Cephalofacial Differences Between Males 18 Years of Age and 20-30 Years of Age

Diferencias Cefalofaciales entre Hombres de 18 Años y de 20-30 Años

Agron M. Rexhepi & Behlul Brestovci

SUMMARY: The human skull is comprised of many flat and irregular bones, divided into two groups: cranial and facial bones. The size, shape and growth of the human skull are the product of many interrelated internal and external factor interactions. The purpose of the present study was to explore the systematic differences in cephalofacial size and shape classification between two measured groups of different ages and different periods of done measurements. Five cephalofacial variables and four cephalofacial indexes were measured on 795 entities of the Kosovo Albanian population in two different timelines; 401 male entities aged 20–30 years old were measured during the timeline 1997-1999, while 394 male entities aged 18 years old were measured during the timeline 2016-2018. The gained data were analyzed in terms of basic descriptive statistical parameters and the percentage of distribution of results. The most pronounced differences between the age groups of 18 year-olds and the age group of 20-30 year-olds, are mainly emphasized in the morphological height of the face, total facial index and transverse cephalic index. While in other dimensions, the distribution of results is very similar. Differences between groups can be justified by the age at which the growth of the cephalofacial bones ends and the influence of external factors such as nutritional and socio-economic factors.

KEY WORDS: Head length; Morphological face height; Cephalic indexes; Total face index.

INTRODUCTION

From the ethno-anthropological point of view, the chronological study of the nations anthropological status helps compare the anthropological features between nations in different period of time. Also, the common position of the ethno-anthropologists is that the information collected from the measurement of the human head/skull (cephalo/craniofacial variables) enables a more reliable study of the anthropological status of nations (Coon, 1939; Ylli, 1975; Dhima, 1985). The anthropometric method of cephalometry is used in identification, forensic medicine, clinical diagnosis, plastic surgery, oral and maxillofacial surgery, orthodontics, archaeology and ethno-anthropology (Rexhepi & Brestovci, 2014).

The human bones development begins in the embryo’s mesenchyme and occurs through two processes: endochondral and intramembranous osteogenesis. While endochondral ossification is responsible for developing long and short bones, intramembranous ossification is responsible for the development of flat and irregular bones (Jin et al., 2016). The human head/skull is a bony structure comprised of many flat and irregular bones, joined by sutures, which are divided into two groups: cranial (neurocranium) and facial bones (visceral cranium). The size, shape and growth of this bony structure are the product of many, still not fully understood, interrelated internal and external factor interactions such as phylogenetic, developmental, functional (Lieberman et al., 2000), racial and ethnic affiliation (Morton, 1839; Enlow, 1968; Yokota, 2005), climate and environmental factors (Morton; Radovic et al., 2000; Buretic-Tomiljanovic et al., 2007), socio-economic factors (Eder, 1995), nutritional factors (Shils & Shike, 2005) and genetic influences (Rexhepi & Meka, 2008; Vijay Kumar et al., 2012).

While the cranium grows quickly during a child’s early development (causing neurocranial morphological changes in size and shape), the facial bones grow much slower and are responsible for changing the form of the skull/head throughout a person’s life (Scheuer & Black, 2004).
This bone structure development process starts between the 23rd and 26th days of gestation; meanwhile, the skull sutures commence closing from age 22 onward.

According to Krogman (1962), the assessment of suture closure may be used as a predictor criterion for age estimation of the entity.

This study aims to explore the systematic differences in cephalofacial size and shape classification between two measured groups of different ages and different period of done measurements.

MATERIAL AND METHOD

Research design. The study data are derived from the national project titled "Morphological characteristics of Kosovo Albanian population", which has been accomplished by the Institute of Sports Anthropology (INASP) in Pristina, Kosovo. This research has a cross-sectional exploratory and descriptive nature.

Site of study and sampling. The measurements were done on 795 entities of the Kosovo Albanian population in two different timelines; 401 male entities aged 20–30 years old have been measured during the timeline 1997-1999, while 394 male entities aged 18 years old have been measured during the timeline 2016-2018. Sample selection of entities was chosen randomly, always respecting the rule that their psycho-physical, dental and soft tissue condition were in the normal range.

Measuring tools and data collection. Respecting the International Biological Program protocols, five cephalofacial variables have been measured by the professional measuring team of the INASP, using professional anthropometrical instruments (anthropological cephalometer, anthropometric tape, as well as sliding compass) with accuracy of 1 mm:

- G-Op (glabella-opistocranium) – head length;
- Eu-Eu (eurion-eurion) – head width;
- V-Po (vertex-porion) – head height;
- N-Gn (nasion-gnathion) – morphological face height;
- Zy-Zy (bizygomatic) – Maximal facial breadth;

The differentiates between two groups regarding the distribution of the particular cephalofacial types (according to Martin-Saller scale) were analyzed in terms of four cephalofacial indexes:
- Horizontal cephalic index (HCI) - shows the ratio of the maximum width of the head (Eu-Eu) to its maximum length (G-Op) multiplied by 100 (HCI = (eu-eu / g-op) x 100).
- Vertical cephalic index (VCI) – shows the ratio of the maximum height of the head to its maximum length multiplied by 100 ((v-po / g-op) x 100);
- Transverse cephalic index (TCI) – shows the proportion of the maximum head height to its maximum breadth multiplied by 100 ((v-po / eu-eu) x 100);
- Total facial index (TFI) – shows the relation of the morphological height of the face to its maximum breadth ((n-gn / zy-zy) x 100).

Data analysis. The gained data were analyzed in terms of basic descriptive statistical parameters. According to their cephalofacial characteristics, the entities categorization was done based on the distribution of their values according to the respective scale (Lebzelter-Saler scale, Routil scale). Comparisons of cephalofacial characteristics were determined by systematic differences between two groups of entities based on the basic descriptive parameters and the percentage of distribution of results.

Ethical considerations. This project was approved by the Ethics Committee of the Institute of Sports Anthropology.

RESULTS AND DISCUSSION

Table I shows the basic statistical parameters findings (Mean, Min. and Max. values, and SD) for the measured cephalofacial variables of both treated groups. While the mean values of the data indicate systematic differences between groups of measured subjects, the low values of Standard Deviation indicate the normal distribution of the measured variables mainly concentrated near their mean values.

The measured groups realize systematic differences in almost all the measured variables. The 18-year-old age group compared to the 20-30 age group shows higher average values in the variables that inform about the length and height of the head and the horizontal and vertical cephalic index.

The classification data of the two measured groups (Table II) regarding cephalofacial dimensions, always respecting the correspondent scale, are listed as follows:

- Head length (G-Op): age group 20-30 years old is mainly characterized by the long head (48.9 %) and medium-long head (28 %), compared to age-group 18 years old which is primarily characterized by the long head (45.69 %) and very long head (31.47 %);
- Head width (Eu-Eu): Both measured groups are characterized by wide and medium head (age-group 20-30 years old: 49.6%, 32.9%; age-group 18 years old: 40.36%, 42.39%); 
- Regarding the head height dimension (V-Po), both groups are mainly characterized by the medium high head and low head (age-group 20-30 years old: 45.9%, 26%; age-group 18 years old: 41.37%, 37.82%); 
- Regarding the face width (Zg-Zg), the age group 20-30 years old is characterized with the medium-large face (43.6%) and narrow face (22%), while the 18-year-old age group is characterized with the medium-large face (52.54%) and large face (26.65%); 
- The morphological facial height (N-Gn) does the most pronounced differentiation between the two measured groups. Age group 20-30 years is characterized by moderately high face (33.7%) and high face (30.2%), while the age group 18 years is characterized by high face (37.31%) and very high face (32.74%).

Based on cephalofacial indices (Table III), a relatively similar distribution of results can be observed when it comes to horizontal cephalic index (HCI) and vertical cephalic index (VCI), compared to transverse cephalic index (TCI) and the total facial index (TFI). Most of the tested subjects of both groups are characterized by Brachycephalic, and Low Hypsicephalic heads. Meanwhile, in terms of the transverse cephalic index (TCI), the age group 20-30 years old is characterized by a Tapeinocephalic (66.6%) head type and with a Leptoproso (31.3%) and Hyperleptoproso (28.3%) face type (a low, flattened skull and with a long narrow face), in contrast to the age group 18 years old which is characterized by the Metroicephalic head type (50.25%) and the Euryproso (35.28%) – Mesoproso (30.71%) face type (Fig. 1).

Based on the data of the above tables, we can conclude that the most pronounced differences between the age group 18 years old and the age group 20-30 years old are mainly emphasized in the morphological height of the face, total facial index and transverse cephalic index. While in other dimensions, the distribution of results is very similar.

Differences between groups can be justified by the age at which the growth of the cephalofacial bones ends and the influence of external factors.

The fact that facial bones grow more slowly and end up growing later, compared to the bones of the head, made them even more responsible for changing the shape of the head during life (Scheuer & Black). Among the external factors influencing the shape of the head and the general morpho-functional development are undoubtedly the nutritional factors and socio-economic factors. The 20-year time difference of cephalofacial measurements made between the two groups and the major socio-economic changes that have occurred in post-war Kosovo, in 1999, within this period reinforce the influence of these external factors.

![Fig. 1. The figurative appearance of different types of horizontal cephalic index and total facial index.](image-url)
Table II. Classification of the measured subjects based on the cephalofacial dimensions.

| Head Length G-Op (Lebzelter-Saler scale) | Age-group: 20-30 years old | 18 years old |
|-----------------------------------------|---------------------------|--------------|
| Scale-Value                            | N\textsuperscript{o} entities | % | N\textsuperscript{o} entities | % |
| Very short head                        | x–169                             | 1     | 0.20   | 3     | 0.76 |
| Short head                             | 170–177                           | 16    | 4.00   | 10    | 2.54 |
| Medium long head                       | 178–185                           | 113   | 28.00  | 77    | 19.54 |
| Long head                              | 186–193                           | 196   | 48.90  | 180   | 45.69 |
| Very long head                         | 194<                               | 76    | 18.70  | 124   | 31.47 |
| Head Width Eu-Eu (Lebzelter-Saler scale) |                       | | | | |
| Very narrow head                       | > 139                              | 4     | 1.00   | 1     | 0.25 |
| Narrow head                            | 140–147                            | 11    | 2.70   | 31    | 7.87 |
| Medium large head                      | 148–155                            | 132   | 32.90  | 167   | 42.39 |
| Large head                             | 156–163                            | 199   | 49.60  | 159   | 40.36 |
| Very large head                        | 164<                               | 55    | 13.70  | 36    | 9.14 |
| Head Height V-Po (Routil scale)        |                       | | | | |
| Very low head                          | x–109                              | 14    | 3.50   | 40    | 10.15 |
| Low head                               | 110–117                            | 103   | 26     | 149   | 37.82 |
| Medium high head                       | 118–125                            | 184   | 45.90  | 163   | 41.37 |
| High head                              | 126–133                            | 81    | 20.20  | 37    | 9.39 |
| Very high head                         | 134<                               | 19    | 4.70   | 5     | 1.27 |
| Face Width Zg-Zg (Lebzelter-Saler scale) |                               | | | | |
| Very narrow face                        | > 127                              | 61    | 15.20  | 11    | 2.79 |
| Narrow face                            | 128–135                            | 90    | 22     | 65    | 16.50 |
| Medium large face                      | 136–143                            | 175   | 43.60  | 207   | 52.54 |
| Large face                             | 144–151                            | 72    | 18.00  | 105   | 26.65 |
| Very large face                        | 152<                               | 3     | 0.70   | 6     | 1.52 |
| Very low face                          | > 111                              | 19    | 4.70   | 3     | 0.76 |
| Low face                               | 112–117                            | 73    | 18.20  | 22    | 5.58 |
| Medium high face                       | 118–123                            | 135   | 33.70  | 93    | 23.60 |
| High face                              | 124–129                            | 121   | 30.20  | 147   | 37.31 |
| Very high face                         | 130<                               | 53    | 13.20  | 129   | 32.74 |

Table III. Cephalofacial indexes (Martin-Saller scale).

| Age-group 20-30 years old | HCl | Scale-Value | N\textsuperscript{o} entities | % | Age-group 20-30 years old |
|---------------------------|-----|-------------|-------------------------------|---|---------------------------|
| Age-group 20-30 years old |     | Scale-Value | N\textsuperscript{o} entities | % | Age-group 20-30 years old |
| Dolichocephalic           | 71.0–75.9 | 10          | 2.5  | 18  | 4.57 |
| Mesoecephalic             | 76.0–80.9 | 82          | 20.4 | 146 | 37.06 |
| Brachycephalic            | 81.0–85.9 | 206         | 51.4 | 176 | 44.67 |
| Hyperbrachycephalic       | 86.0–90.9 | 99          | 24.7 | 54  | 13.71 |
| Ultrabrachycephalic       | 91.0–x   | 4           | 1    | 18  | 4.57 |
| VCI                       | x–57.9   | 11          | 2.7  | 1   | 0.25 |
| Chamaecephalic            | 58.0–62.9 | 129         | 32.2 | 52  | 13.20 |
| Orthocephalic             | 63.0–67.9 | 192         | 47.9 | 198 | 50.25 |
| Low Hypsicephalic         | 68.0–72.9 | 65          | 16.2 | 128 | 32.49 |
| Moderate Hypsicephalic    | 73.0–x   | 4           | 1    | 15  | 3.81 |
| High Hypsicephalic        | >78.9    | 267         | 66.6 | 96  | 24.37 |
| TCI                       | 79.0–84.9 | 111         | 27.7 | 216 | 54.82 |
| Tapeinocephalic           | 85.0<    | 23          | 5.7  | 82  | 20.81 |
| Metriocephalic            | x–78.9   | 8           | 2    | 59  | 14.97 |
| Acrocephalic              | 79.0–83.9 | 58          | 14.5 | 139 | 35.28 |
| TFI                       | 84.0–87.9 | 96          | 23.9 | 121 | 30.71 |
| Hyperleptoprosop          | 88.0–92.9 | 126         | 31.3 | 54  | 13.71 |
| Hyperleptoprosop          | 93.0–x   | 114         | 28.3 | 21  | 5.33 |
This study confirms cephalofacial morphometric differences between the age group 18 years and the age group 20-30 years. For a more concrete explanation of these findings, of course, longitudinal research will have to be done. Regular periodic measurements will precisely highlight the period when the cephalofacial morphometric dimensions change from the age of 18 to the age of 25. Such a longitudinal study will be our next goal.

RESUMEN: El cráneo humano está compuesto por huesos planos e irregulares, divididos en dos grupos: huesos craneales y faciales. El tamaño, la forma y el crecimiento del cráneo humano son el producto de muchas interacciones de factores internos y externos interrelacionados. El propósito del presente estudio fue explorar las diferencias sistémicas en la clasificación de tamaño y forma cephalofacial entre dos grupos de diferentes edades y en diferentes períodos de mediciones. Se midieron cinco variables cephalofaciales y cuatro índices céfalo-faciales en 795 entidades de población albanesa de Kosovo en dos líneas de tiempo diferentes. Se midieron 401 entidades masculinas de 20 a 30 años. Durante el periodo 1997-1999 se midieron 401 entidades masculinas de 20 a 30 años, mientras que 394 entidades masculinas de 18 años se midieron durante el periodo 2016-2018. Los datos obtenidos se analizaron en términos de parámetros estadísticos descriptivos básicos y el porcentaje de distribución de los resultados. Las diferencias más pronunciadas entre los grupos de edad de 18 años y el grupo de 20-30 años, se enfatizan principalmente en la altura morfológica de la cara, índice facial total e índice cefálico transversal. Mientras que en otras dimensiones, la distribución de resultados es muy similar. Las diferencias entre grupos pueden estar asociadas a la edad en la que finaliza el crecimiento de los huesos céfalo-faciales y la influencia de factores externos, tal como aspectos nutricionales y socioeconómicos.

PALABRAS CLAVE: Longitud de la cabeza; Altura morfológica de la cara; Índices cefálicos; Índice facial total.

REFERENCES

Broadbent, B. H. & Golden, W. H. Bolton Standards of Dentofacial Developmental Growth. Saint Louis, Mosby, 1975.
Buretic-Tomljanovic, A.; Giacometti, J., Ostojic, S. & Kapovic, M. Sex-specific differences of craniofacial traits in Croatia: the impact of environment in a small geographic area. Ann. Hum. Biol., 34(3):296-314, 2007.
Coon, C. S. The Races of Europe. 2nd ed. New York, Macmillan Co., 1939, pp.293.
Dhima, D. H. A. Gjurmime Anthropologjike për Shqiptarët. Tirana, Akademia e shkencave e RPS të Shqipërisë, 1985. pp.28-9, 106-12, 126-8.
Eder, R. A. Craniofacial Anomalies: Psychological Perspectives. New York, Springer-Verlag, 1995, pp.68-71.

Enlow, D. H. The Human Face. An Account of the Postnatal Growth and Development of the Craniofacial Skeleton. New York, Hoeber Medical Division, Harper & Row, 1968.
Jin, S. W.; Sim, K. B. & Kim, S. D. Development and Growth of the Normal Cranial Vault: An Embryologic Review. J. Korean Neuropsy Soc., 59(3):192-6, 2016.
Krogman, W. M. The Human Skeleton in Forensic Science. Springfield, Charles C. Thomas, 1962.
Lieberman, D. E.; Ross, C. F. & Ravosa, M. J. The primate cranial base: ontogeny, function, and integration. An. J. Phys. Anthropol., Suppl. 31:117-69, 2000.
Morton S. G. Crania Americana, or, A Comparative View of the Skulls of Various Aboriginal Nations of North and South America. To Which is Prefixed an Essay on the Varieties of the Human Species. Philadelphia, J. Dobson, 1839.
Radovic, Z.; Muretic, Z.; Nemirovskij, V. & Gazi-Coklica, V. Craniofacial variations in a South Dalmatian population. Acta Stomatol. Croat., Vol. 34(4):399-403, 2000.
Rexhepi, A. & Meka, V. Cephalofacial morphological characteristics of Albanian Kosovo population. Int. J. Morphol., 26(4):935-40, 2008.
Rexhepi, A. M. & Brestovci, B. Neurocranial morphology of the Albanian Kosovo population. Int. J. Morphol., 32(1):97-100, 2014.
Scheuer, L. & Black, S. The Juvenile Skeleton. Burlington, Elsevier, 2004.
Shils, M. E. & Shike, M. Modern Nutrition in Health and Disease. 10th ed. Philadelphia, Lippincott Williams & Wilkins, 2005. pp.1155-67.
Vijay Kumar, A. G.; Agarwal, S. S. & Shivaramu, M. G. Fusion of Skull Vault Sutures in Relation to Age. A Cross Sectional Postmortem Study Done in 3rd, 4th & 5th Decades of Life. Chisinau, LAP Lambert Academic Publishing, 2012.
Ylli, A. Disa të Dhëna Kranimetrike. Tirana, Mihail Duri, 1975. pp.64-97.
Yokota, M. Head and facial anthropometry of mixed-race US Army male soldiers for military design and sizing: a pilot study. Appl. Ergon., 36(3):379-83, 2005.

Corresponding author:
Agron M. Rexhepi
Rr. Sali Butka
10000 Pristhina
KOSOVO

E-mail: agronmrrexhepi@gmail.com

Received: 22-04-2021
Accepted: 22-05-2021