GEORGIAN MEDICAL NEWS

ISSN 1512-0112

NO 7-8 (352-353) Июль-Август 2024

ТБИЛИСИ - NEW YORK

ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

Monthly Georgia-US joint scientific journal published both in electronic and paper formats of the Agency of Medical Information of the Georgian Association of Business Press. Published since 1994. Distributed in NIS, EU and USA.

GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

GEORGIAN MEDICAL NEWS
No 7-8 (352-353) 2024

Содержание:

GEORGIAN MEDICAL NEWS
No 7-8 (352-353) 2024

INDIVIDUAL ANATOMICAL VARIABILITY OF THE SKULL`S FACIAL SECTION CONSIDERING GENDER AND CRANIOTYPE BASED ON COMPUTED TOMOGRAPHY DATA

Sosonna L[1], Ohurtsov O[2], Piriatinska N[3], Vdovitchenko V[1], Seleznova R[4], Kolba O[2], Gryzodub D[2], Rozhkova O[3], Shevtsov O[1].

[1]*Kharkiv National Medical University, Kharkiv, Ukraine.*

[2]*Kharkiv National University named after V.N. Karazin, Kharkiv, Ukraine.*

[3]*Kyiv Medical University, Kyiv, Ukraine.*

[4]*American-Ukrainian Concordia University, Kyiv, Ukraine.*

Abstract.

The study of individual anatomical variability has long attracted attention, with this topic being widely covered in the works of both domestic and foreign scientists.

The aim of our work is to study the individual anatomical variability of the facial section of the skull, taking into account gender and craniotype, based on computed tomography data.

Material and Methods. The material for our study consisted of 80 results from computed tomography (CT) scans of the human head, without any existing pathologies of the bone tissue.

Results. Brachycrania was established in males with a cranial index ranging from 80.6 to 92.4 (with $\bar{x} = 86.68$, $\sigma = 3.20$, and $m\bar{x} = 0.91$), and in females from 80.2 to 88.3 (with $\bar{x} = 84.32$, $\sigma = 2.81$, and $m\bar{x} = 0.77$). Similarly, mesocrania was confirmed by our data, with males showing a range from 76.8 to 79.2 (with $\bar{x} = 77.93$, $\sigma = 1.72$, and $m\bar{x} = 0.68$), and females from 75.6 to 79.1 (with $\bar{x} = 77.12$, $\sigma = 1.74$, and $m\bar{x} = 0.59$). Dolichocrania presented a variability range of cranial index values in adult males from 71.8 to 74.6 (with $\bar{x} = 73.80$, $\sigma = 1.52$, and $m\bar{x} = 0.63$), and in females from 72.2 to 73.9 (with $\bar{x} = 72.67$, $\sigma = 1.48$, and $m\bar{x} = 0.59$).

Conclusions. The individual anatomical variability of the facial section of the skull, taking into account gender and craniotype, based on computed tomography data was detected. Cranial profile characteristics of the facial skeleton are dependent on both gender and on the existing craniotype. We were able to establish clear differences between male and female skulls, particularly in terms of overall linear dimensions, the shapes of lateral polygons, and profilograms. A clear description of the brachycranial, mesocranial, and dolichocranial craniotypes was obtained, along with their relationships to other existing skull types.

Key words. Cranial index, computer tomography, Height-length index, height-breadth index.

Introduction.

The study of individual anatomical variability has long attracted attention, with this topic being widely covered in the works of both domestic and foreign scientists [1]. Most of such research was conducted on cadaveric material, which has many drawbacks [2].

A new phase of research into individual anatomical variability is linked to the rapid development of modern research methods, one of which is computed tomography (CT) [3,4]. CT has become routinely incorporated into the diagnostic protocols for most acute and chronic diseases [5]. The CT era significantly expands not only the range of diagnostic methods but also allows detailed study of specific parts of the human body based solely on CT data [6]. Moreover, CT is a relatively simple, non-invasive, and highly informative method [7]. CT studies allow for detailed examination of structures by viewing the area of interest in axial projection [8], constructing coronal image reconstructions, and even creating 3D models for further structure detailing [9].

One of the anatomical areas of greatest interest to scientists is the skull. This interest is driven by the complex configuration of its structures and the need for a comprehensive evaluation of the spatial relationships between the cranial and facial sections [10]. Interest in studying the skull may also be due to the prevalence of skull pathologies and the frequency of injuries that require surgical interventions for correction.

It is impossible to study the craniometric characteristics [11] of the facial skull without a detailed analysis of its relationship to the cranial section, vault, and base, and the skull as a whole. This includes the morphometric and osteometric dependence of the facial section on the shape, size, overall and partial indices, and various craniometric indicators of other parts of the skull.

Considering the above, **the aim of our work** is to study the individual anatomical variability of the facial section of the skull, taking into account gender and craniotype, based on computed tomography data.

Materials and Methods.

The material for our study consisted of 80 results from computed tomography (CT) scans of the human head, without any existing pathologies of the bone tissue. These results were collected from medical diagnostic centers based on cooperation agreements with the Department of Human Anatomy, Clinical Anatomy, and Operative Surgery at KhNMU. For the study, we selected representatives of both genders (59 males and 56 females) who were of mature age, specifically: men aged 22 to 60 years (average age 31 years) and women aged 21 to 55 years (average age 28 years).

Craniometric analyses of the CT scan results were conducted using measurement tools within specialized software programs designed for analyzing tomograms and constructing three-dimensional reconstructions. Licensed versions of these programs are always available on the CT scanner and allow for the acquisition of metric characteristics of the cranial base with high precision. The programs used in our work included Ez3D Plus 3D, DICOM Vidar Dicom Viewer, and eFilmLite. A demonstration of how these programs function is presented in Figure 1.

Figure 1. *The software used for conducting craniometric analysis of CT scan results includes:*
- Vidar Dicom Viewer – shown at the top.
- Ez3D Plus – shown at the bottom.

These programs facilitate the analysis and measurement of cranial structures, enabling precise craniometric assessments from the CT images.

The primary method for determining craniotypes in craniology involves calculating a series of indices that have well-defined ranges and are widely used in studies focused on establishing signs of individual anatomical variability. According to the recommendations presented in classical monographs, the following indices should be calculated:

Cranial Index: This index is the ratio of the width to the length of the skull. It allows for the classification of craniotypes as follows [12]:

1. Dolichocranial: Cranial index of 74.9 or less.
2. Mesocranial: Cranial index ranging from 75.0 to 79.9.
3. Brachycranial: Cranial index of 80.0 or more.

$$Ind_{cran} = \frac{\text{Transverse size of the skull (width) } (eu{-}eu_1)}{\text{Longitudinal size of the skull (length) } (gl{-}op)} \times 100;$$

Height-Length Index– is the ratio of the height to the length of the skull, allowing for the classification of craniotypes as follows [13]:

1. Hamecranic: Height-length index of less than 70.0.
2. Orthocranic: Height-length index ranging from 70.0 to 74.9.
1. Hypsicranic: Height-length index of 75.0 or more.

$$Ind_{H/L} = \frac{\text{height of the skull } (b{-}ba)}{\text{length of the skull } (g{-}op)} \times 100;$$

Height-Breadth Index is the ratio of the height to the width of the skull, which allows for the classification of craniotypes as follows [14]:

1. Tapeynocranic: Height-breadth index of 91.9 or less.
1. Metriocranic: Height-breadth index ranging from 92.0 to 97.9.
1. Akrocranic: Height-breadth index of 98.0 or more.

$$Ind_{H/B} = \frac{\text{height of the skull } (b{-}ba)}{\text{maximum width of the skull } (eu{-}eu)} \times 100;$$

The statistical analysis was performed using methods of variation statistics. The normality of the distribution was assessed using the Shapiro-Wilk test, which indicated that the samples were close to a normal distribution. The statistical data are presented in the format M±σ, where M is the arithmetic mean, σ is the standard deviation, and Student's t-test was applied. Correlation analysis was conducted using Spearman's rank correlation coefficient. A statistical difference between the

examined parameters was considered significant at p less than 0.05.

Results.

According to our data, the largest group of skulls studied consisted of representatives with a brachymorphic head structure, also known as brachycranic, totalling 59 specimens - 30 males and 29 females. The intermediate group in terms of size was the mesomorphic type - mesocranic, consisting of 40 observations (20 males and 20 females). The smallest group was the dolichomorphic type - dolichocranic, with only 16 specimens, including 9 males and 7 females.

Interestingly, this distribution of craniotypes among adult human skulls is quite characteristic for our country. The general data on cranial index measurements are provided in Table 1.

Table 1. *Individual Values of the Cranial Index in Adults.*

Cranial Index / Craniotype	Male	Female
Brachycephalic	80,6-92,4	80,2-88,3
Mesocephalic	76,8-79,2	75,6-79,1
Dolichocephalic	71,8-74,6	72,2-73,9

To clarify the existing differences in cranial index values among adults, a statistical analysis of this parameter was conducted, and the results are presented in Table 2.

Table 2. *Statistical indicators of the cranial index of a person of mature age.*

Indicator / Craniotype	Male			Female		
		σ	$m_{\bar{x}}$		σ	$m_{\bar{x}}$
Brachycephalic	86,68	3,20	0,91	84,32	2,81	0,77
Mesocephalic	77,93	1,72	0,60	77,12	1,74	0,59
Dolichocephalic	73,80	1,52	0,63	72,67	1,48	0,59

Based on the calculated cranial index for all parts of the specimen collection and CT study results, brachycrania was established in males with a cranial index ranging from 80.6 to 92.4 (with $\bar{x}$ = 86.68, σ = 3.20, and $m_{\bar{x}}$ = 0.91), and in females from 80.2 to 88.3 (with $\bar{x}$ = 84.32, σ = 2.81, and $m_{\bar{x}}$ = 0.77). Similarly, mesocrania was confirmed by our data, with males showing a range from 76.8 to 79.2 (with $\bar{x}$ = 77.93, σ = 1.72, and $m_{\bar{x}}$ = 0.68), and females from 75.6 to 79.1 (with $\bar{x}$ = 77.12, σ = 1.74, and $m_{\bar{x}}$ = 0.59). Dolichocrania presented a variability range of cranial index values in adult males from 71.8 to 74.6 (with $\bar{x}$ = 73.80, σ = 1.52, and $m_{\bar{x}}$ = 0.63), and in females from 72.2 to 73.9 (with $\bar{x}$ = 72.67, σ = 1.48, and $m_{\bar{x}}$ = 0.59).

Based on the results of craniotyping according to the cranial index, the sample was divided into three groups: brachycranics, mesocranics, and dolichocranics, with a distinct quantitative distribution and average values that clearly differentiated each group. This distribution confirms the quality and high degree of validity of the selected material.

In parallel, the height-length index of the skull was calculated (Table 3), showing a certain range of variability, along with the computed statistical indicators of this index (Table 4).

According to our data, in brachycranics, the height-length index of the skull ranges from 68.8 to 74.8 (with $\bar{x}$ = 72.66, σ = 2.85, and $m_{\bar{x}}$ = 0.91) in males, and from 67.7 to 73.6 (with $\bar{x}$ = 71.72, σ = 2.16, and $m_{\bar{x}}$ = 0.87) in females.

Table 3. *Individual Values of the Height-to-Length Index in Adults.*

Height-to-Length Index / Craniotype	Male	Female
Brachycephalic	68,8-74,8	67,7-73,6
Mesocephalic	72,4-76,3	73,2-75,9
Dolichocephalic	76,9-79,8	77,4-81,9

Table 4. *Statistical Indicators of the Height-to-Length Index in Adults.*

Indicator / Craniotype	Male			Female		
		σ	$m_{\bar{x}}$		σ	$m_{\bar{x}}$
Brachycephalic	72,66	2,85	0,91	71,72	2,16	0,87
Mesocephalic	73,18	2,68	0,64	74,60	2,31	0,48
Dolichocephalic	77,98	1,72	0,38	78,80	1,36	0,42

For mesocranics, the characteristic range of variability for this index is from 72.4 to 76.3 (with $\bar{x}$ = 73.18, σ = 2.68, and $m_{\bar{x}}$ = 0.64) in males, and from 73.2 to 75.9 (with $\bar{x}$ = 74.6, σ = 2.31, and $m_{\bar{x}}$ = 0.48) in females.

For dolichocranics, the height-length index ranges from 76.9 to 79.8 (with $\bar{x}$ = 77.98, σ = 1.72, and $m_{\bar{x}}$ = 0.38) in males, and from 77.4 to 81.9 (with $\bar{x}$ = 78.8, σ = 1.36, and $m_{\bar{x}}$ = 0.42) in females.

Analyzing these data, it can be concluded that both brachycranics and mesocranics typically exhibit a medium skull shape according to the height-length index, which corresponds to the orthocranic craniotype. In contrast, dolichocranics tend to have narrower skull shapes, closer to the hypsicranic craniotype.

To gain a fuller understanding of the shape of the facial skull, the height-breadth index should also be considered, as it significantly refines the individuality of the studied objects (Tables 4 and 5).

Table 5. *Individual Values of the Height-to-Width Index in Adults.*

Height-to-Width Index / Craniotype	Male	Female
Brachycephalic	84,9-97,8	88,6-93,8
Mesocephalic	93,1-97,2	92,7-96,2
Dolichocephalic	105,6-110,4	98,1-100,8

Table 6. *Statistical Indicators of the Height-to-Width Index in Adults.*

Indicator / Craniotype	Male			Female		
		σ	$m_{\bar{x}}$		σ	$m_{\bar{x}}$
Brachycephalic	90,68	2,05	1,06	91,04	1,12	0,98
Mesocephalic	94,88	1,51	0,58	93,76	1,18	0,62
Dolichocephalic	108,38	1,28	0,66	99,82	1,08	0,56

Statistical indicators of the height-to-width index in adults were also calculated. (Table 6).

It has been established that in brachycranics, a classic broad and flattened skull shape is observed, with the average values for males being $\bar{x}$ = 90.68, σ = 2.05, and $m_{\bar{x}}$ = 1.06, and for females $\bar{x}$ = 91.04, σ = 1.12, and $m_{\bar{x}}$ = 0.98. This type of skull shape is referred to in craniology as tapeinocranic. Individuals with

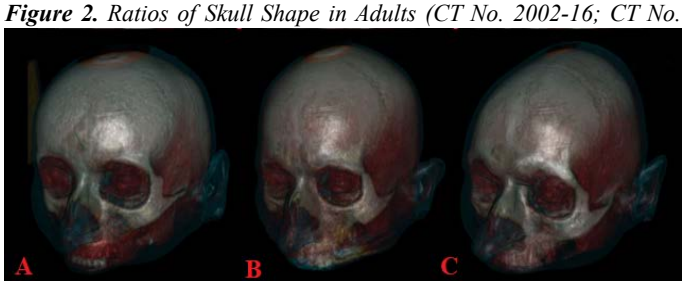
this skull type form a group called tapeinocranics, and their head shape is referred to as tapeinocephalic. In this case, brachycrania is combined with tapeinocrania (flattening of the head).

In mesocranics, a typical medium skull type is observed, with the arithmetic mean of the height-breadth index being $\bar{x} = 94.88$, $\sigma = 1.51$, and $m\bar{x} = 0.58$ in males, and $\bar{x} = 93.76$, $\sigma = 1.18$, and $m\bar{x} = 0.62$ in females. This corresponds to a metriocranic skull shape, which aligns with mesocephaly.

For dolichocranics, the average values of this index in adult males are $\bar{x} = 108.38$, $\sigma = 1.28$, and $m\bar{x} = 0.66$, and in females, $\bar{x} = 99.82$, $\sigma = 1.08$, and $m\bar{x} = 0.56$. These values indicate a narrow and elongated skull shape, known as acrocranic or acrocrania (narrowness of the head).

According to our data, there is a certain craniometric relationship between the mentioned cranial indices: the cranial index, the height-length index, and the height-breadth index. The larger the transverse dimensions of the skull, the smaller its height and length. The range of individual anatomical variability in the proportions of adult human skull shapes is shown in Figure 2.

Figure 2. *Ratios of Skull Shape in Adults (CT No. 2002-16; CT No. 1992-16; CT No. 1851-16): a – Brachycephalic, b – Mesocephalic, c – Dolichocephalic.*



Thus, brachycephaly is associated with hamycephaly or orthocephaly (according to the data of the height-to-length index) and with tapeinocrany (according to the data of the height-to-width index). Accordingly, mesocephaly has a craniological connection with orthocephaly and metriocephaly, while dolichocephaly is related to hypsicephaly and acrocephaly, which is schematically illustrated in Figure 3. These data are of particular significance for further study of the cranial profile of the facial section of the skull, as well as for establishing the natural range of variability within this age group.

An interesting fact is that a strong correlation is not found when studying the relationship between all indices. A weak negative correlation (-0.32) is observed when analyzing the height-length and height-breadth indices. A moderate positive correlation (0.63) is observed when studying the overall facial and specific facial indices. A very weak positive correlation is observed between the other indices.

Discussion.

One of the objectives of our study was to determine the relationships between various existing craniotypes, which can be established using craniometric indices. To address this issue, we initially classified the material based on the cranial index and then proceeded to calculate the height-length, height-breadth, overall facial, and specific facial indices, taking into account the previously identified brachycranial, mesocranial, and dolichocranial craniotypes (Figure 4).

Figure 3. *Types of the skull structure of a mature person (CT No. 2002-16; CT No. 1992-16; CT No. 1914-16; CT No. 1914-16; CT No. 1998-16; CT No. 2019-16; CT No. 1851-16; CT No. 1983-16; CT No. 2123; CT No. 1938-16).*

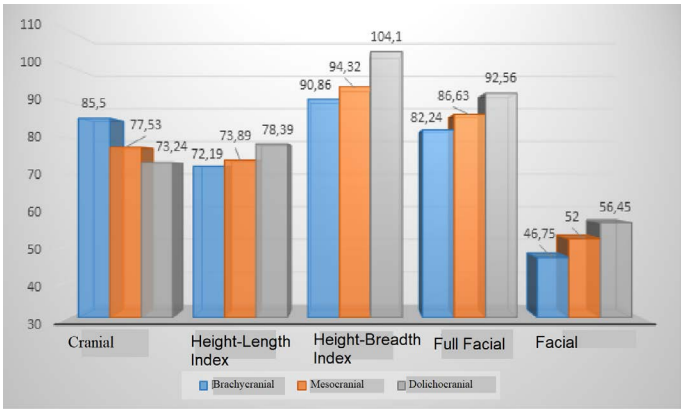


Figure 4. *Average values of craniometric indices (in percentages) among representatives of brachy-, meso-, and dolichocranial cranial types.*

This approach allowed us to analyse the connections between different skull types and their corresponding craniometric characteristics. By systematically calculating these indices, we were able to refine our understanding of how craniotypes relate to the dimensions and proportions of the skull and face. These findings contribute to a more detailed assessment of individual anatomical variability, which is essential for both diagnostic and anthropological purposes.

The presented values demonstrate a clear and consistent interrelationship between different skull types, allowing for the formulation of a characteristic set of features for each group. For brachycranics, the average height-length index corresponds to orthocrany, although a significant number of observations in this group showed pronounced chamaecrany (a flattened skull shape). The height-breadth index indicated tapeinocrany (a broad and flat skull), while facial indices suggested an euryprosopic (broad-faced) type of facial structure. Mesocranics were characterized by orthocrany with metriocrany (moderate skull height) and mesoprosopic (medium-faced) facial structure. In contrast, the dolichocranic skull type exhibited strong connections to hypsicrany (elongated skull), pronounced acrocrany (a narrow, elongated skull), and a leptoprosopic (narrow-faced) facial structure.

The overall linear dimensions of the skull and its facial section tend to be larger in men than in women, a conclusion supported by numerous morphologists [15,16]. These findings have significant relevance for various medical fields, such as otolaryngology, neurosurgery, ophthalmology, neurology, diagnostics, anatomy, dentistry, and pathology [17,18]. They emphasize early links between anatomical traits and the onset of pathological processes [19,20], particularly in complex disease mechanisms involving harmful factors, inflammation, and infections [21,22]. While advancements in medical technology have greatly improved treatment and diagnostics, traditional anatomical methods remain crucial. Future studies could build on these results, integrating new research techniques to further enhance both clinical and educational practices in medicine [23 24].

To summarize the material presented in the analysis of the obtained data, it is essential to note that the cranial profile characteristics of the facial skeleton are dependent on both sex and, even more so, on the existing craniotype. We were able to establish clear differences between male and female skulls, particularly in terms of overall linear dimensions, the shapes of lateral polygons, and profilograms. A clear description of the brachycranial, mesocranial, and dolichocranial craniotypes was obtained, along with their relationships to other existing skull types.

The data from this study have profound implications for various medical disciplines, including ear, nose, and throat medicine, neurosurgery, ophthalmology, neurology, diagnostics, anatomy, dentistry, and pathological anatomy. They highlight early correlations between anatomical characteristics and the development of pathological processes [24], particularly in complex disease mechanisms involving harmful factors, inflammation, and infections [25]. While new medical technologies offer significant advancements in treatment and diagnosis, traditional anatomical methods remain indispensable. Future research could expand upon these findings, incorporate new investigative approaches, and enhance the educational and clinical practices of medical professionals. Intensive development of image analysis technology last years [26] resulted in significant improvement of understanding of nature pathological processes in head regions [27,28] and their possible correction [29,30] with variable treatment [31]. Performed morphometric measures allow obtaining objective knowledge about human condition [32,33] as in our previously published work [34] that should be taken into account by doctoral activity [35].

Today, the concept of biological races is highly contested within anthropology and biology [36]. The genetic diversity within human populations does not map neatly onto traditional racial categories. Skull form, like other human traits, can show regional variation, but these variations are not sufficient to define discrete races. Instead, they are better understood as clinal, meaning they change gradually across geographic space rather than in distinct, categorical boundaries [37].

In forensic anthropology, skull measurements can sometimes help estimate ancestry, but they are probabilistic and not definitive [38]. Studies have shown that while certain skull traits may be more prevalent in one population versus another, there is a significant overlap, and the classifications are not clear-cut. This indicates that skull form does not strictly align with racial categories, but rather with broad regional patterns of ancestry [38].

Conclusion.

The individual anatomical variability of the facial section of the skull, taking into account gender and craniotype, based on computed tomography data was detected. Cranial profile characteristics of the facial skeleton are dependent on both gender and on the existing craniotype. We were able to establish clear differences between male and female skulls, particularly in terms of overall linear dimensions, the shapes of lateral polygons, and profilograms. A clear description of the brachycranial, mesocranial, and dolichocranial craniotypes was obtained, along with their relationships to other existing skull types.

Funding: This research received no external funding

Conflict of interest statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

REFERENCES

1. Domenech-Fernandez P, Yamane J, Domenech J, et al. Analysis of skull bone thickness during growth: an anatomical guide for safe pin placement in halo fixation. Eur Spine J. 2021;30:410-415.

2. Tatar İ, Huri E, Selçuk İ, et al. Review of the effect of 3D medical printing and virtual reality on urology training with 'MedTRain3DModsim' Erasmus + European Union Project. Turk J Med Sci. 2019;49:1257-1270.

3. Epperly E, Whitty JA. Equine Imaging: Computed Tomography Interpretation. Vet Clin North Am Equine Pract. 2020;36:527-543.

4. Baratt RM. Dental Radiography and Radiographic Signs of Equine Dental Disease. Vet Clin North Am Equine Pract. 2020;36:445-476.

5. Ruszkowski JJ, Zdun M, Arciszewski MB. Anatomy, digital radiography and cone-beam computed tomography of Western European hedgehog (Erinaceus europaeus) skull. BMC Vet Res. 2024;20:420.

6. Morani AC, Ramani NS, Wesolowski JR. Skull base, orbits, temporal bone, and cranial nerves: anatomy on MR imaging. Magn Reson Imaging Clin N Am. 2011;19:439-56.
7. Ramdat Misier KRR, Breakey RWF, Caron CJJM, et al. Correlation of Intracranial Volume With Head Surface Volume in Patients With Multisutural Craniosynostosis. J Craniofac Surg. 2020;31:1445-1448.
8. Sulong S, Alias A, Johanabas F, et al. Intracranial Volume Post Cranial Expansion Surgery Using Three-Dimensional Computed Tomography Scan Imaging in Children With Craniosynostosis. J Craniofac Surg. 2020;31:46-50.
9. Maeda J, Tanikawa C, Nagata N, et al. Comparison of 3-D mandibular surfaces generated by MRI and CT. Orthod Craniofac Res. 2022;25:351-358.
10. Wangaryattawanich P, Chavali LS, Shah KB, et al. Contrast-enhanced Reformatted MR Images for Preoperative Assessment of the Bridging Veins of the Skull Base. Radiographics. 2016;36:244-57.
11. Dias P, Neves L, Santos D, et al. CraMs: Craniometric Analysis Application Using 3D Skull Models. IEEE Comput Graph Appl. 2015;35:11-17.
12. Al-Shaqsi SZ, Rai A, Forrest C, et al. Standardization of Cranial Index Measurement in Sagittal Craniosynostosis. J Craniofac Surg. 2019;30:366-369.
13. Jayaratne YS, Deutsch CK, Zwahlen RA. Normative findings for periocular anthropometric measurements among Chinese young adults in Hong Kong. Biomed Res Int. 2013;2013:821428.
14. Ji C, Yao D, Li MY, et al. A study on facial features of children with Williams syndrome in China based on three-dimensional anthropometric measurement technology. Am J Med Genet A. 2020;182:2102-2109.
15. Alekseeva V, Nechyporenko A, Frohme M, et al. Intelligent Decision Support System for Differential Diagnosis of Chronic Odontogenic Rhinosinusitis Based on U-Net Segmentation. Electronics (Switzerland). 2023:12.000
16. Nechyporenko AS, Radutny R, Alekseeva VV, et al. Complex Automatic Determination of Morphological Parameters for Bone Tissue in Human Paranasal Sinuses. Open Bioinformatics J. 2021;14:130-7.
17. Chumachenko D. On intelligent multiagent approach to viral Hepatitis B epidemic processes simulation. In: Proceedings of the 2018 IEEE 2nd International Conference on Data Stream Mining and Processing (DSMP); 2018 Aug 21-25; Lviv, Ukraine. IEEE. 2018:415-419.
18. Chumachenko D, Piletskiy P, Sukhorukova M, et al. Predictive model of Lyme disease epidemic process using machine learning approach. Appl Sci (Basel). 2022;12:4282.
19. Kozko VM, Bondarenko AV, Gavrylov AV, et al. Pathomorphological peculiarities of tuberculous meningoencephalitis associated with HIV infection. Interv Med Appl Sci. 2017;9:144-149.
20. Behar JA, Bonnemains L, Shulgin V, et al. Noninvasive fetal electrocardiography for the detection of fetal arrhythmias. Prenat Diagn. 2019;39:178-187.
21. Gargin V, Radutny R, Titova G, et al. Application of the computer vision system for evaluation of pathomorphological images. 2020 IEEE 40th International Conference on Electronics and Nanotechnology, ELNANO 2020 – Proceedings. 2020:469-473.
22. Mpolokeng K, Luckrajh J, Avilova O. Accessory head of the semitendinosus muscle: an unusual variation. Folia Morphol (Warsz). 10.5603/FM.a2023.0037.
23. Nechyporenko AS, Nazaryan RS, Semko GO, et al. Application of spiral computed tomography for determination of the minimal bone density variability of the maxillary sinus walls in chronic odontogenic and rhinogenic sinusitis. Ukrainian journal of radiology and oncology. 2021;29:65-75.
24. Nechyporenko AS, Alekseeva VV, Sychova LV, et al. Anatomical prerequisites for the development of rhinosinusitis. Lek Obz. 2020;6:334-338.
25. Nechyporenko AS, Reshetnik VM, Alekseeva VV, et al. Implementation and analysis of uncertainty of measurement results for lower walls of maxillary and frontal sinuses. In: 2020 IEEE 40th International Conference on Electronics and Nanotechnology, ELNANO 2020 – Proceedings. 2020. 2020:460-463.
26. Krivenko S, Krylova O, Bataeva E, et al. Smart lossy compression of images based on distortion prediction. Telecommunications and Radio Engineering (English translation of Elektrosvyaz and Radiotekhnika). 2018;77:1535-1554.
27. Nazaryan R, Tkachenko M, Kovalenko N, et al. Analysis of local immunity indicators of the oral cavity and degree of gingivitis depending on mutation of CFTR gene in children with cystic fibrosis. Georgian Med News. 2019;296:27-31.
28. Gutarova N, Kryvenko L, Kovach I, et al. Features of the morphological state of bone tissue of the lower wall of the maxillary sinus with the use of fixed orthodontic appliances. Pol Merkur Lekarski. 2020;49:232-235.
29. Kovach I, Kravchenko L, Khotimska Y, et al. Influence of ozone therapy on oral tissue in modeling of chronic recurrent aphthous stomatitis. Georgian Med News. 2017;264:115-119.
30. Nazaryan RS, Kryvenko LS, Gargin VV. The role of nitric oxide synthase in the modulation of the immune response in atopic disease. The New Armenian Medical Journal. 2017;11:52-57.
31. Tkachenko M, Fomenko Y, Bondarenko A, et al. The use of miramistin in the treatment of chronic gingivitis in children with cystic fibrosis. Pharmacologyonline. 2021;3:398-404.
32. Shyian D, Avilova O, Bondareva A, et al. Organometric changes in thymus under the influence of propylene glycol. Georgian Med News. 2019;291:112-117.
33. Erokhina V, Avilova O. Ultramicroscopic changes of rats parathyroid glands and thymus after single administration of cyclophosphamide at the different periods of observation. Wiad Lek. 2019;72:362-367.
34. Sosonna L, Boiagina O, Yurevych N, et al. Individual anatomical variability of the anteroposterior lateral dimensions of the facial skull in mature adults. Georgian Med News. 2024;351:80-84.
35. Schenström A, Rönnberg S, Bodlund O. Mindfulness-based cognitive attitude training for primary care staff: A pilot study. Complement Health Pract Rev. 2006;11:144-152.

36. Butterfield JT, Golzarian S, Johnson R, et al. Racial disparities in recommendations for surgical resection of primary brain tumours: a registry-based cohort analysis. Lancet. 2022;400:2063-2073.
37. Muscatell KA, Alvarez GM, Bonar AS, et al. Brain-body pathways linking racism and health. Am Psychol. 2022;77:1049-1060.
38. Sevillano Oriola L, Armentano Oller N, Martínez-Abadías N. Virtual anthropology: Forensic applications to cranial skeletal remains from the Spanish Civil War. Forensic Sci Int. 2022;341:111504.