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Anthropometry of Romany school age children from eastern Slovakia

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Abstract

Study aim: The aim of the study was to perform an anthropometric analysis of children of the minority population of younger school age from eastern Slovakia.
Material and methods: The main aim of the study was to perform an anthropometric analysis of 6–10-year-old Romany children at primary schools in eastern Slovakia. In the study, we evaluated twenty measured anthropometric parameters in a group that consisted of 150 children (59 boys and 91 girls).
Results: We compared the differences between the sexes and evaluated the body size effect between sexes. We found that in most of the measured parameters, the boys had higher average values.
Conclusions: Our results confirmed differences in size for most somatic characteristics in the minority Slovak population. However, in order to confirm the findings, it will be necessary in future to evaluate a larger sample of children from Slovakia.

Key words: Variability – Sex differences – Anthropometric parameters – OLS regression

Introduction

Several authors have measured anthropological body dimensions in their studies [8, 12, 15, 21, 22, 26, 53, 54]. The usefulness of these dimensions is important and reliable for monitoring the health of children of different ages. Moreover, the body height and the body weight are the most reliable parameters used to assess the nutritional status of a community. Koštalová et al. [34] observed that each age group has its own anatomical, psychological and functional peculiarities, where childhood was a very dynamic period of life. During this period the differences between children of different ages were more pronounced than between adults of different ages.

The advantage of anthropometric research is that it is one of the non-invasive methods. On the other hand, it is also inexpensive, but well reflective of the nutritional status of the individual [14]. During the ontogeny of an individual, changes in body structure occur depending on sex, populations, and ethnic groups [1, 3, 4, 5, 8, 18, 20, 24, 38, 40, 44, 45, 46, 48, 50, 52, 56]. Therefore, reference charts are necessary for pediatric monitoring of child growth and development [9, 11, 29, 30]. Based on anthropometric measurements, monitoring and evaluation of healthy development and performance of children in the Czech Republic and Slovakia were also carried out [7, 12, 25 35]. Other studies have also paid considerable attention to metric differences in individual proportions and body parts [10, 19, 23, 28]. According to Das and Roy [13], anthropometric characteristics serve to better understand the growth process by describing changes in body size and morphology as a function of age. Changes in the proportions and shape of the human body are caused by differences in genetic predispositions, lifestyle such as hygiene, diet, health case and environment [2, 8, 13].

This study was undertaken because new reports on the anthropometric variability of children from Slovakia, Central Europe, are still insufficient. Accordingly, the main purposes of our research were to i) contribute to the knowledge of quantitative characteristics of the size of body variables and describe their variability, ii) test the presence of sexual dimorphism in body size, and iii) compare our results with those of other researchers from other populations.

Material and methods

We evaluated twenty anthropometric parameters of school age Romany children (the minority ethnic group) from eastern Slovakia. The anthropometric research was

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conducted from April 2017 to September 2017 in four primary schools from the following villages: Košarovce, Zámutov, Ohradzany and Zbudské Dlhé. The evaluation included only children with signed informed consent from their parents. In total, we obtained data from 150 Romany children (59 boys and 91 girls). For age categories of 6 to 10 years old we took the following measurements: body weight (M71), body height (M1), head circumference (M45), chest circumference (M61), sitting height (M23), arm span (M17), upper limb length (M54), lower limb length (M53), biacromial breadth (M35), transverse chest diameter (M42), bispinal breadth (M41), maximum head length (M1b), maximum head breadth (M3), breadth of the face (M6), morphological height of the face (M18), hand length (M49), hand width (M52), forearm length [M48: obtained deduction of the dimension M9 (height to the radiale point) to the dimension M10 (height to the stylion point)], foot length (M58) and foot width (M59).

All parameters were measured according to recommendations of the International Standards for Anthropometric Assessment [33]. Moreover, all pair traits were measured only on the right side using anthropometric instruments.

The obtained dataset was evaluated using the following statistical parameters: mean (M), standard deviation (SD), 95% confidence interval (95% CI) and coefficient of variation (V). Simple linear regressions (ordinary least squares – OLS) were also used on untransformed data to fit body height against further anthropometric measures to test the relationships between these variables. We investigated allometric relationships with OLS to determine whether the slopes differed from zero [32, 55].

All measurements were performed with the consent of the principals of primary school. Informed consent was also provided by the parents of the children, while the requested data were anonymous, and the children participated in the measurement voluntarily. In physiologically healthy children, all anthropometric parameters were measured separately for each child. All measurements were made exclusively by one person (SD) to avoid measurement inaccuracies.

All descriptive analyses and regression (OLS) were performed using the statistical analysis system GraphPad Prism version 5.01 (GraphPad Software, Inc., San Diego, CA, USA). Hotelling's T^2 (used for multivariate analyses) was used to detect and to validate the statistical significance of traits' differences between the sexes. Hotelling's T^2 and discriminant function analysis (DFA) were evaluated using the program PAST version 4.03. Similarly, we evaluated the effect size (Cohen's d) for differences between sexes [45, 51]. Effect size was estimated using the free MS Excel 2003 effect size calculator (https://www.cem.org/attachments/EBE/EffectSizeCalculator.xls).

Results

The descriptive statistics for each measurement considered were reported with samples divided into sexes and age groups in Tables 1–5. Evidently, the values of anthropometric measurements for both sexes overlapped (see Tables 1–5, Figures 1–2). However, Hotelling's T^2 test ($T^2 = 128.36$, $p < 0.0001$) shows presence of sexual dimorphism in general. This overlap between the sexes was due to the age group of 6-year-old children, for whom the absence of sexual dimorphism ($T^2 = 42.36$, $p = 0.60$) was confirmed. For all other age groups, the presence of sexual dimorphism was confirmed. Moreover, the values of the measured parameters increased continuously with

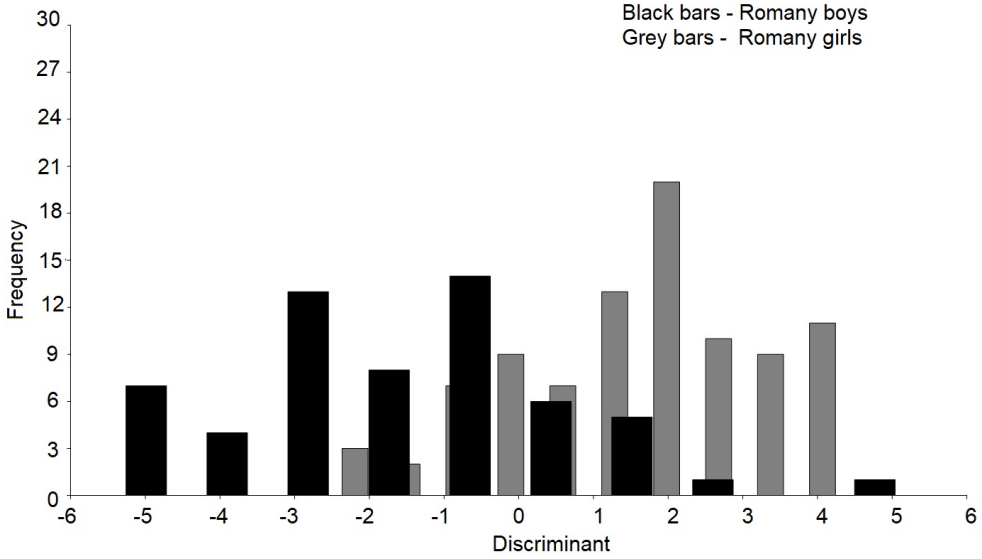


Figure 1. Frequency histogram of the canonical scores for the standard discriminant analysis between the Romany boys (black bars) and Romany girls (grey bars) from eastern Slovakia

Table 1. Descriptive statistics of Roma children at the school age of 6 years

	Boys			Girls			Effect size		
Trait	M ± SD	95% CI	V	M ± SD	95% CI	CV	d	95% CI	Power
Body height	116.70 ± 7.43	112.40–121.00	6.37	116.00 ± 4.69	113.70–118.30	4.4	0.12	–0.59–0.81	very small
Sitting height	62.80 ± 5.42	59.67–65.93	8.63	61.35 ± 3.64	59.54–63.16	5.94	0.32	–0.39–1.02	small
Arm span	115.90 ± 6.67	112.10–119.80	5.76	110.10 ± 6.49	106.80–13.30	5.89	0.88	0.13–1.59	large
Upper limb length	49.21 ± 2.75	47.63–50.80	5.59	48.07 ± 2.13	47.01–49.13	4.44	0.47	–0.25–1.17	small
Lower limb length	60.16 ± 2.75	58.58–61.75	4.56	61.49 ± 4.48	59.27–63.72	7.28	0.35	–0.36–1.04	small
Biacromial length	26.57 ± 2.77	24.97–28.17	10.41	26.56 ± 3.02	25.06–28.05	11.35	0.00	–0.70–0.70	very small
Bitrochanteric distance	20.12 ± 3.23	18.26–21.99	16.5	20.49 ± 2.52	19.24–21.75	12.29	0.13	–0.57–0.83	very small
Bispinal length	20.34 ± 3.43	18.36–22.32	16.86	20.51 ± 2.28	18.88–22.14	15.99	0.06	–0.64–0.76	very small
Chest circumference	62.18 ± 8.88	57.05–67.30	14.27	61.11 ± 6.24	58.01–64.21	10.21	0.14	–0.56–0.84	very small
Maximum head length	16.45 ± 0.85	15.96–16.94	5.18	18.14 ± 7.99	14.17–22.12	44.03	0.28	–0.43–0.97	small
Maximum head breadth	13.09 ± 1.26	12.36–13.81	9.61	14.24 ± 1.16	13.67–14.82	8.16	0.95	0.20–1.67	large
Breadth of the face	11.13 ± 1.91	10.03–12.23	17.16	11.89 ± 1.49	11.15–12.64	12.53	0.45	–0.27–1.15	small
Height of the face	10.77 ± 1.49	9.91–11.63	13.80	11.19 ± 1.14	10.63–11.76	10.18	0.32	–0.39–1.02	small
Head circumference	50.96 ± 1.50	50.10–51.83	2.94	50.78 ± 1.35	50.11–51.45	2.66	0.13	–0.58–0.82	very small
Hand length	12.29 ± 1.31	11.53–13.05	10.68	12.08 ± 1.81	11.18–12.98	14.94	0.13	–0.57–0.83	very small
Hand width	7.11 ± 1.26	6.38–7.84	17.75	7.28 ± 0.92	6.83–7.74	12.60	0.16	–0.55–0.85	very small
Forearm length	20.14 ± 6.62	16.32–23.97	32.87	16.28 ± 2.11	15.23–17.33	12.96	0.83	0.09–1.54	large
Foot length	18.61 ± 1.50	17.74–19.47	8.4	18.37 ± 1.52	17.61–19.12	8.24	0.16	–0.54–0.85	very small
Foot width	7.54 ± 1.15	6.88–8.21	15.26	7.01 ± 1.23	6.40–7.62	17.54	0.44	–0.27–1.14	very small

The statistics given are mean (M); standard deviation (SD); interval of margins (min. max); (95% CI) lower and upper 95% of the confidence interval of mean and coefficient of variance (CV). Abbreviations of the anthropometric variables are explained in the Material and methods section. Age category of respondents: 6 years. Number of respondents: 14 boys, 18 girls.

Table 2. Descriptive statistics of Roma children at the school age of 7 years

	Boys			Girls			Effect size		
Trait	M ± SD	95% CI	V	M ± SD	95% CI	CV	d	95% CI	Power
Body height	119.60 ± 3.17	118.00–121.20	2.65	126.10 ± 6.93	122.40–129.80	5.49	1.22	0.45–1.93	very large
Sitting height	61.61 ± 2.09	60.54–62.69	3.39	64.94 ± 4.84	62.37–67.52	7.45	0.90	0.17–1.60	large
Arm span	117.80 ± 4.39	115.50–120.00	3.73	122.10 ± 6.34	118.80–125.50	5.19	0.79	0.07–1.48	medium
Upper limb length	51.41 ± 1.97	50.40–52.42	3.83	54.13 ± 3.96	52.02–56.23	7.31	0.88	0.14–1.57	large
Lower limb length	66.15 ± 2.87	64.67–67.62	4.33	69.97 ± 3.57	68.07–71.87	5.10	1.18	0.42–1.89	large
Biacromial length	24.06 ± 4.53	21.73–26.39	18.82	22.63 ± 5.48	19.70–25.55	24.23	0.29	–0.41–0.96	small
Bitrochanteric distance	20.88 ± 1.43	20.15–21.62	6.86	21.13 ± 2.88	19.59–22.66	13.65	0.11	–0.57–0.79	very small
Bispinal length	22.34 ± 2.07	21.27–23.40	9.28	22.00 ± 2.31	20.77–23.23	10.50	0.16	–0.53–0.84	very small
Chest circumference	61.56 ± 7.53	57.69–65.43	12.23	66.50 ± 6.74	62.91–70.09	10.12	0.69	–0.03–1.37	medium
Maximum head length	16.79 ± 0.29	16.64–16.94	1.74	17.00 ± 1.24	16.34–17.66	7.28	0.24	–0.45–0.92	small
Maximum head breadth	13.42 ± 1.45	12.68–14.17	10.77	13.09 ± 1.09	12.51–13.67	8.32	0.26	–0.44–0.94	small
Breadth of the face	11.55 ± 0.87	11.10–12.00	7.56	11.63 ± 0.62	11.30–11.95	5.33	0.11	–0.58–0.79	very small
Height of the face	10.22 ± 0.69	9.87–0.58	6.79	11.32 ± 1.69	10.42–12.22	14.88	0.86	0.13–1.55	large
Head circumference	51.74 ± 1.16	51.14–52.33	2.24	51.31 ± 0.95	50.81–51.82	1.84	0.40	–0.29–1.08	small
Hand length	10.09 ± 5.23	7.41–12.78	51.84	13.92 ± 1.49	13.12–14.71	10.72	0.98	0.24–1.68	large
Hand width	6.77 ± 0.78	6.37–7.17	11.50	7.33 ± 0.79	6.91–7.75	10.73	0.71	–0.01–1.40	medium
Forearm length	21.76 ± 6.80	18.27–25.26	31.23	17.25 ± 2.38	15.98–18.52	13.80	0.87	0.14–1.57	large
Foot length	19.36 ± 1.31	18.69–20.04	6.76	19.44 ± 1.26	18.76–20.11	6.50	0.06	–0.62–0.74	very small
Foot width	7.95 ± 0.91	7.49–8.42	11.39	8.21 ± 0.95	7.71–8.72	11.58	0.28	–0.41–0.96	small

The statistics given are mean (M); standard deviation (SD); interval of margins (min. max); (95% CI) lower and upper 95% of the confidence interval of mean and coefficient of variance (CV). Abbreviations of the anthropometric variables are explained in the Material and methods section. Age category of respondents: 7 years. Number of respondents: 17 boys, 16 girls.

Table 3. Descriptive statistics of Roma children at the school age of 8 years

	Boys			Girls			Effect size		
Trait	M ± SD	95% CI	V	M ± SD	95% CI	CV	d	95% CI	Power
Body height	127.60 ± 4.81	124.40–130.80	3.77	130.80 ± 9.65	126.70–135.00	7.37	0.38	–0.35–1.09	very small
Sitting height	65.44 ± 3.01	63.42–67.46	4.60	67.37 ± 4.54	65.40–69.33	6.74	0.47	–0.27–1.18	small
Arm span	124.80 ± 8.36	119.20–130.40	6.68	125.70 ± 11.09	120.90–130.50	8.82	0.09	–0.63–0.80	very small
Upper limb length	55.15 ± 4.81	51.93–58.38	8.71	55.17 ± 3.50	53.66–56.69	6.34	0.01	–0.71–0.72	very small
Lower limb length	69.55 ± 3.36	67.29–71.80	4.83	70.57 ± 4.64	68.56–72.58	6.57	0.24	–0.49–0.95	small
Biacromial length	29.18 ± 3.52	26.82–31.54	12.5	21.48 ± 4.98	19.32–23.63	23.19	0.50	–1.22–0.24	medium
Bitrochanteric distance	22.64 ± 2.94	20.66–24.66	12.97	20.61 ± 3.60	19.05–22.17	17.48	0.60	–0.15–1.31	medium
Bispinal length	22.20 ± 2.25	20.69–23.71	10.12	23.09 ± 2.73	21.91–24.27	11.80	0.34	–0.39–1.06	small
Chest circumference	60.73 ± 6.28	56.51–64.95	10.34	68.74 ± 7.39	65.54–71.94	10.76	1.13	0.34–1.87	large
Maximum head length	16.51 ± 0.92	15.89–17.13	5.56	17.27 ± 0.58	17.02–17.52	3.35	1.8	0.29–1.81	large
Maximum head breadth	13.55 ± 1.58	12.49–14.61	11.65	12.80 ± 1.33	12.22–13.38	10.40	0.53	–0.21–1.25	medium
Breadth of the face	11.72 ± 0.76	11.21–12.23	6.44	11.15 ± 1.56	10.48–11.82	13.95	0.42	–0.32–1.13	small
Height of the face	10.92 ± 0.69	10.46–11.38	6.30	10.60 ± 1.03	10.15–11.05	9.72	0.34	–0.39–1.06	small
Head circumference	51.18 ± 1.54	50.15–52.21	3.00	51.83 ± 2.10	50.92–52.74	4.6	0.33	–0.40–1.05	small
Hand length	13.50 ± 0.56	13.12–13.88	4.14	14.73 ± 1.96	13.90–15.57	13.7	0.74	–0.01–1.46	medium
Hand width	7.56 ± 0.60	6.85–7.66	8.23	7.37 ± 0.84	7.00–7.73	11.34	0.25	–0.48–0.96	small
Forearm length	20.36 ± 7.08	15.61–25.12	34.74	19.13 ± 2.44	18.08–20.18	12.74	0.28	–0.45–0.99	small
Foot length	21.06 ± 2.07	19.67–22.45	9.83	19.39 ± 1.44	18.77–20.01	7.41	1.00	0.23–1.74	large
Foot width	8.28 ± 0.94	7.65–8.91	11.31	8.64 ± 0.90	8.26–9.03	10.35	0.39	–0.34–1.11	small

The statistics given are mean (M); standard deviation (SD); interval of margins (min. max); (95% CI) lower and upper 95% of the confidence interval of mean and coefficient of variance (CV). Abbreviations of the anthropometric variables are explained in the Material and methods section. Age category of respondents: 8 years. Number of respondents: 11 boys, 23 girls.

Table 4. Descriptive statistics of Roma children at the school age of 9 years

	Boys			Girls			Effect size		
Trait	M ± SD	95% CI	V	M ± SD	95% CI	CV	d	95% CI	Power
Body height	136.20 ± 7.35	130.60–141.90	5.39	139.80 ± 7.22	134.60–144.90	5.16	0.49	–0.44–1.39	small
Sitting height	67.56 ± 6.91	62.24–72.87	10.23	68.45 ± 2.89	66.38–70.52	4.22	0.17	–0.74–1.07	very small
Arm span	135.90 ± 8.78	129.10–142.60	6.46	134.10 ± 5.70	130.10–138.20	4.24	0.25	–0.67–1.14	small
Upper limb length	59.93 ± 5.08	56.03–63.84	8.47	60.17 ± 3.66	57.55–62.79	6.8	0.05	–0.85–0.95	very small
Lower limb length	73.76 ± 6.01	69.13–78.38	8.15	75.44 ± 5.95	71.19–79.69	7.88	0.28	–0.64–1.17	small
Biacromial length	28.89 ± 7.10	23.43–34.34	24.57	26.80 ± 5.82	22.64–30.96	21.71	0.32	–0.60–1.22	small
Bitrochanteric distance	24.93 ± 4.65	21.36–28.50	18.64	24.98 ± 1.80	23.69–26.27	7.22	0.01	–0.89–0.91	very small
Bispinal length	26.92 ± 4.06	23.80–30.04	15.9	25.74 ± 3.23	23.43–28.05	12.53	0.32	–0.60–1.22	small
Chest circumference	73.22 ± 11.95	64.04–82.40	16.31	76.20 ± 11.11	68.25–84.15	14.58	0.26	–0.66–1.15	small
Maximum head length	16.89 ± 0.93	16.18–17.60	5.49	17.00 ± 0.47	16.66–17.34	2.77	0.15	–0.76–1.05	very small
Maximum head breadth	13.62 ± 1.69	12.33–14.92	12.36	13.97 ± 1.04	13.23–14.71	7.42	0.25	–0.66–1.15	small
Breadth of the face	12.02 ± 1.34	10.99–13.05	11.17	12.20 ± 0.54	11.82–12.58	4.41	0.18	–0.73–1.07	very small
Height of the face	11.33 ± 1.50	10.18–12.49	13.24	12.70 ± 1.60	11.55–13.85	12.61	0.88	–0.10–1.78	large
Head circumference	52.89 ± 1.45	51.77–54.01	2.75	54.20 ± 2.70	52.27–56.13	4.98	0.59	–0.35–1.49	medium
Hand length	15.13 ± 1.37	14.05–16.18	9.1	15.32 ± 1.86	13.99–16.65	12.16	0.13	–0.77–1.03	very small
Hand width	9.19 ± 0.82	8.56–9.82	8.92	8.00 ± 1.02	7.27–8.73	12.76	1.28	0.24–2.20	very large
Forearm length	20.67 ± 2.29	18.91–22.43	11.9	18.30 ± 1.57	17.18–19.42	8.56	1.22	0.19–2.14	very large
Foot length	22.56 ± 0.88	21.88–23.23	3.91	21.51 ± 1.51	20.43–22.59	7.00	0.84	–0.14–1.74	large
Foot width	10.18 ± 0.93	9.46–0.90	9.17	8.78 ± 0.66	8.31–9.25	7.49	1.75	0.63–2.72	very large

The statistics given are mean (M); standard deviation (SD); interval of margins (min. max); (95% CI) lower and upper 95% of the confidence interval of mean and coefficient of variance (CV). Abbreviations of the anthropometric variables are explained in the Material and methods section. Age category of respondents 9 age. Number of respondents: 9 boys, 10 girls.

Table 5. Descriptive statistics of Roma children at school age of 10 years

	Boys			Girls			Effect size		
Trait	M ± SD	95% CI	V	M ± SD	95% CI	CV	d	95% CI	Power
Body height	143.80 ± 8.03	137.10–150.50	5.58	142.10 ± 9.26	138.20–146.00	6.52	0.19	–0.62–0.99	very small
Sitting height	71.89 ± 4.82	67.86–75.92	6.71	72.59 ± 6.10	70.02–75.17	8.40	0.12	–0.68–0.92	very small
Arm span	137.70 ± 8.28	130.80–144.60	6.1	143.90 ± 9.94	139.70–148.10	6.91	0.65	–0.18–1.45	medium
Upper limb length	63.38 ± 3.96	60.06–66.69	6.25	62.33 ± 6.17	59.73–64.94	9.89	0.18	–0.62–0.98	very small
Lower limb length	75.31 ± 6.43	69.94–80.69	8.54	79.33 ± 7.95	75.98–82.69	10.2	0.53	–0.30–1.32	medium
Biacromial length	32.88 ± 2.23	31.01–34.74	6.79	31.63 ± 3.63	30.09–33.16	11.49	0.37	–0.44–1.17	small
Bitrochanteric distance	26.69 ± 4.37	23.03–30.34	16.38	28.30 ± 5.13	26.13–30.47	18.12	0.32	–0.49–1.12	small
Bispinal length	25.66 ± 3.22	22.97–28.35	12.54	26.81 ± 3.09	25.51–28.12	11.53	0.37	–0.45–1.16	small
Chest circumference	67.63 ± 16.65	53.71–81.54	24.62	72.88 ± 7.44	69.73–76.02	10.21	0.51	–0.31–1.30	medium
Maximum head length	16.51 ± 0.92	15.89–17.13	5.56	17.47 ± 1.02	17.04–17.90	5.83	0.74	–0.10–1.54	medium
Maximum head breadth	14.94 ± 1.32	13.84–16.04	8.80	12.29 ± 1.67	11.58–12.99	13.57	1.66	0.73–2.51	very large
Breadth of the face	12.38 ± 1.19	11.38–13.37	9.60	11.65 ± 1.15	11.16–12.14	9.87	0.63	–0.20–1.43	medium
Height of the face	11.46 ± 1.11	10.54–12.39	9.66	10.82 ± 1.03	10.38–11.26	9.55	0.61	–0.22–1.41	medium
Head circumference	53.38 ± 1.41	52.20–54.55	2.64	52.38 ± 1.86	51.59–53.16	3.55	0.57	–0.26–1.36	medium
Hand length	15.96 ± 1.18	14.98–16.95	7.38	16.20 ± 1.15	15.71–16.68	7.9	0.21	–0.60–1.00	small
Hand width	8.86 ± 0.61	8.36–9.37	6.82	9.95 ± 1.52	9.31–10.59	15.28	0.80	–0.04–1.60	large
Forearm length	20.25 ± 2.32	18.31–22.19	11.43	22.13 ± 3.82	20.51–23.74	17.27	0.53	–0.29–1.33	medium
Foot length	24.64 ± 2.54	22.51–26.76	10.31	23.73 ± 2.57	22.64–24.81	10.81	0.36	–0.46–1.15	small
Foot width	9.60 ± 0.74	8.98–10.22	7.70	11.20 ± 2.16	10.29–12.12	19.26	0.83	–0.01–1.63	large

The statistics given are mean (M); standard deviation (SD); interval of margins (min. max); (95% CI) lower and upper 95% of the confidence interval of mean and coefficient of variance (CV). Abbreviations of the anthropometric variables are explained in the Material and methods section. Age category of respondents: 10 age. Number of respondents: 8 boys, 24 girls.

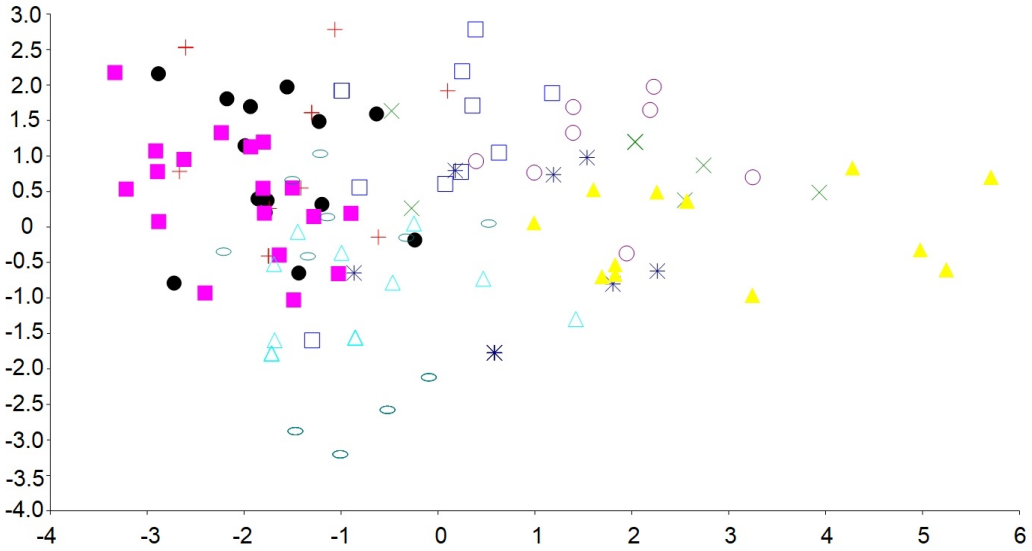


Figure 2. Results of discriminant analysis calculated with all the variables of Romany boys and girls from eastern Slovakia
Symbols: black dot – 6-year-old boys; cross – 7-year-old boys; open square – 8-year-old boys; filled triangle – 9-year-old boys; filled diamond – 10-year-old boys; filled square – 6 years girls; open triangle – 7-year-old girls; open oval – 8-year-old girls; black stars – 9-year-old girls; open diamond – 10-year-old girls.

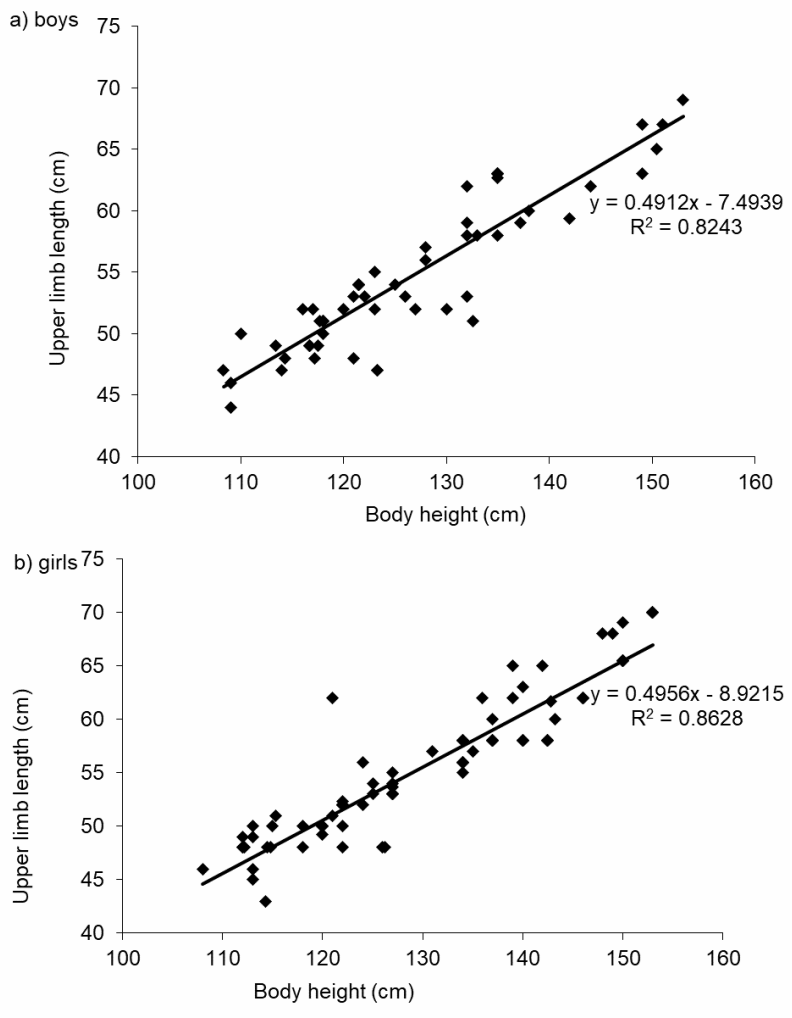


Figure 3. Relationships between the body height (M1) and upper limb length (M54); in Romany boys (a) and Romany girls (b) from eastern Slovakia. The lines represent the slopes calculated from reduced ordinary least squares regression (OLS)

Table 6. Results of OLS regression slopes, intercepts and 95% confidence intervals (CI), $F_{DFn, DFd}$ and p-values for relationships between body height (Y variable) and other anthropometric traits (Y variable) are shown for 59 Romany boys from eastern Slovakia. Legend: coefficient of determination (R^2)

Body height (M1) versus	R^2	OLS slope	Intercept	$F_{1, 57}$	p–values	Allometry
Other variables (Mxy)		(95% CI)	(95% CI)			
Sitting height (M23)	0.672	0.404 (0.329, 0.479)	13.94 (4.470, 23.42)	117.00	<0.0001	negative
Arm span (M17)	0.874	0.912 (0.819, 1.003)	9.037 (–2.580, 20.65)	396.70	<0.0001	negative
Upper limb length (M54)	0.824	0.491 (0.431, 0.551)	–7.494 (–15.12, 0.131)	267.40	<0.0001	negative
Lower limb length (M53)	0.687	0.491 (0.403, 0.579)	5.842 (–5.297, 16.98)	125.00	<0.0001	negative
Biacromial breadth (M35)	0.367	0.271 (0.177, 0.366)	–6.689 (–18.68, 5.298)	32.98	<0.0001	negative
Bitrochanteric distance (M42)	0.575	0.267 (0.202, 0.321)	–10.59 (–18.14, –3.029)	77.22	<0.0001	negative
Bispinal breadth (M41)	0.492	0.229 (0.167, 0.290)	–5.879 (–13.69, 1.936)	55.18	<0.0001	negative
Chest circumference (M61)	0.230	0.451 (0.232, 0.671)	7.177 (–20.59, 34.95)	17.2	0.0001	negative
Maximum head length (M1b)	0.102	0.260 (0.056, 0.465)	–14.87 (–40.77, 11.04)	6.491	0.014	negative
Maximum head breadth (M3)	0.227	0.063 (0.032, 0.095)	5.561 (1.603, 9.519)	16.69	0.0001	negative
Breadth of the face (M6)	0.220	0.054 (0.027, 0.081)	4.801 (1.362, 8.240)	16.11	0.0002	negative
Morphological height of the face (M18)	0.230	0.049 (0.026, 0.074)	4.529 (1.466, 7.592)	17.7	0.0001	negative
Head circumference (M45)	0.286	0.076 (0.044, 0.108)	42.24 (38.20, 46.29)	22.79	<0.0001	negative
Hand length (M49)	0.238	0.156 (0.082, 0.229)	–6.809 (–16.17, 2.551)	17.78	<0.0001	negative
Hand width (M52)	0.605	0.088 (0.069, 0.107)	–3.478 (–5.862, –1.095)	87.22	<0.0001	negative
Forearm length (M48)	0.015	–0.061 (–0.196, 0.073)	28.48 (11.49, 45.48)	0.84	0.364	negative
Foot length (M58)	0.808	0.209 (0.182, 0.236)	–5.672 (–9.092, –2.251)	240.40	<0.0001	negative
Foot width (M59)	0.586	0.091 (0.070, 0.111)	–2.952 (–5.511, –0.393)	80.72	<0.0001	negative

Table 7. Results of OLS regression slopes, intercepts and 95% confidence intervals (CI), $F_{DFn, DFd}$ and p-values for relationships between body height (Y variable) and other anthropometric traits (Y variable) are shown for 91 Romany girls from eastern Slovakia. Legend: coefficient of determination (R^2)

Body height (M1) versus Other variables (Mxy)	R^2	OLS slope (95% CI)	Intercept (95% CI)	$F_{1, 89}$	p–values	Allometry
Sitting height (M23)	0.772	0.435 (0.385, 0.485)	10.27 (3.705, 16.83)	301.20	<0.0001	negative
Arm span (M17)	0.889	1.122 (1.039, 1.205)	–19.32 (–30.28, – 8.360)	718.90	<0.0001	positive
Upper limb length (M54)	0.863	0.496 (0.454, 0.537)	–8.922 (–14.41, – 3.434)	559.70	<0.0001	negative
Lower limb length (M53)	0.798	0.603 (0.539, 0.667)	–7.448 (–15.87, 0.976)	351.10	<0.0001	negative
Biacromial breadth (M35)	0.084	0.139 (0.042, 0.236)	7.735 (–5.048, 20.52)	8.11	0.006	negative
Bitrochanteric distance (M42)	0.484	0.276 (0.216, 0.336)	–12.94 (–20.85, – 5.026)	83.31	<0.0001	negative
Bispinal breadth (M41)	0.667	0.246 (0.209, 0.283)	–8.612 (–13.45, – 3.778)	178.20	<0.0001	negative
Chest circumference (M61)	0.613	0.559 (0.465, 0.653)	–4.532 (–16.88, 7.811)	140.80	0.0001	negative
Maximum head length (M1b)	0.007	0.024 (–0.037, 0.085)	14.25 (6.234, 22.27)	0.62	0.432	negative
Maximum head breadth (M3)	0.072	–0.033 (–0.057, – 0.008)	17.39 (14.15, 20.63)	6.89	0.010	negative
Breadth of the face (M6)	0.044	0.021 (0.000, 0.042)	4.801 (1.362, 8.240)	4.09	0.046	negative
Morphological height of the face (M18)	0.103	0.036 (0.013, 0.058)	6.473 (3.552, 9.394)	10.17	0.002	negative
Head circumference (M45)	0.407	0.105 (0.078, 0.132)	38.15 (34.63, 41.68)	61.18	<0.0001	negative
Hand length (M49)	0.742	0.150 (0.132, 0.169)	–5.196 (–7.661, – 2.731)	255.50	<0.0001	negative
Hand width (M52)	0.291	0.068 (0.045, 0.090)	–0.781 (–3.719, 2.157)	36.46	<0.0001	negative
Forearm length (M48)	0.536	0204 (0.164, 0.244)	–7.824 (–13.10, – 2.548)	102.80	<0.0001	negative
Foot length (M58)	0.629	0.175 (0.146, 0.203)	–2.313 (–6.040, 1.414)	150.70	<0.0001	negative
Foot width (M59)	0.523	0.118 (0.095, 0.142)	–6.573 (–9.712, – 3.434)	97.52	<0.0001	negative

age and in the group of boys we recorded higher average values in almost all measured parameters than in girls. The small numbers in each age category did not allow us to test for sex differences. Effect size analyses for measured traits between sexes confirmed mainly small and/or medium statistical power for younger ages. Conversely, for 9- and 10-year-old children, medium to very large statistical power was also confirmed (see Tables 1–5).

A summary of the results for our OLS analyses are shown in Table 6–7; Figures 3–4. All allometric slopes of the body height and other measured anthropometric traits were significantly less than 1.00 (with the exception of

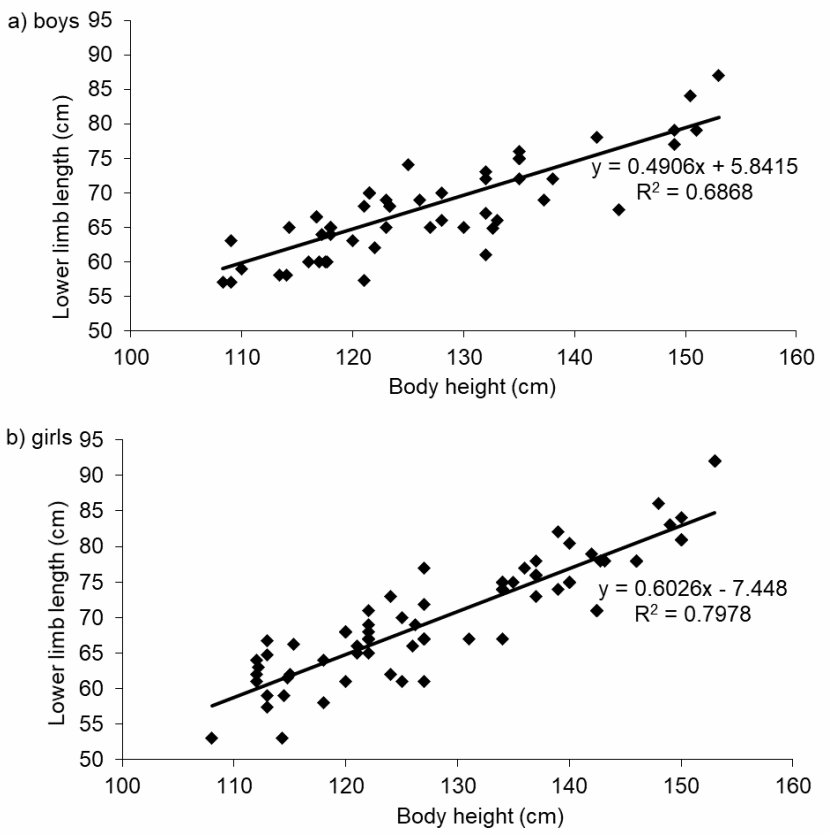


Figure 4. Relationships between body height (M1) and lower limb length (M53); in Romany boys (a) and Romany girls (b) from eastern Slovakia. The lines represent the slopes calculated from reduced ordinary least squares regression (OLS)

arm span for girls) as calculated by OLS regression and most were also confirmed as statistically significant.

Discussion

The present study includes anthropological investigations of the somatic traits of younger school age Roma children from eastern Slovakia. We also tested the presence of sexual dimorphism in morphological variation. The results confirmed that the values for boys were higher than for girls. Our results revealed sexual differences in the measured traits. Analysis of the effect size showed only a small effect size for sex. The values of anthropological parameters of younger school age were presented in other countries, e.g., from Africa (Nigeria) [17, 18]; from South America (Brazil) [38, 40]; from Taiwan [11]; from India [31, 57]; from Malaysia [9]; from Ireland [42]; from Japan [29, 30, 39]; and from Turkey [27].

All anthropometric data are extremely important indicators of the health status of individuals [14]. The most significant somatic changes occur in preschool age [33]. So far, only partial results of research focused on anthropometry of preschool children in different regions of eastern Slovakia have been presented [16].

Comparing our data with those of others [36] confirmed that children in Poland had higher mean values. Measurement of anthropometric parameters useful in clinical practice is also desirable [34]. Therefore, also in the present study we have chosen dimensions for anthropometric measurements that could be useful for several medical specialists in future.

Several studies have compared somatic parameters of preschool children [6, 11, 12, 21, 22, 41, 47]. In a study [11] conducted using anthropometric research in Taiwan, they investigated the anthropometric parameters of upper limb length, leg length and width, arm length and width, and face length and width in children aged 2 to 6 years. Other research [41] surveyed the sitting height, lower limb length, arm span and foot length. Anthropometric research on multiple measures as growth tracking tools has also been conducted by other authors [6, 21, 22, 47].

In summary, a sample of Roma children from eastern Slovakia was examined in this study. We found sexual size dimorphism with slightly higher values in boys. The results also confirmed differences in dimensions for most anthropometrical characteristics in other populations of children from Europe as well as from Africa and South America. In general, the variability was found to be very high. Sexual dimorphism was expressed, and its direction varies in

different parts of the distribution range as well with age. Moreover, to confirm the above statements, more numerous datasets from several parts of Europe as well from all over Slovakia will need to be examined and evaluated in future.

Conclusion

The aim of the study was to carry out an anthropometric analysis of children of the minority population of younger school age from eastern Slovakia. A total of 20 anthropometric parameters were measured. Our results also confirmed differences in size for most somatic characteristics in the minority Slovak population. However, in order to confirm the above statements, it will be necessary in future to evaluate a larger sample of children from Slovakia.

Conflict of interest: Authors state no conflict of interest.

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