Anthropometric Evaluation of Cranial Indexes

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ABSTRACT

Introduction: Craniometric measurements are used in anatomy, anthropometry and surgical fields, especially in maxillofacial and plastic surgery. The aim of this study was to investigate the cranial index values anthropometrically and to contribute to the literature data.

Material and methods: For this purpose, 30 cranium bones with unknown age and gender belonging to Anatomy Department, Faculty of Medicine and University of Cukurova were used.

Results: In this study, maximum cranial width, maximum cranial length, bizygomatic width, cranial height, upper face height and minimum frontal width were measured. The mean and standard deviation values of the measured values are; 139.15 ± 9.89, 172.20 ± 7.90, 125.24 ± 9.47, 126.07 ± 6.23, 65.07 ± 5.40, 95.33 ± 5.09 mm, respectively. By using these values, cranial index, transverse cranio - facial index, cranial height - width index, cranial height - length index, upper facial index and fronto - parietal index values were calculated. The mean and standard deviation of index values are 81.59 ± 5.60, 90.21 ± 6.69, 92.30 ± 6.16, 73.73 ± 3.79, 52.61 ± 5.52, 68.76 ± 4.86 mm, respectively.

Conclusions: The results of our study were classified and compared with the studies performed in different populations. We believe that the obtained data will contribute to the research and literature data in clinical areas.

Keywords: Cranium, Skull, Cranial Index, Anthropometry, Anatomy, Surgery

INTRODUCTION

Cranium is the head of the skeleton that is formed by twenty-two bones jointing each other. When one hyoid bone and three pairs of ear ossicles are added, they become twenty-nine in totally. Cranium is examined under two sub-headings according to their surrounding structures. The part that surrounds the brain is called neurocranium, and the part that surrounds the oral and nasal cavities is called splanchnocranium (viscerocranium). There are eight bones in the neurocranium surrounding the brain and fourteen bones in the splanchnocranium surrounding the face. These bones belong to flat and irregular bone groups. All the bones except the mandible bone are connected to each other by immobilized joints. The joints are called sutures. Some of the bones that consists the skeleton are involved in the structure of both neurocranium and splanchnocranium. The hyoid bone is actually a neck bone. It only has the same origin as the cranial bones.[1]

Anthropometry identifies the dimensions of the human body and provides information about growth and development. Morphological differences are influenced by genetic and environmental factors. In general, adult men have larger and stronger bones. As people get older, cranium bones become thinner. In these individuals; the bone marrow loses blood cells and adipose tissue and a gelatinous appearance occurs.[2] Cranial anthropometry is an increasingly important area for anatomists, anthropologists and plastic surgeons.[3-9] Besides metric measurements on the cranium, another method that provides information about the cranial morphology is cranial indexes. Cranial index calculation; is a method used to categorize human populations. In this study, craniometric measurements were made with the previously defined parametric values; and various index values were calculated with these measurements. These indexes provide information about the morphology of the head and face of the societies as well as the effects of various factors on the development of head and face. In addition, it is important in planning surgical procedures. The aim of this study was to investigate the cranial index values anthropometrically and to contribute to the literature data.

MATERIAL AND METHODS

In our study, 30 cranium whose age and sex were not known belonging to Cukurova University, Faculty of Medicine, Department of Anatomy were used. This study which has a descriptive and cross-sectional design. For statistical analysis of the data obtained in this study, the "Statistical Package for Social Sciences for Windows 20.0" program was used. Descriptive statistical methods (mean, standard deviation, frequency%, minimum, maximum value) were used to evaluate the study data. Measurements were made with caliper (0.1 mm). The parameters measured in our study are given in Figure 1.

Measured parameters

Maximum cranial width: Also called “the maximum transverse width”, it is the linear distance measured between the eurion points located on both parietal bones.

Maximum cranial length: In the sagittal plane, it is the largest distance measured between the glabella and the opisthocranion, which is the most protruding point on the occipital bone.

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Bizygomatic width: It is the linear distance measured between zygion points, which are the most lateral points on arcus zygomaticus.

Cranial height: The linear distance measured between basion and bregma points.

Upper face height: The distance between nasion and prosthion points.

Minimum frontal width: It is the smallest distance between the frontotemporale points on the temporal crest on the frontal bone.

Calculated index values

Cranial Index = Maximum Cranial Width ÷ Maximum Cranial Length × 100

This index, also called "Horizontal Cranial Index", is used to define the top view of the skull. Index classification and results are examined in seven categories[2,6-11], which are ultradolichocranial / very long (≤ 65), hyperdolichocranial / very long (65 - 69.9), dolichocranial / long (70 - 74.9), mesocranial / medium (75 - 79.9), brachycranial / round (80 - 84.9), hyperbrachycranial / very round-short (85 - 89.9), ultrabrachycranial / very round / short (≥ 90).

Transverse Cranio - Facial Index = Bizygomatic Width ÷ Maximum Cranial Width × 100

The index value is evaluated in two categories.[5] These are criptozygy (≤ 99.9), phenozygy (≥ 100).

Cranial Height - Width Index = Cranial Height ÷ Maximum Cranial Width × 100

This index is used to define the relationship between the height and width of the skull. Index values are examined in three categories[3,8,12,13], which are tapeinocrane / low (≤ 92), metriocrane / medium (92 - 97.9), acrocrane / high (≥ 98).

Cranial Height - Length Index = Cranial Height ÷ Maximum Head Length × 100

This index is used to define the relationship between the height and length of the skull. Index values are examined in three categories[4,14,15], which are chamaecrane / low (≤ 70), orthocrane / medium (70 - 74.9), hypsicrane / high (≥ 75).

Upper Facial Index = Upper Face Height ÷ Bizygomatic Width × 100

This index provides information on the relationship between the height of the upper face and the width of the face and the shape of the upper face. Calculated index values are examined in five categories[2,13], which are hypereuryene / very wide / low (≤ 45), euryene / wide / low (45 - 49.9), mesene / medium (50 - 54.9), leptene / narrow / high (55-59.9), hyperleptene / very narrow / high (≥ 60).

Transverse Fronto-Parietal Index = Minimum Frontal Width ÷ Maximum Cranial Width × 100

This index is used to define the relationship between frontal and cranial width. Index values are examined in three categories[14], which are sthenometopia / narrow forehead (≤ 66), metriometopia / middle face (66 - 68.9), eurymetopia / wide forehead (≥ 69).

Parameters	Mean ± Standard Deviation (mm)
Maximum Cranial Width	139.15 ± 9.89
Maximum Cranial Length	172.20 ± 7.90
Bizygomatic Width	125.24 ± 9.47
Cranial Height	126.07 ± 6.23
Upper Face Height	65.07 ± 5.40
Minimum Frontal Width	95.33 ± 5.09

Table-1: Mean and standard deviation values of parameters

Index Values	Mean	Classification
Cranial Index	81.59	Brachycranial
Transverse Cranio - Facial Index	90.21	Criptozygy
Cranial Height - Width Index	92.30	Metriocrane
Cranial Height - Length Index	73.73	Orthocrane
Upper Facial Index	52.61	Mesene
Transverse Fronto - Parietal Index	68.76	Metriometopia

Table-2: Mean results and classification of index values

RESULTS

In our study, calculated index values were used to determine head types. Cranial index; brachycranial, transverse cranio - facial index; criptozygy, cranial height - width index; metriocrane, cranial height - length index; orthocrane, upper facial index; mesene and transverse fronto - parietal index determined that belongs to the metriometopia classification. The mean and standard deviation values of the measured

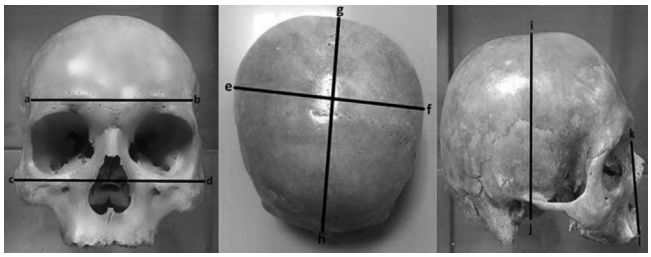

Figure-1: Measured parameters, a-b; minimum frontal width, c-d; bizygomatic width, e-f; maximum cranial width, g-h; maximum cranial length, i-j; cranial height, k-l; upper face height

Author	Population	Maximum Cranial Width	Maximum Cranial Length
Salve et al.[16]	India	136.61 ± 3.43	177.705 ± 7.32
Kenneth et al.[9]	Nigeria	140.28 ± 3	172.9 ± 2.8
Khan et al.[10]	Arabia	151.72 ± 6.33	188.03 ± 9.71
Shankar et al.[19]	India	-	214.3 ± 9.4
The present study	Turkey	139.15 ± 9.89	172.20 ± 7.90

Table-3: Maximum cranial width and maximum cranial length mean ± standard deviation (mm) values

Author	Population	Mean
Bilgin et al.[5]	Turkey (Erzurum)	82.77
		80.80
	Turkey (İznik)	81.31
		82.64
Kenneth et al.[9]	Nigeria	93.31
Basu et al.[2]	India	79.50
Shah et al.[18]	India	80.42
Raveendranath et al.[14] Bhargava et al.[3,4]	India India (Bhills) India (Barelas)	77.98 76.98 79.80
The present study	Turkey	81.59

Table-4: Cranial index values

Author	Population	Gender	Transvers Cranio Facial Index	Transvers Fronto Parietal Index	Upper Facial Index
Bilgin et al.[5]	Erzurum	Male	91.76	67.89	54.30
		Female	94.03	68.3	53.25
	İznik	Male	99.43	67.02	52.59
		Female	96.95	70.01	49.95
The present study	Turkey		90.21	68.76	52.61

Table-5: Transverse cranio-facial, transverse fronto-parietal and upper facial index values

Author	Population	Cranial Height Width Index	Cranial Height Length Index
Salve et al.[16]	India	95.67 ± 5.26	73.56
Rexhepi et al.[15]	Kosovo	77.14	64.41
		75.22	63.72
Dubey et al.[6] Saharma et al.[20]	India India	71.26 107.02 ± 1.20 81.74 ± 1.06	76.80 - -
The present study	Turkey	92.30 ± 6.16	73.73

Table-6: Cranial height - width and cranial height-length index values

parameters are shown in Table 1. Calculated index values mean and standard deviation values are shown in Table 2.

DISCUSSION

A study conducted in 2013 showed that the mean and standard deviation values of the parameters were as follows: cranial height 130.68 ± 7.77 mm The maximum cranial width and the maximum cranial length results obtained in our study are similar to the literature data but Khan et al. and Shankar et al. showed that the values were found to be higher than our results.[10-17] These results are shown that Table 3. Upper face height values in the literature were found to be low compared to the results in our study. Some of these studies, Erden showed that the upper face height of males and females was 5.2 and 5.1 cm, respectively.[18] A study which was conducted in Turkish population reported the upper face height of males and females as 5.3 and 4.94 cm, respectively.[19] Also, upper face height value was calculated as 54.01 and 50.18 mm in the United States.[20] In our study, this value was found as 65.07 ± 5.40. The nearest values to our study belong to Önal's study in Turkish population; the upper face height for Turkish males and females as 7.52 cm and 7.85 cm, respectively. The mean value was 7.76 ± 0.635 cm.[12] A study which conducted in Nigeria showed that the cranial index value was found to be higher than our results. Among the cranial index value studies in the literature, results showed that the similarities when compared to our values.[2,6-11] These results are shown in Table 4. Bilgin et al. compared the populations of Erzurum and Iznik. While the transverse cranio-facial index value in the Iznik population was found to be higher than our results, the other index results were in close proximity with our results.[2] This results are shown that Table 5. Compared to our study; Salve et al. and Saharma et al. showed that the cranial length index and height index values were found to be parallel and Rexhepi et al. and Dubey et al. showed that these results were found to be lower.[4,14,15,21] These results are shown in Table 6. Sengupta S. studied cranial height-width index and cranial height-length index in India. In the study, the mean cranial height-length index values were: 72.43 ± 1.36 for Koch; 64.45 ± 0.51 for Rabha; 64.31 ± 0.53 for Garo; 69.71 ± 0.56 for Kachari; 72.02 ± 0.79 for Lalung and 68.18 ± 0.56 for Mikir. In the study, mean cranial height - width index values were: 92.39 ± 1.77 for Koch; 85.53 ± 0.71 for Rabha; 85.33 ± 0.69 for Garo; 88.01 ± 0.73 for Kachari; 91.65 ± 1.11 for Lalung and 86.78 ± 0.69 for Mikir. In our study, cranial height - width index was found as 92.30, and cranial height-length index

was found as 73.73.[22] In the study performed by Yesmin et al., the mean and standard deviation value of bizygomatic width was found as 127.3 ± 8.0 mm. It shows parallelism with our results.[5] In a study conducted by Gabarre-Mir et al., the relationship between morphological structure of arcus zygomaticus and some psychological features was investigated. Subjects were separated into two groups according to pre-determined scales and self-sufficiency level measurement and skill research results. As a result, in terms of the bizygomatic width, the mean and standard deviation values were 137.05 ± 7 and 124.38 ± 6.52 mm, respectively.[23]

CONCLUSION

The organs responsible for eye and vision, nose and odor, chewing and tasting, swallowing, vocalization and speech, hearing and balance are established in the head area with their very complex structures. Many of these clinical problems are directly related to their anatomical structures. Diagnosis and treatment are impossible without anatomical knowledge. This research can be useful for clinical and research purposes for anatomists, anthropologists, forensic medicine experts, neurosurgeons, plastic surgeons.

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