of the lower limbs length to the sitting height, the higher the values of blood pressure.⁴² This study also serves the role of the biological reference system. Anthropometric length parameters: body height, length of the upper limb, lower limb, arm and forearm are strongly correlated with one other.⁴³ In South Korea, detailed anthropometric studies containing various parameters (length, width, circumferences, ratio indices) describing the body of children and adolescents, including sex and age, are used e.g. in the clothes and shoes industry.³⁸

In children and adolescents with health conditions, abnormal differentiation of body proportions occurs. Measurement of anthropometric features and the use of ratio coefficients allowed to determine that children with cystic fibrosis are characterized by short lower limbs and a long trunk in relation to body height, compared to healthy peers, while children operated on due to spinal cord herniation and hydrocephalus are characterized by short lower limbs and short trunk in relation to body height.^{28,44} Other researchers have observed that girls with the Turner syndrome burdened with dwarfism have a more disturbed length of the upper and lower limbs than the length of the trunk. Growth hormone treatment in this group of girls significantly accelerates the growth rate, mainly due to the increase in trunk length, and to a lesser extent, lower limbs and does not compensate for the disturbances of body proportions characteristic for this syndrome. This phenomenon is probably connected with strongly conditioned genetic determination of body proportions.³⁶ Girls with the Turner's syndrome have shorter lower limbs and longer trunk not only in relation to healthy peers, but also to the peers with dwarfism.³⁷

Most research on the secular trend is based on body weight, body height (B-v) and BMI. Below are some examples. It is believed that the rate of body height increase is accelerated, and the final height of the body is reached at earlier age.^{25,45} Research conducted among 24,070 children aged 5 to 17 in Bogalusa (LA) in the United States confirms this trend in the period from 1973 to 1992. In addition, a reduced percentage of short stature was found. Basic data of Argentinian children aged 6 to 12 years were compared: body height, body mass, BMI collected in 1990 (1049 people) and in 2005-2007 (935 people). A disharmony in the secular trend was found between the body height and mass leading to increased incidence of overweight and obesity. The incidence of overweight increased by 4.4% and obesity by 5.9%, reaching respectively: 17.0% and 7.8%. There were no differences between sex, but in younger children excess body mass was higher than in the case of the body height.²⁵ Chinese researchers observing the secular trend on the basis of research conducted among 1,269,655 children, in 1985, 1995, 2000, 2005 and 2010, found that the incidence of weight gain before the age of 9 is responsible for the increasing prevalence of overweight and obesity among Chinese children and lack of acceleration of body height after the age of 12.²⁹ The acceleration of body height and weight has taken place in the last fifty years in the Seychelles, Indian Ocean. The body height curve is steeper than body weight - which confirms the tendency to overweight and obesity. At the same time, there is a significant improvement in social, economic and nutritional conditions. Researchers believe that acceleration of development is associated with the improvement of living conditions.³¹

The results of research on the secular trend are important for the determination of recommendations, preventive behavior and education.^{32,46} The example may be the need to prevent the growing problems of overweight and obesity at the beginning of the 21st century among children from the city of Guangzhou in China, or to reduce the differences in body height between the rural areas of Guizhou and urban Shanghai.³³ It is generally believed, however, that better socio-economic conditions favor acceleration of body height and inferior acceleration of body mass.^{33,34}

Studies on the secular trend based on different parameters than body weight, body height or BMI are less frequently performed. Thanks to the additional application of a waist circumference, researchers determined an increase in the incidence of abdominal obesity in children aged 6-13 years living in the city of Arequipa, Peru, located at the altitude of 2,320 meters above sea level. In 2001, 955 people were examined, and in 2015 - 83,547. In Lodz, research was conducted on the secular trend in a total of 1576 first-year students of the Medical Academy in 1978/1979, 1882/83, 1988/89 and 2003/2004.

Over 25 years, changes in body height (B-v), lower body height (B-ic), shoulder width (a-a), intertrochanteric distance (tro-tro) and resting chest circumference were analyzed. In both sexes, lower body height (B-ic), intertrochanteric (tro-tro) distance, and deceleration of the resting chest circumference were found. In the female sex, acceleration of shoulder width (a-a) caused blurring of sex differences of this feature. Intra-generational changes in body height (B-v) in both sexes in the last fifteen years have not been confirmed.²⁶ In our studies, acceleration of the length of the upper limbs (a-daIII) was observed in both sexes, both in 35 and 10-year period. Lower limb acceleration (B-sy) in both sexes is observed over a period of 35 years, but in the last decade it only occurs in the age groups: 17-year-old girls, 18-year-old girls and boys. In 35 and 10-year periods, shoulder width acceleration (a-a) is observed in boys and deceleration of shoulder width in girls (a-a) and hip width (ic-ic) in both sexes. Boys in younger age groups continue to have moderate-size trunk, while short trunk is found in older age groups and in girls of all age groups. On the basis of the upper limb index in both sexes, in the last 10 year period, we observe the transition to the long limb type from the short-limb type. On the basis of the index of the lower limb length, it can be determined that in all series in both sexes short-limbs are observed, except for girls aged 16-18 years from the last series (they have medium-limbs).

The studies on the secular trend among sick children and adolescents are conducted extremely rarely. The secular trend is also observed in the population of girls with the Turner's syndrome. Acceleration of birth body weight, birth body height and body height before growth hormone treatment was demonstrated.³⁵

The effect of various processes taking place in all spheres of development (somatic and functional, mental, social, sexual) is to obtain a set of attributes assigned to adults, and thus to achieve maturity. Their order and onset of full maturity in individual spheres of development does not occur simultaneously, which leads to dissociation (fission) of maturation and the formation of internal conflicts.² A nicely built, slender and proportional body is a reason for satisfaction. In the absence of satisfying this need, adaptive disorders may be conducive to the development of negative health behaviors. Important issues of adolescence are: lowered mood, school difficulties, lack of acceptance in peer groups, depression, suicide attempts, self-mutilation, nicotineism, addiction to psychoactive substances, premature sexual initiation, harmful and risky sexual behavior, reckless driving.⁴⁸⁻⁵² Knowledge of the typogenesis, individualized deletion of development trajectory and rationalization of problems may also help in resolving some internal conflicts.⁵³

Conclusions

The secular trend was confirmed in the population of children and adolescents aged 4 to 18 from Rzeszów in the last 35 years in terms of growing and differentiation in the proportion of body structure.

Further monitoring of trends in children and adolescents from Rzeszów is required.

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