PŮVODNÍ PRÁCE

FACIAL ANTHROPOMETRY OF SCHOOL CHILDREN FROM SLOVAKIA

Antropometria hlavy a tvare u školských detí zo Slovenska

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Abstract

The aim of this study was to evaluate the differences between boys and girls in the same and consequential age groups and evaluate growth increments from 6 to 15 years of age in selected anthropometric parameters of the head and face. 22 facial and head dimensions (13 horizontal, 6 vertical, 2 depth dimensions and head circumference) were measured in the sample of 324 school children from Bratislava and Martin. The statistic program SPSS, version 17.0 was used for the analysis. In both sexes, the most significant differences were found at the age of 11 and 14 years. There were no significant differences between sexes at the age of 6 and 9 years. Postnatally, width and height dimensions of the face marked the greatest increments. The depth dimensions of the face marked the smallest increments.

Key words: *anthropometry, facial and head dimensions, growth increments, intersexual differences*

Introduction

The human face is a reflection of a person´s individual uniqueness (Işcan, Loth, 2000).

It gives many useful information, such as gender, expression, approximate age, etc. (Geng, Zhou, Smith-Miles, 2007).

The growth of the human face has been one of the most complex problems (Scott, 1953), because clinicians have always been interested in understanding how the face changes from birth to adulthood (Ferrario et al., 1998).

The unequal craniofacial growth is the base of the developmental changes in the human face. It is unequal, because its particular parts grow by different rates. The growth of the neurocranium is intensive in first years and the splanchnocranium begins to grow intensively later (Šmahel, 2001).

At the birth, the more precocious cranium (Enlow, 1966) is proportionally wide and gives a face a round appearance. The face is at lower stage of development. Its width is greater than height or depth (Brodie, 1942). The face undergoes considerable amount of changes with aging (Ramanathan, Chellappa, 2005).

After about the third or fourth year of childhood, the brain growth slows and facial bones continue to enlarge to accomodate airway and masticatory growth and functions (Enlow, Hans, 1996).

The face of the infant and yound child is characteristically wide and vertically short. The other features are: large-appearing eyes, dainty jaws, a tiny pug nose, puffy cheeks with buccal and labial fat pads, a high intellectual-like forehead without coarse eyebrow ridges, a low nasal bridge, a small mouth, velvety skin, and overall wide and short proportions. As the face grows and develops through the years, the proportionate size of the forehead becomes reduced, the nasal bridge rises, the chin develops, jaw size catches up, and the eyes appear less wide-set (Enlow, Hans, 1996).

The faces of prepubertal boys and girls are comparable (Enlow, Hans, 1996). During puberty, the jaw becomes longer and more projecting in relation to the front part of the face. The facial profile becomes straighter, the nose more projecting and the incisors of both jaws more upright. These growth changes are greater in boys than in girls (Tanner, 1981).

In the female, the facial development begins to slow markedly after about 13 years of age. In the male, sex-related facial features begin to be fully manifested at about the time of puberty. This maturation process continues actively throughout the adolescent period (Enlow, Hans, 1996) during which the rate of growth accelerates, reaches a peak velocity and then decelerates until adulthood is achieved (Silveira, Fishman, Subtelny et al., 1992).

The structure of the female face is similar to that of infantile face. The male facial structure is more similar to that of mature face (Zebrowitz, 1997).

Aim

The primary aim of this study was to evaluate the differences between boys and girls in selected anthropometric parameters of the head and face at primary schools in Martin and Bratislava.

Methodology

An anthropometric analysis based on 22 measurements was performed on the 158 Slovak boys and 166 Slovak girls from 6 to 15 years of age. Data were collected at schools in Bratislava and Martin (Slovakia) with permission of headmasters, between October 2009 and January 2011. Written permission was required from parents of children.

The measurements included maximum head length (g–op), maximum head width (eu–eu), distance bifrontotemporalis (ft–ft), bizygomatic width (zy–zy), biauricular width (t–t), bigonial width (go–go), physiognomic facial height (tr–gn), morphological facial height (se–gn), interpupillary distance (pu–pu), intercanthal width (en–en), biocular width (ex–ex), nose width (al–al), labial width (ch–ch), physiognomic upper facial height (se–sto), nasal height (se–sn), nasal bridge length (se–prn), nasal depth (sn–prn), physiognomic ear length (sa–sba), physiognomic ear width (pra–pa), upper facial depth (t–se), lower facial depth (t–gn) and head circumference (g–op–g) (Fig. 1, Fig. 2).

The statistic program SPSS, version 17.0 was used for the analysis. Kolmogorov-Smirnov test was used to test intersexual differences and differences in consequential age groups.

Results

The results show that statistically significant intersexual differences were:

At the age of 7 years: in maximum head width ($p = 0.003$), bigonial width ($p = 0.026$) and in upper facial depth ($p = 0.034$).

At the age of 8 years: in maximum head width ($p = 0.046$), nasal height ($p = 0.020$) and in lower facial depth ($p = 0.023$).

At the age of 10 years: in labial width ($p = 0.036$) and in physiognomic ear width ($p = 0.036$).

At the age of 11 years: in distance bifrontotemporalis ($p = 0.011$), biauricular width ($p = 0.028$), intercanthal width ($p = 0.038$) and in upper facial depth ($p = 0.038$).

At the age of 12 years: in biauricular width ($p = 0.024$) and in upper facial depth ($p = 0.024$).

At the age of 13 years: in physiognomic upper facial height ($p = 0.004$) and in upper facial depth ($p = 0.006$).

At the age of 14 years: in maximum head length ($p = 0.047$),

Figure 1. *Anthropometric landmarks*

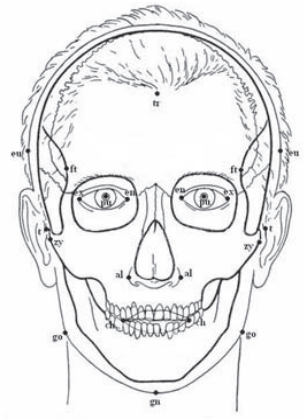
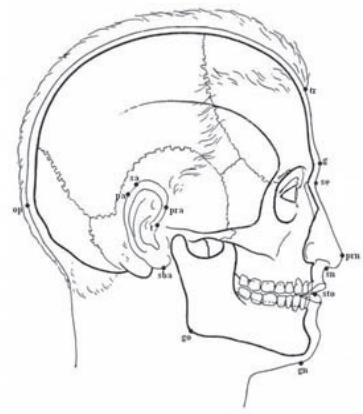


Figure 2. *Anthropometric landmarks*



maximum head width (p = 0.047), morphological facial height (p = 0.035), lower facial depth (p = 0.015) and in head circumference (p = 0.043).

At the age of 15 years: in nose width (p = 0.016) and in upper facial depth (p = 0.016).

There were no significant differences between sexes at the age of 6 and 9 years. Conversely, in both sexes, the most differences were at the age of 11 and 14 years. The parameters with significant difference were in favour of boys.

In boys, significant differences were found between the ages 7 and 8 in nose width (p = 0.040), 9 and 10 in bigonial width (p = 0.037), 13 and 14 in morphological facial height (p = 0.028) and in physiognomic ear length (p = 0.038), in consequential age groups. No significant differences were found in all other parameters.

In girls, significant differences were found between the ages 8 and 9 in biauricular width (p = 0.046), in physiognomic facial height (p = 0.002), in labial width (0.008), 11 and 12 in biocular width (p = 0.035), 12 and 13 in upper facial depth (p = 0.010) and in head circumference (p = 0.004). No significant differences were found in all other parameters.

In girls, the most significant differences were between 8 and

Table 1. *The significance of growth increments in facial and head dimensions between 6 to 15 years in boys*

Anthropometric parameters	6 years old boys (n = 10) Mean (cm) ± SD	15 years old boys (n = 16) Mean (cm) ± SD	p-value
Maximum head length (g–op)	18.11 ± 0.67	18.96 ± 0.78	0.165
Bizygomatic width (zy–zy)	11.24 ± 0.65	12.08 ± 0.64	0.092
Biauricular width (t–t)	12.21 ± 0.67	13.81 ± 0.56	<0.001
Physiognomic facial height (tr–gn)	15.48 ± 1.59	18.07 ± 0.91	<0.001
Morphological facial height (se–gn)	9.94 ± 0.51	11.74 ± 0.47	<0.001
Interpupillary distance (pu–pu)	4.69 ± 0.32	5.80 ± 0.57	<0.001
Biocular width (ex–ex)	8.00 ± 0.41	9.60 ± 0.74	<0.001
Nose width (al–al)	2.98 ± 0.17	3.62 ± 0.22	<0.001
Labial width (ch–ch)	4.40 ± 0.28	5.41 ± 0.51	<0.001
Physiognomic ear width (pra–pa)	3.40 ± 0.24	3.41 ± 0.28	0.999
Upper facial depth (t–se)	11.07 ± 0.53	12.78 ± 0.60	<0.001
Lower facial depth (t–gn)	12.22 ± 0.63	14.59 ± 0.75	<0.001

Table 2. *The significance of growth increments in facial and head dimensions between 6 to 15 years in girls*

Anthropometric parameters	6 years old girls (n = 9) Mean (cm) ± SD	15 years old girls (n = 18) Mean (cm) ± SD	p-value
Biauricular width (t–t)	11.94 ± 0.52	13.47 ± 0.59	<0.001
Biocular width (ex–ex)	7.90 ± 0.51	9.33 ± 0.52	<0.001
Nose width (al–al)	2.79 ± 0.21	3.36 ± 0.25	<0.001
Labial width (ch–ch)	3.98 ± 0.35	5.12 ± 0.38	<0.001
Physiognomic upper facial height (se–sto)	5.89 ± 0.65	7.16 ± 0.38	<0.001
Nasal height (se–sn)	4.20 ± 0.54	5.30 ± 0.32	<0.001
Nasal bridge length (se–prn)	3.49 ± 0.54	4.45 ± 0.32	<0.001
Physiognomic ear length (sa–sba)	5.63 ± 0.55	6.06 ± 0.54	0.187
Physiognomic ear width (pra–pa)	3.22 ± 0.29	3.23 ± 0.25	0.928
Upper facial depth (t–se)	10.61 ± 0.45	12.15 ± 0.51	<0.001
Lower facial depth (t–gn)	11.98 ± 0.55	13.97 ± 0.82	<0.001
Head circumference (g–op–g)	52.26 ± 0.12	55.94 ± 1.61	<0.001

9 years and between 12 and 13 years. In boys, the most differences were between 13 and 14 years.

The significance of growth increments in facial and head dimensions between 6 and 15 years in boys and girls are listed in Table 1 and Table 2.

In boys, the smallest increment was found in maximum head length (0.85 cm), bizygomatic width (0.84 cm) and in physiognomic ear width (0.01 cm) from all measured parameters. The biggest increment noted biauricular width (1.60 cm), physiognomic facial height (2.59 cm), morphological facial height (1.80 cm), interpupillary distance (1.11 cm), biocular width (1.60 cm), nose width (0.64 cm), labial width (1.01 cm), upper facial depth (1.71 cm) and lower facial depth (2.37 cm).

In girls, the smallest growth increment was found in physiognomic ear length (0.43 cm) and in physiognomic ear width (0.01 cm). The biggest increment noted biauricular width (1.53 cm), biocular width (1.43 cm), nose width (0.57 cm), labial width (1.14 cm), physiognomic upper facial height (1.27 cm), nasal height (1.10 cm), nasal bridge length (0.96 cm), upper facial depth (1.54 cm), lower facial depth (1.99 cm) and head circumference (3.68 cm).

Discussion

Although, differences in nearly all width dimensions were statistically significant, their growth increments were lower than increments in height and depth dimensions, both in boys and girls. The height and depth dimensions, that noted the biggest growth increment, were: physiognomic facial height, morphological facial height, physiognomic upper facial height, upper facial depth and lower facial depth. It is because the craniofacial growth is complete first in head, then in facial width, and last in height and depth (Krogman, 1939).

The face of child appears to be broad because of earlier and faster development of the brain and basicranium in relation to the facial composite (Enlow, Hans, 1996). According to Krogman (1951), at birth, breadths are 55–60% of adult value, heights are 40–45% and depths are 30–35%. This means, that postnatal facial growth will be most in depths, next in heights and least in breadths. The broad, moderately high shallow children face becomes the deeper, moderately high and relatively narrow face of the adult (Krogman, 1940). The adult face is higher and deeper than broader (Farkas, Posnick, Hreczko, 1992).

Some parameters, as physiognomic ear length and physiognomic ear width, noted the small or nearly none increment.

From 6 to 15 years, nearly all mean values of particular facial dimensions of girls in each age category were lesser in comparison to boys. The face of girls was smaller in comparison to the face of boys.

Conclusion

In the same age groups, the most significant differences were found in boys and girls in the age of 11 and 14 y. The parameters with significant difference were in favour of boys. There were no significant differences between boys and girls in the age of 6 and 9 y.

In the consequential age groups, girls had the most significant differences between the ages 8 and 9 y. and between 12 and 13 y. In boys, the most significant differences were found between the ages 13 and 14 y.

The increments from 6 to 15 years were the biggest in height and depth dimensions. Although the width dimensions were statisticaly significant, they were lower. Some parameters (physiognomic ear length and physiognomic ear width) noted small or nearly none increment.

Boys had bigger faces in every age group, because they had nearly all mean values of particular facial dimensions bigger than girls.

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Súhrn

Príspevok poukazuje na rozdiely v sledovaných antropometrických parametroch tváre a hlavy chlapcov a dievčat v rovnakých a nadväzujúcich vekových kategóriách a na množstvo rastových prírastkov od 6. do 15. roku. 324 probandom bolo zmeraných 22 rozmerov. Výsledky našej štúdie ukázali, že medzi chlapcami a dievčatami v rovnakých vekových kategóriách bolo najviac štatisticky významných rozdielov vo veku 11 a 14 rokov. Všetky parametre so signifikantným rozdielom boli v prospech chlapcov. Vo veku 6 a 9 rokov neboli zistené žiadne štatisticky významné rozdiely medzi chlapcami a dievčatami. V nadväzujúcich vekových kategóriách mali dievčatá najviac signifikantných rozdielov medzi 8. a 9. a medzi 12. a 13. rokom. U chlapcov bolo najviac signifikantných rozdielov medzi 13. a 14. rokom. Rozdiely v šírkových parametroch tváre boli štatisticky významné, ale nie všetky prírastky boli také výrazné ako rozdiely vo výškových a hĺbkových parametroch. Niektoré rozmery, ako napríklad fyziologická dĺžka ušnice a fyziologická šírka ušnice, zaznamenávajú malý alebo takmer žiadny rast. Chlapci majú v porovnaní s dievčatami vo všetkých vekových kategóriách väčšie tváre.

Kľúčové slová: *antropometria, tvárové a hlavové rozmery, rastové prírastky, intersexuálne rozdiely*

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VPLYV KONCENTRÁCIE TUHÝCH ČASTÍC PM_{10} V OVZDUŠÍ NA VÝSKYT BRONCHIÁLNEJ ASTMY NA SLOVENSKU V OBDOBÍ ROKOV 2004–2009

The influence of solid particles PM_{10} and their concentration in the air on the prevalence of bronchial asthma in the Slovak Republic in period between years 2004 and 2009

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Abstract

Recent researches support causal relation between polluted air and lower function of lungs. The main pollutants are particulate matter with a diameter less than 10 μm (PM_{10}) and ozone. Portion of diseases caused by PM is adequate to value of this indicator, which combines concentration of PM_{10} and abundance of afflicted population. Intensity of average long-term exposition determines the risks of chronic pollution effects on health.

The authors focused on observing bronchial asthma, which is important indicator of impaired quality of air in relation to health of population. The prevalence was observed in scope of the whole Slovak Republic as well as on the level of individual regions. There was also considered the extent of the prevalence of the stated diseases in relation to pollution caused by PM_{10} particles.

Conclusions of report confirm the rising tendency of prevalence of bronchial asthma in the Slovak Republic in period between years 2004 and 2009. Simultaneously, there was not confirmed positive association between the prevalence of allergic diseases and polluted air by PM_{10} particles.

Key words: *bronchial asthma, particulate matter (PM), slovak population, slovak regions*

Úvod

Kvalitu ovzdušia vo všeobecnosti určuje obsah znečisťujúcich látok vo vonkajšom ovzduší. Kvalita ovzdušia je považovaná za dobrú, ak úroveň znečistenia neprekračuje limitné hodnoty (Ronchetti et al., 2010).

Na Slovensku, ako aj vo väčšine európskych krajín, predstavuje najväčší problém kvality ovzdušia jeho znečistenie časticami PM_{10} (tuhé častice s priemerom menším ako 10 mikrometrov). Priemerné úrovne vystavenia PM_{10} pre krajinu sú v rozsahu od 13–14 μg/m^3 (Fínsko, Írsko) po 53–56 μg/m^3 (Bulharsko, Rumunsko a Srbsko). Väčšina ľudí v európskych mestách, kde sa monitoruje koncentrácia PM_{10}, je vystavených úrovniam koncentrácie PM_{10}, ktoré prekračujú úroveň stanovenú v smernici WHO pre kvalitu ovzdušia (AQG) (20 μg/m^3), čo výrazne zvyšuje riziko poškodenia zdravia. Limitná hodnota Európskej únie (EÚ) 40 μg/m^3 je tak prekročená pre 14 % ľudí (WHO, 2005).