

## ANTHROPOMETRIC STUDY OF THE FACIAL INDEX IN THE POPULATION OF CENTRAL SERBIA

D. JEREMIĆ<sup>1</sup>, SANJA KOCIĆ<sup>2</sup>, MAJA VULOVIĆ<sup>1</sup>, MAJA SAZDANOVIĆ<sup>3</sup>, P. SAZDANOVIĆ<sup>1</sup>,  
B. JOVANOVIĆ<sup>4</sup>, J. JOVANOVIĆ<sup>4</sup>, Z. MILANOVIĆ<sup>5</sup>, NELA ĐONOVIĆ<sup>2</sup>,  
ALEKSANDRA SIMOVIĆ<sup>6</sup>, KATARINA PAREZANOVIĆ-ILIC<sup>4</sup>, A. MALIKOVIĆ<sup>7</sup>, J. TOŠEVSKI<sup>1</sup> and  
IVANA ŽIVANOVIĆ-MAČUŽIĆ<sup>1</sup>

<sup>1</sup> *Department of Anatomy and Forensic Medicine, Faculty of Medical Sciences, University of Kragujevac, 34000 Kragujevac, Serbia*

<sup>2</sup> *Institute for Public Health, University of Kragujevac, 34000 Kragujevac, Serbia*

<sup>3</sup> *Department of Histology, Faculty of Medical Sciences, University of Kragujevac, 34000 Kragujevac, Serbia*

<sup>4</sup> *Clinical Center Kragujevac, 34000 Kragujevac, Serbia*

<sup>5</sup> *Faculty of Sport and Physical Education, University of Niš, 18000 Niš, Serbia*

<sup>6</sup> *Pediatric Clinic, Clinical Center, 34000 Kragujevac, Serbia*

<sup>7</sup> *Department of Anatomy, Faculty of Medicine, University of Belgrade, 11000 Beograd, Serbia*

**Abstract** - The aim of this study was to determine the craniofacial parameters in the population of the central part of Serbia. The research was conducted on 700 persons (360 males and 340 females), aged 18-65 years, selected randomly. The measured parameters were morphological facial height and breadth. The standard spreading caliper with scale was used for the measurement of facial parameters. There were significant differences in the facial parameters of male compared to female subjects in all observed parameters. The mean value of the morphological facial height in the study population was 116.8 mm  $\pm$  7.28, maximum facial breadth 124.12 mm  $\pm$  8.44, while the mean value of the total facial index was 93.68  $\pm$  6.86. The total facial index was calculated according to the formula and the obtained results were analyzed statistically using the t-test. The dominant phenotype in the studied population was leptoprosopic. The data obtained in our study may be useful in anthropological research, forensics, genetic research, as well as in medical clinical practice.

**Key words:** Anthropometry, facial height, facial breadth, facial index, facial phenotype

### INTRODUCTION

Craniofacial anthropometry, as an important part of anthropology and medicine, is used for the determination of the morphological characteristics of the head and face. Face shape depends on many factors, such as gender, race and ethnicity, climate, socio-economic, nutritional, and genetic factors. The determination of facial parameters is of great importance for the evaluation of facial trauma, congenital

and traumatic deformities and easier identification of certain congenital malformations (Oladipo et al., 2008a; Oladipo et al., 2008b; Oladipo et al. 2009a). The collected data can be used in anthropology and forensic medicine for identification of racial and sexual differences as well as in reconstructive surgery for facial reconstruction.

Types of faces, as determined by craniofacial measurements, were divided into five international

anatomical categories: hypereuryprosopic, euryprosopic, mesoprosopic, leptoprosopic and hyperleptoprosopic (Martin and Saller, 1957).

The aim of this study was to determine the craniofacial parameters in the population of the central part of Serbia and to compare them with the those determined in earlier studies in different populations, which is important for anthropological research, research in forensic medicine and clinical practice (reconstructive surgery).

#### MATERIALS AND METHODS

This study was conducted on 700 persons (360 males and 340 females), aged 18-65 years, that were randomly selected. Measurements were performed at the Institute of Anatomy, Faculty of Medical Science, University of Kragujevac, as well as at the Center for Rehabilitation Medicine of the company "Zavodi Crvena Zastava", from 2001-2006. All subjects were without past and existing craniofacial trauma, deformities or facial scars. The measurement process was explained to each subject and written permission was obtained from each tested person before the measurement.

All measurements were performed in the same way and under the same conditions. The subjects were in a sitting position, relaxed, with the head in the correct anatomical position (neutral position of the head). Measurements were performed during the period from 14.00-16.30 to eliminate discrepancies in relation to diurnal variation. All measurements were repeated three times and the mean value of the measurements was taken for further analysis. The measurements were made with a permissible error of 1 mm.

A standard spreading caliper with scale was used for the measurement of facial parameters. The statistical significance of sex differences in mean values of the measured parameters was examined by using an independent t-test.

Landmark points used in measuring of the parameters were: n – nasion: the midpoint of the nasofrontal suture; gn – gnation: in the midline, the lowest point on the lower border of the chin; zy - zygomatic prominences, zygion: the most lateral point on the zygomatic arch.

Morphological facial height (MHF) is the distance between nasion and gnation (n-gn). It was measured by standard caliper with scale as follows: the fixed tip of the caliper was placed at the subject's gnation and the movable part was moved and placed on the nasion.

The maximum width of face or maximum facial breadth (MFB) is the distance between the two zygomatic prominences (zy-zy). It was measured by standard caliper with a scale in the following way: after palpation (by fingers) to locate the most lateral point of the zygomatic arch (*arcus zygomaticus*) on the both sides of the face, the ends of spreading caliper were placed at these points, with enough pressure to feel the bone under the caliper. The caliper was slightly shifted in the direction of up and down and back and forth, until the maximum value was shown.

Total facial index (TFI) is the ratio of morphological facial height (obtained by measuring the distance from n to gn) and maximum facial breadth (the distance between two zygomatic prominences – from zy to zy) and can be calculated according to the formula:

$$TFI = (n-gn / zy-zy) \times 100$$

The values of TFI were used to determine the incidence of certain facial types (according to Martin-Saller's scale). Based on the total facial index (TFI), the facial phenotype was classified as: hypereuryprosopic ( $TFI \leq 78,9$ ), euryprosopic ( $79,0 < TFI < 83,9$ ), mesoprosopic ( $84,0 < TFI < 87,9$ ), leptoprosopic ( $88,0 < TFI < 92,9$ ) and hyperleptoprosopic ( $TFI \geq 93,0$ ) (Martin and Saller, 1957).

**Table 1.** The craniofacial parameters in studied populations

Parameter	Male	Female	Total-both gender	p value
MHF (mm±SD)	121.42±5.79	110.84±5.61	116.28±7.28	<0.001*
MFB (mm±SD)	129.12±8.86	119.98±6.38	124.12±8.44	<0.001*
TFI	94.04±7.00	92.38±6.72	93.68±6.86	<0.001*

\* Statistically significant difference

MHF (morphological facial height), MFB (maximal facial breadth) and TFI (total facial index)

**Table 2.** The frequency of facial phenotype, according to the value of total facial index, in studied population

Facial phenotype	Male	Female	Total-both gender	p value
hypereuryprosopic	(0)	(0)	(0)	-
euryprosopic	(0)	(0)	(0)	-
mesoprosopic	17.78% (64)	10.59% (36)	14.29% (100)	<0.001*
leptoprosopic	76.67% (276)	87.06% (296)	81.71% (572)	<0.001*
hyperleptoprosopic	5.56% (20)	2.35% (8)	4.00% (28)	<0.001*

\* Statistically significant difference

## RESULTS

The conducted research provides important new information concerning the total facial index, face shape, and facial phenotype in the adult population of central Serbia. The mean values of the morphological facial height, facial breadth and total facial index in males were, respectively, 121.42 mm ± 5.79, 129.12 mm ± 8.86, 94.04 ± 7.00, while the following values of parameters were obtained in females, respectively: 110.84 mm ± 5.61, 119.98 mm ± 6.38, 92.38 ± 6.72 (Table 1). It has been shown that males in the studied population of the central part of Serbia have significantly higher values of morphological facial height, the facial breadth and total facial index, compared to the tested females ( $p < 0.001$ ).

The dominant type of face phenotype in the studied population, according to the value of total facial index, was leptoprosopic with an incidence of 81.71% (76.66% males and 87.05% females), which was followed by mesoprosopic with an incidence of 14.28% (17.77% males and 10.58% females) (Table 2,

Fig. 1) and hyperleptoprosopic with a frequency of 4.00% (5.55% males and 2.35% females). In the study population of both sex, face shape corresponding phenotypes designated as hypereuryprosopic and euryprosopic were not observed (0%).

The phenotype of face, leptoprosopic, dominant in both sexes, has a higher incidence in females compared to males, while mesoprosopic and hyperleptoprosopic are more common in male subjects compared to females (Table 2, Fig. 1).

## DISCUSSION

Earlier studies have indicated racial and ethnic differences in the mean value of total facial index in different populations of people. The mean value of the total facial index observed in this study was higher than the those observed in the population of central Croatia – TFI value of 80.08, southern Dalmatia (Croatia) – TFI value of 93.37 (Radović et al., 2000), the population of Croatia – TFI value of 63.07, the population of Syria – TFI value of 83.12 (Grbeša et al.,

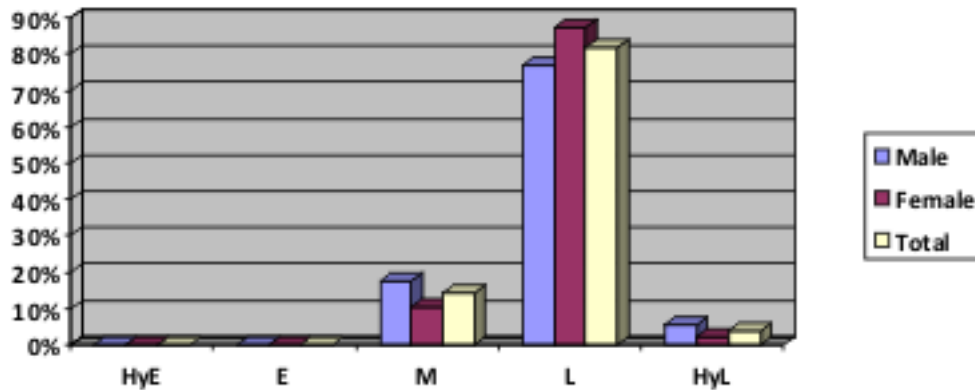


Fig.1. The frequency of facial phenotype of both genders in studied population

2007). TFI values obtained in our study were higher in both males and females than the values obtained in the following populations: the Onge population of India (Indian Onges), 77.98 male, 75.29 female (Ashok, 2006), the population of Malaysia, 85.72 males, 87.71 females (Shetti et al., 2011), the population of India, 87.19 males, 86.75 females (Shetti et al., 2011), Japanese adult females 82.66 (Hossain et al., 2011), the Far ethnic group of Iran (Iranian Fars): 88,22 males, 84.48 females; Turkman ethnic group of Iran (Iranian Turkman), 87.25 males, 81.48 females (Jahanshahi et al., 2008).

In the present study, the mean value of the total facial index of both genders was higher than those obtained in a similar study conducted among adult Hungarians in Vojvodina (Serbia) in which the mean total facial index was 87.9, and the phenotype of highest incidence was mesoprosopic (Pavlica et al., 2004). In our research, according to the value of the total facial index, the most common facial phenotype was leptoprosopic, which is consistent with the research results of Pavlica et al. conducted among Montenegrins in Vojvodina (Serbia) (Pavlica et al., 2007).

Nagle and associates (Nagle et al., 2005) conducted a study in which craniofacial measurements were taken in female and male populations of Lithuania. In their study, the mean value of the morphologi-

cal facial height of male subjects was  $12.48 \text{ cm} \pm 0.5$ , which was higher compared to our study (Table 1). Also, the mean value of maximum facial breadth of Latvian females was  $11.8 \text{ cm} \pm 0.65$ , which was higher compared to the one obtained in our study (Table 1).

The study conducted in the Turkman ethnic group of northern Iran showed that the dominant facial phenotype in males was mesoprosopic (38.4%), and for females, euryprosopic (51.7%). For the Far ethnic group of northern Iran it was shown that the dominant facial phenotype in males was mesoprosopic (44%), and euryprosopic (37.7%) for females (Jahanshahi et al., 2008).

Pavlica et al. (2006), in their study of anthropometric characteristics of the head and face conducted among adult populations of northwest Bačka (Serbs, Montenegrins, Hungarians) concluded that the presence of euryprosopic, mesoprosopic and leptoprosopic facial phenotypes was equal in this population. A survey of the anthropological characteristics of adult Poles living in northern Banat (Yugoslavia, Serbia), showed that in this population the most common shape of face was the euryprosopic phenotype (Bozić-Krstić et al., 1997).

Morphological facial height values obtained in our study ( $121.42 \text{ mm} \pm 5.79$  for males and  $110.84$

mm  $\pm$  5.61 in females) were lower than the values obtained after anthropometric research in the population of northeastern part of Nigeria (141.15 mm  $\pm$  7.5 in males and 141.29 mm  $\pm$  7.6 in females) (Maina et al., 2011), the population of India (130.02 mm  $\pm$  7.2 in males and 125.4 mm  $\pm$  6.0 in females), and the population of Sri Lanka (140.2 mm  $\pm$  10.3 in males and 138.8 mm  $\pm$  12.9 in females) (Gohiya et al., 2010; Ilayperuma, 2011).

The mean value of morphological facial height in adult Egyptian males (121.1 mm  $\pm$  0.41) was lower than that in our study (121.42 mm  $\pm$  5.79), while the same parameter values in female subjects were higher in the Egyptian population (111.5 mm  $\pm$  0.68) compared to those obtained in our study (110.84 mm  $\pm$  5.61) (Muhammad and Haze, 2011).

The mean value of morphological facial height observed in our study (116.28 mm  $\pm$  7.28) was lower than the value obtained in the study of anthropometric characteristics of the population of Lithuania (120.8 mm) (Nagle et al., 2005), the Caucasian population (the white race) (120.9 mm) (Farkas et al., 1989), Brazilian Indians (125.7 mm) (Niswander et al., 1967), as well as the Nigerian population (120.2 mm) (Didia and Dapper, 2005).

The mean morphological facial height observed in our study (116.28 mm  $\pm$  7.28) was higher than the value obtained in a survey conducted among West Africans (108.4 mm) (Herskovits, 1937).

After conducting the research, it was concluded that the dominant facial phenotype in the population of the central part of Serbia is leptoprosopic. The data obtained in our study may be useful in anthropological research, forensics, genetic research, as well as in medical clinical practice (reconstructive surgery).

## REFERENCES

- Ashok, K.P. (2006). Cephalo-facial variation among Onges. *Anthropologist* **28** (4), 245-249.
- Božić-Krstić, V., Radovanović, Đ., Rakić, R., Pavlica, T., and M. Savić (1997). Some anthropological characteristics of adult Poles inhabiting a north of Yugoslav Banat. *Glasnik Antropološkog društva Jugoslavije* **33**, 203-207.
- Didia, B.C., and D.V. Dapper (2005). Facial, nasal, maxillary, mandibular and oro-facial heights of adult Nigerians. *J. Orien. Med.* **17**, 1 - 8.
- Farkas, L.G., Hreczko, T.A., Kolar, J.C., and I.R. Munro (1989). Vertical and horizontal proportions of the face in adult North American Caucasians: revision of neoclassical canons. *Plast. Reconstr. Surg.* **75**, 328 - 338.
- Gohiya, V.K., Shrivatava, S., and S. Gohiya (2010). Estimation of cranial capacity in 20-25 year old population of Madhya Pradesh a State of India. *Int. J. Morphol.* **28** (4), 1211-1214.
- Grbeša, Đ., Pezerović-Panijan, R., Kalaya, M.N., Goršić, I., Čavčić, A., Žura, N., and B. Berberović (2007). Craniofacial characteristics of Croatian and Syrian populations. *Coll. Antropol.* **31** (4), 1121-1125.
- Herskovits, M.J. (1937). Physical types of West African Negroes. *Hum. Biol.* **9**, 483.
- Hossain, M.G., Saw, A., Ohtsuki, F., Lestrel, P.E., and T. Kamarul (2011). Change in facial shape in two cohorts of Japanese adult female students twenty years apart. *Singapore Med. J.* **52** (11), 818-823.
- Ilayperuma, I. (2011). Evaluation of cephalic indices: a clue for racial and sex diversity. *Int. J. Morphol.* **29** (1), 112-117.
- Jahanshahi, M., Golalipour, M.J., and K. Heidari (2008). The effect of ethnicity on facial anthropometry in Northern Iran. *Singapore Med.* **49**(11), 940-3.
- Maina, M.B., Shapu, Y.C., Garba, S.H., Muhammad, M.A., Garba, A.M., Yaro, A.U., and O.N. Omoniyi (2011). Assessments of cranial capacities in a North-Eastern adult Nigerian population. *Journal of Applied Sciences* **11**, 2662-2665.
- Martin, R., and K. Saller (1957). *Lehrbuch der anthropologie*. Gustav Fischer Verlag, Stuttgart
- Muhammad, H., and A.S. Hazem (2011). Vertical facial dimensions and indices in adult upper Egyptians. *Journal of American Science* **7** (10), 785-791.
- Nagle, E., Teibe, U., and D. Kapoka (2005). Craniofacial anthropometry in a group of healthy Latvian residents. *Acta Med. Lituonica* **12** (1), 47-53.
- Niswander, J.D., Keiter, F., and J.V. Neel (1967). Further studies on the Xavante Indians. Some anthropometric, dermatoglyphic and non quantitative morphological traits of the Xavantes of Simoes Lopes. *Amer. J. Hum. Genet.* **19**, 490-501.
- Oladipo, G.S., Didia, B.C., Okoh, P.D., and J.S. Hart (2008a). Sexual dimorphism in facial dimensions of adult Ijaw. *J. Expt. and Clin. Anat.* **7** (2), 10-14.

- Oladipo, G.S., Fawehinmi, H.B., and P.D. Okoh (2009a). Canthal indices of Urhobo and Itsekiri ethnic groups. *Australian Journal of Basic and Applied Sciences* **3** (4), 3093-3096.
- Oladipo, G.S., Olotu, E., and I.U. Guinireama (2008b). Anthropometric comparison of canthal indices between the Ijaw and Igbo tribes. *Scientia Africana* **7** (1), 141-144.
- Pavlica, T., Božić-Krstić, V., and R. Rakić (2004). Anthropological characteristics of adult Hungarians in Vojvodina. *Glasnik Antropološkog Društva Jugoslavije* **39**, 123-130.
- Pavlica, T., Božić-Krstić, V., and R. Rakić (2006). Some anthropometric characteristics of head and face in adult population of northwest Bačka. *Glasnik Antropološkog društva Jugoslavije* **41**, 45-55.
- Pavlica, T., Božić-Krstić, V., and R. Rakić (2007). Anthropological characteristics of Montenegrins living in Vojvodina. *Glasnik Antropološkog društva Jugoslavije* **42**, 167-177.
- Radović, Z., Muretić, Ž., Nemirovskij, V., and V. Gaži-Čoklica (2000). Craniofacial variations in a south Dalmatian population. *Acta Stomat. Croat.*, 399-403.
- Shetti, V.R., Pai, S.R., Sneha, G.K., Gupta, C., Chethan, P., and Soumya (2011). Study of prosopic (facial) index of Indian and Malaysian students. *Int. J. Morphol.* **29** (3), 1018-1021.