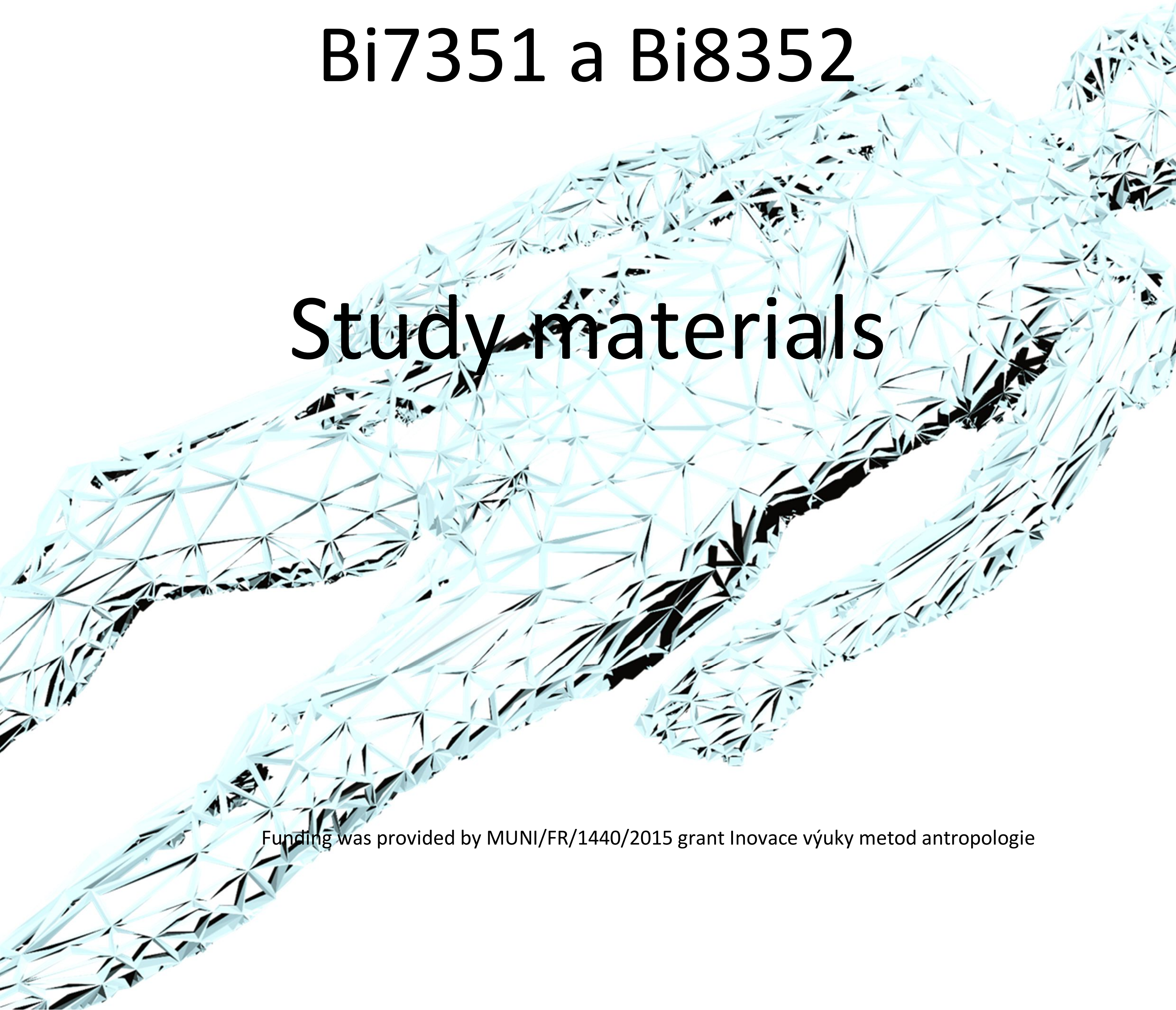
Methods of anthropology I and II

Bi7351 a Bi8352

Study materials



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The courses Methods of anthropology I and II (Bi7351 and Bi8352) acquaint the students of Anthropology – bachelor study program – with fundamental and advanced methods of skeletal anthropology and anthropology of the living human. These newly created study materials emphasize maximum usability and practical applicability by “graphically” simplifying the decision-making process of choosing the material-adequate method out of the variety of the available ones.

In the annex, an .xls file Vek/vyska is available, containing a complex notion of the skeletal find’s age and body height.

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Introduction to somatic characteristics assessment in Man

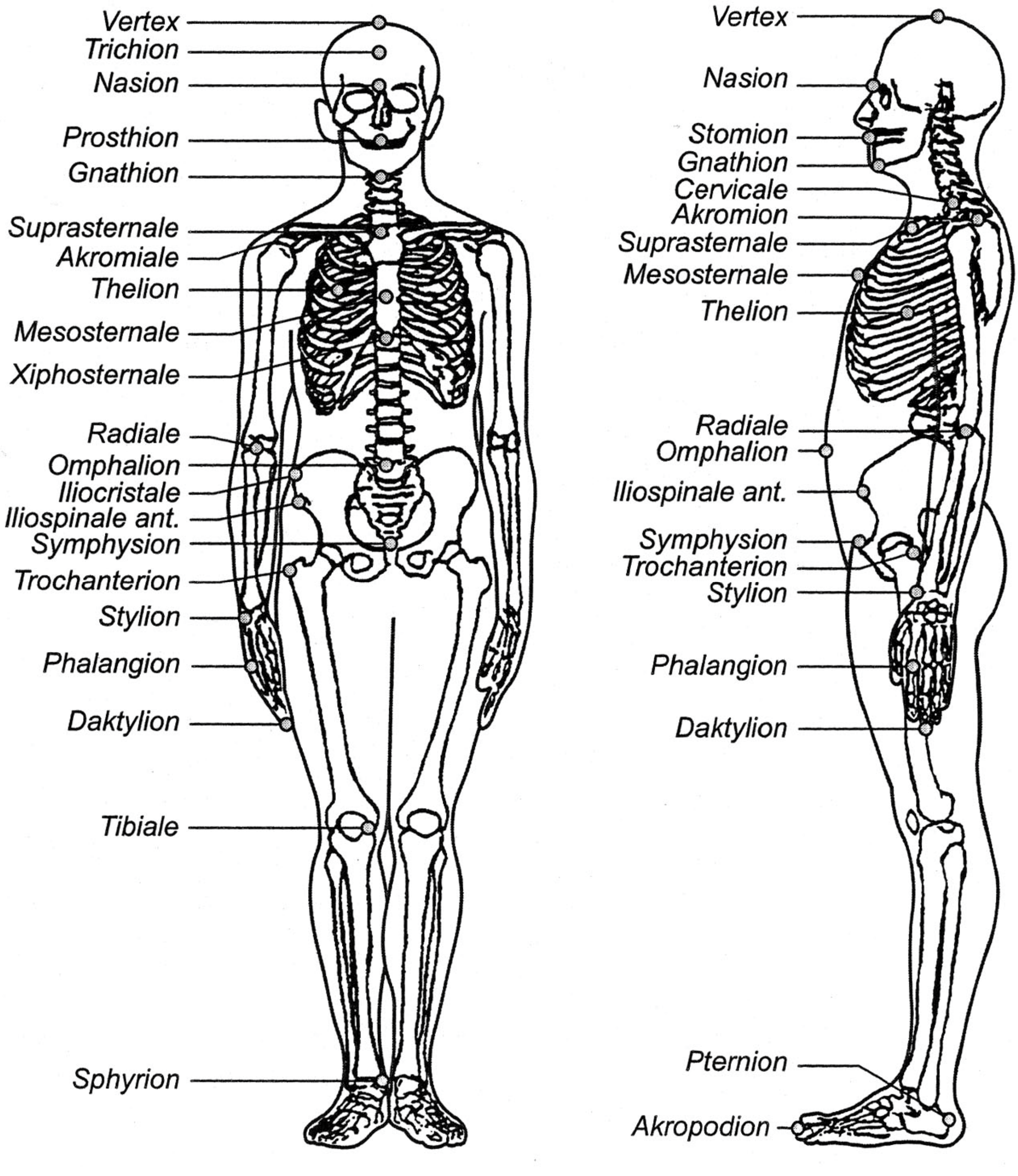
To measure and visually or electronically record human somatic characteristics (as well as any other research of Man) requires a specific scientific approach. Man can never be an object of research, in research of Man, he/she always has to be a subject of research. A participant in research always has to be informed in detail with research goals and methods, understand them and must express his/her consent (ideally by signing a written consent form approved by an ethical committee, in our case Ethical committee for research, Masaryk University). When measuring and recording somatic characteristics, methods used are strictly limited to non-invasive procedures which are painless when correctly performed.

However, anthropological examination can be unpleasant for the participant also from the psychological point of view with respect to the relationship between the participant and researcher – such relationship is not equal. The participant is put in a position which can be uncomfortable from the intimate point of view – to minimalize measurement (and recording) error the measurements have to be performed on the bare skin (this is true for body surface recording as well) and therefore it is necessary for the participants to be clad in their underwear or elastic exercise gear. In contrast to historical experience it is nowadays therefore considered standard that female participants are examined by female researchers and male participants by male researchers. Many anthropometric landmarks are palpated by the researcher on the participant's body which can further increase his/her discomfort. It is desirable for the researcher to be able to assess the situation emphatically and using a sensitive (or at times also resolute and self-confident or humorous and relaxed) approach make the stressful situation more tolerable for the participant. This is not only matter of professional courtesy; researching somatic characteristics requires overall relaxed feel. Contracted/cramped muscles do not permit a reliable measurement and recording. An anthropologist should be able to act in a professional way and establish a relationship of trust with the participant. The first and easiest step is to utilize a white lab coat during examinations. It is true that the so called white coat syndrome can manifest itself also during anthropological examinations and provoke the sensation of nervousness in the participant yet the positive factors prevail – white lab coat signalizes professional approach, respectability and meaningfulness of the research. Another element which heralds professionalism is perfect research design and preparation – the methods must be well thought trough and prepared in detail, designed with the goal of verification (or rejection) of beforehand established working hypotheses. The approach of "peoplemetrics – measure everything and surely there will be some results" in unacceptable. Working hypotheses must be established with good theoretical knowledge in the field, acquired by literary research. Corresponding methods are selected to fulfil a second major consideration – minimum time consumption, besides of course the first major consideration – acquisition of data crucial to verify/reject the working hypothesis. The question of time consumption is often crucial in the sample recruiting/motivation process. A tried and trusted motivation factor is offering a compensation for the lost time. In most anthropological research in our country the investigator/investigating team does not have funding available to financially remunerate the participants; it is desirable to offer an attractive outcome connected to the examination – for instance a facial or full-body 3D model in studies focusing on body surface recording, a strongest hand-grip in physical condition studies or body composition assessment (especially body fat percentage) in nutritional status-oriented studies.

An ethical approach of the researcher is a must – in no respect can the trust of the participant be taken advantage of, be it in the tangible (treatment of personal data in scientific research is regulated by the law 101/2000 Coll., on personal data protection) or in the intangible sphere.

In anthropology of the living Man (when measuring, recording or visually observing/assessing somatic parameters) a standardized method exists which is based on precisely defined anthropometric landmarks. Between these landmarks a battery of standard basic and specialized dimensions can be measured. Further in the text a list of anthropometric dimensions with definitions is included, also charts to help in the decision-making process when selecting basic and advanced methods based on available material and instruments.

Definitions of fundamental anthropometric landmarks



Vertex - (v) *The most superior point on the crown of the head oriented in the Frankfort horizontal*

Suprasternale - (sst) - *the deepest point in the hollow of the jugular notch lying at the middle of the anterior-superior border of the sternal manubrium*

Akromiale - (a) - *The lateral-most point on the acromion of the scapula, with the upper limb in the position of adduction.*

Mesosternale - *A reference point on the frontal surface of the chest, on the midsagittal line, in the center of the sternum.*

Thelion (th) – *A reference point in the middle of the nipple.*

Xiphosternale - A reference point *on the frontal surface of the chest, on the midsagittal line where the xiphoid process joins the body of the sternum.*

Omphalion - (om) - *A reference point in the middle of the navel.*

Symphysion - (sy) - *The uppermost point on the symphysis pubica, on the midsagittal line.*

Radiale - (r) - *The uppermost point on the radius head (upper limb in adduction position). The landmark is palpated on the outer side of the limb, as the fissure (articular cavity) between the humerus and radius is well defined.*

Stylion - (sty) - *A reference point located at the end of the processus styloideus of the radius. The landmark is palpated at the radial side of the forearm.*

Daktylion - (da) – *A reference point located at the end of the finger which is the most distant on the upper limb in adduction. Usually the third finger daktylion is used.*

Metacarpale radiale (mr)

Metacarpale ulnare (mu)

Iliocristale - (ic) - *The most lateral and superior point located on the iliac crest.*

Iliospinale (anterius) - (is) - *The anterior-most point located on the spina iliaca anterior superior. When following the iliac crest forward the landmark can be palpated at its frontal extreme.*

Trochanterion - (tro) - *The superior-most point on the greater trochanter of the femur. Palpation of the point is performed in a slight dorso-anterior direction on the largest hip breadth level.*

Tibiale - (ti) - *The upper-most point on the proximal end of the tibia (on the lateral border of the lateral condyle of the tibia).*

Sphyrion - (sph) – *A reference point on the tip (the most distal in the upright position) of the inner ankle (malleolus medialis).*

Metatarsale fibulare (mtf)

Metatarsale tibiale (mtt)

Pternion - (pte) *The most posterior point located on the heel of the foot when the subject is standing.*

Akropodion - (ap) *The most anterior (distal) point on the distal phalange of the longest toe when the subject is standing.*

Anthropometric landmarks on the head:

Glabella - (g) - *The most anterior point on the forehead, above the nasal root, on a midsagittal plane between the eyebrow ridges.*

Opisthokranion - (op) - *A reference point located on a midsagittal plane in the occipital part of the head. Opisthokranion is the point most distant (when measuring straight distance – length of the head) from the glabella landmark.*

Euryon - (eu) -

The lateral-most point on the side of the head (most often located on the parietal bone). The bilateral points are established when head breadth is measured.

Nasion (n) – *A reference point located on a midsagittal plane on the nasal root in the nasofrontal suture (at the superior end of the nasal bones). This landmark is not always located in the lowest depression of the nasal root, it is best located by palpation of the shallow ridge of the suture (a finger nail can be used to distinguish the sutural ridge).*

Zygion (zy) – *The lateral-most point on the zygomatic arch. The bilateral landmarks are located when the maximum face breadth is measured.*

Gnathion (gn) – *A reference point on the lower edge of the mandible located inferior-most on the midsagittal plane. Palpation is performed from below up.*

Gonion (go) –*The most inferior and lateral point on the angle of the mandible.*

Alare (al) –*The lateral-most point on the ala of the nose. The bilateral landmarks are located when the maximum nasal breadth is measured.*

Ectocanthion - a reference point located in the lateral canthus where the upper and lower eyelids meet.

Entocanthion – a reference point located in the lateral canthus where the upper and lower eyelids meet.

Frontotemporale (ft) – *A reference point located on the temporal line, front-most and closest to the midsagittal plane; in the exact spot where the distance between bilateral temporal lines is the smallest.*

Stomion (sto) – *A reference point on the intersection of the oral fissure with the midsagittal plane (lips closed, neutral expression)*

Subaurale (sba) – *The inferior-most point on the lower extremity of the earlobe, head of the subject is oriented in the Frankfort plane.*

Subnasale (sn) – *A reference point located in the angle between the base of the nasal septum and the upper lip (its philtrum).*

Superaurale (sa) –*The superior-most point on the upper extremity of the auricle, head of the subject is oriented in the Frankfort plane.*

Tragion (t) –*A reference point located at the notch just above the upper margin of the tragus of the ear, in the spot where the cartilages connect.*

Definition of fundamental anthropometric measurements

Body weight – weighed using a digital personal scale

Height characteristics – measured using the anthropometer, in the anatomic stance; the participant is clad in underwear or in an elastic exercise clothing. Heels of the feet are positioned near each other, toes slightly apart; back, buttocks and heels touch the wall; stance is upright yet relaxed to avoid „stretching the height“. Lateral dimensions are measured on the right side.

Body height (stature) – vertical distance of the vertex landmark from the standing surface.

Suprasternale height – vertical distance of the suprasternale landmark from the standing surface.

Acromiale height – vertical distance of the acromiale landmark from the standing surface.

Elbow joint fissure height (radiale height) – vertical distance of the radiale landmark from the standing surface.

Height of the radius styloid process (wrist height) - vertical distance of the stylion landmark from the standing surface.

Height of the tip of the middle finger (dactylion height) - *vertical distance of the dactylion landmark from the standing surface.*

Height of the iliac crest - vertical distance of the iliocristale landmark from the standing surface.

Height of the anterior superior iliac spine - vertical distance of the iliospinale landmark from the standing surface.

Height of the great trochanter - vertical distance of the dactylion landmark from the standing surface.

Knee joint fissure height - vertical distance of the tibiale landmark from the standing surface.

Height of the symphysis upper margin - vertical distance of the symphysion landmark from the standing surface.

Height of the navel - vertical distance of the omphalion landmark from the standing surface.

Sitting height – the measured person is seated in an actively upright straightened position, thighs parallel in a horizontal position, lower legs at a right angle, head oriented in the Frankfurt horizontal plane.

Breadths are measured using a pelvimeter (or the top part of an anthropometer can be used), limb breadths are measured using a sliding caliper.

Biacromial breadth (shoulder breadth) – a direct distance between the right and left acromiale landmarks.

Bideltoid breadth – the maximum horizontal distance between the lateral margins of the upper arms, measured on the greatest expansion of the deltoid muscles (soft tissues are not to be compressed)

Transverse chest diameter – horizontal distance of the lateral-most points on the chest, measured at mid-sternum height (mesosternale landmark). The instrument branches are lightly pressed on the ribs, the chest in normal position (between inspiration and expiration).

Sagittal (fronto-dorsal) chest diameter – direct distance of the mesosternale landmark (mid-sternum) from the spinal process of the thoracic vertebra on the same horizontal plane

Bicristal breadth – direct distance between the right and left iliocristale landmarks

Bispinous breadth – direct distance between the right and left iliospinale landmarks

Bitrochanterion breadth - direct distance between the right and left trochanterion landmarks

Span – distance between the right and left dactylion landmarks (on the third finger; arms are maximally spread horizontally, palms facing forward

Ankle breadth (bimaleolar breadth) – distance between the medial and lateral sphyrion landmarks

Foot breadth – the maximum distance between the lateral and medial margin of the foot at the metatarso-phalangeal joint.

Hand breadth – maximum distance between the lateral and medial margin of the hand at the metacarpo-phalangeal joint.

Humeral bi-epicondylar breadth (humeral epiphyseal breadth) – direct distance of the most lateral and medial points on epicondylus lateralis and epicondylus medials of the humerus. The arm and the forearm are at right angle.

Wrist breadth (bi-styloid breadth) – distance of the stylion radiale and ulnare landmarks

Femoral bi-epicondylar breadth (femoral epiphyseal breadth) – direct distance of the most lateral and medial points on epicondylus lateralis and epicondylus medials of the femur. The thigh and the lower leg are at right angle.

Circumferences – measured by measuring tape

Chest circumference (on the thelion/mesosternale landmark) in normal position (between inspiration and expiration) – on the back the tape runs slightly below the lower angles of the scapulae, in front slightly above the nipples – in men; in women the circumference is measured at the mesosternale landmark level

Chest circumference (on the xiphosternale landmark) in normal position (between inspiration and expiration) – the circumference is measured at the level of the xiphosternale landmark

Abdominal circumference – a circumference measured horizontally at the level of the navel

Gluteal circumference (hip circumference) - a circumference measured horizontally at the level of the maximum development of gluteal muscles

Relaxed arm circumference (extended arm circumference) – a circumference measured mid-distance between the akromiale and olecranon landmarks on a freely suspended arm

Flexed arm circumference (arm in flexion) – maximum arm circumference when both flexor and extensor muscles are fully contracted

Forearm circumference – a circumference measured where the forearm is the widest

Wrist circumference – a circumference measured at the processus styloideus ulnae level

Obvod stehna gluteální – obvod měřený v proximální partii stehna pod hýždní rýhou (M68).

Gluteal circumference of the thigh – a circumference measured horizontally in the proximal part of the thigh, below the gluteal sulcus

Mid-thigh circumference – a circumference measured half-way between the trochanter major and the lateral epicondyle of the femur

Maximum circumference of the calf – a circumference measured at the level of maximum development of the triceps surae muscle

Neck circumference – a circumference measured horizontally at the level of the thyroid cartilage.

Waist circumference – a circumference measured horizontally at the narrowest spot, in the region between the last rib and the iliac crest

<u>Basic cephalometric characteristics (measurements of the human head</u>)

Head circumference (measuring tape) – a circumference measured through the glabella and opisthocranion landmarks

Transverse head arc (measuring tape) – an arc measurement connecting bilateral tragion landmarks and the vertex landmark.

Sub-nasal arc (measuring tape) – an arc measurement connecting bilateral tragion landmarks and the subnasale landmark

Mandible arc (measuring tape) – an arc measurement connecting bilateral gonion landmarks and the gnathion landmark

Head length (cephalometer) – direct distance of the glabella landmark to the opisthokranion landmark.

Head breadth (cephalometer) – direct distance of the right and left euryon landmarks

Smallest forehead breadth (cephalometer) – direct distance of the right and left frontotemporale landmarks

Bi-zygomatic breadth (cephalometer) – direct distance of the right and left zygion landmarks

Mandible arc breadth (lower face breadth; cephalometer) – direct distance of the right and left gonion landmarks.

Cranial base breadth (cephalometer) – *direct distance of the right and left tragion landmarks*

Distance of the outer corners of the eye (sliding caliper) – direct distance of the right and left ektokanthion landmarks

Distance of the inner corners of the eye (sliding caliper) – direct distance of the right and left entokanthion landmarks

Nasal breadth (sliding caliper) – direct distance of the right and left alare landmarks

Morphological height of the face (sliding caliper) – direct distance of the nasion and gnathion landmarks

Nasal height (sliding caliper) – direct distance of the nasion and subnasale landmarks

Physiognomic height of the upper face (sliding caliper) – direct distance of the nasion and stomion landmarks

Lower face height (sliding caliper) – direct distance of the subnasale and gnathion landmarks

Mandible height (sliding caliper) – direct distance of the stomion and gnathion landmarks

Mandible depth (sliding caliper) – direct distance of the gnathion and gonion landmarks

Upper face depth (sliding caliper) – direct distance of the nasion and tragion landmarks

Middle face depth (sliding caliper) – direct distance of the subnasale and tragion landmarks

Lower face depth (sliding caliper) – direct distance of the ganthion and tragion landmarks

Tragion – gonion distance (sliding caliper) – a direct distance of these two landmarks

Physiognomic auricle length (sliding caliper) – direct distance of the superaurale and subaurale landmarks; maximum length of the auricle’s longitudinal axis

Skinfold thickness measurement (caliperation)

The skinfold thickness is measured using a caliper. There are various types, with Best and Harpenden caliper being the most used (each body composition assessment, or somatotype, method requires a different caliper).

The most frequently used skinfold locations are:

On the cheek

Below the chin

On the triceps

On the biceps

On the forearm

On the chest

On the chest II

Subscapular

Suprailiac

Abdominal

Patellar

On the thigh

On the calf

Biological age assessment

Biological age is a parameter which unlike the chronological (calendar) age characterizes the overall growth and development status of an individual. In the majority of biological age assessment cases in anthropology the age assessment of sub-adult (child or adolescent) individuals is concerned. In these cases, the maturation stage of the developing organism is ascertained. Biological age can be significantly different than chronological age (a plain number of days elapsed since birth). Same-age (chronologically) individuals can vary in the measure of morphological and functional trait formation – either within normal variation range or more markedly in case of disproportions outside physiological growth and development course. Biological age is a unique indicator of somatic development in many scientific disciplines (forensic anthropology and medicine, sports anthropology, auxology…). Especially in auxology biological estimation is a primary diagnostic tool when developmental disorders are suspected.

(Note: less frequently does an anthropologist come across biological age estimation in adult individuals as these cases are usually reserved for so called anti-aging medicine. Biological age in adults is basically a synonym of organism aging rate. Also in adults can biological age be significantly different from chronological age. Owing to the influence of various internal and external factors an individual can age either slower or faster than the calendar age would indicate. Ageing is characterized as functional capacity decrease in an organism (usually is evaluated at the organ or organ system level).

Adolescent individual's biological age can be estimated with use of various methods. Each assess the age of the individual based on different parameters; therefore, different scientific disciplines – auxology, stomatology, forensic anthropology – require different methods. To select an appropriate biological age estimation method one needs to understand the limits of respective methods – each requires different material and equipment. See below a concise list of individual method principles and a decision process flowchart when selecting a relevant method.

"Growth age" assessment (evaluates the somatic development stage of the individual based on his/her position on a percentile graph for the relevant population)

Dental age assessment (methods ranging from a basic observation of tooth eruption to methods assessing a complex of traits from a dental radiograph – an eruption stage, apical opening on the root etc.)

"Proportional age" assessment (regards age-specific changes in somatic parameters proportionality; so called KEI index – somatic development index – is one of the most frequently used methods)

Developmental age (assesses the development of the secondary sexual traits an evaluates the state of sexual maturity)

Skeletal (bone) age assessment (assessment is based on ossification stages of various regions on the sub-adult skeleton; the most frequent is the use of a complex of the distal parts of forearm bones, wrist and hand bones x-rays in a comparative analysis with standards in form of the TW2 scoring system or TW3 PC atlas)

Decision-making process

1) I plan to use the most reliable method to assess biological age (for example as a diagnostic tool in auxology or stomato-surgery or to estimate adult height in sports anthropology)

- Do I have access to left wrist and hand x-rays of the research sample members? The legislation in effect does not allow taking x-rays of the research sample members without (medical cause) indication; ethical committee approval and parents' informed consent are necessary.

If x-rays are available, the most suitable skeletal age assessment method is the TW3 (Tanner JM, Healy MJR, Goldstein H, Cameron N. 2001. Assessment of skeletal maturity and prediction of adult height (TW3 method). London – Edinburg – New York – Philadelphia –St. Louis – Sydney – Toronto or its predecessor version TW2: Tanner JM, Whitehouse RH, Cameron N, Marshall WA, Healy MJR, Goldstein H. Assessment of skeletal maturity and prediction of adult height, 2nd ed. London: Academic Press, 1983.). The TW3/2 is the most accurate method (compared to other methods) which assesses biological age based on a score attributed to individual bones on an x-ray of the distal parts of the forearm bones, carpal bones and the bones of the hand according to a detailed text description, x-ray photographs and schematic drawings of each developmental stage. The method has high requirements on the investigators experience with skeletal age assessment.

- Do I have access to x-rays of the head of the research sample members? The legislation in effect does not allow taking x-rays of the research sample members without (medical cause) indication; ethical committee approval and parents' informed consent are necessary.

If x-rays are available, the most suitable method is the one by Demirjian: Demirjian A, Goldstein H, Tanner JM. A new system of dental age assessment. Hum Biol. 1973 May; 45(2):211-227. The method assesses a complex of traits on the oral cavity x-ray; it is highly demanding of the evaluator's experience.

- X-rays are not available – I need to look for alternative methods – see step 2

2) I plan to assess biological age using a relatively reliable method to evaluate the discrepancy between the biological and chronological age on a population sample

- Do I have access to a sufficiently-sized research sample, ethical committee approval and parents' informed consent to measure (or acquire previously measured) somatic characteristics which have a direct relation to age-specific growth and development dynamics (i.e. body height, biacromial breadth, bispinal breadth, maximum arm circumference (boys), maximum thigh circumference (girls) and Rohrer index values? If so, it is recommended to assess the so called proportional age using a somatic development index called KEI index by Brauer: Brauer, B. M.: Die Bestimmung des biologischen Alters in der Sport und jugendärztlichen Praxis mit neuen anthropometrischen Methoden. Ärztl. Jugend., 1982, vol. 73, s. 94-100.

3) Developmental age can be used to assess sexual maturity of an individual or a population sample (for example to analyse a sexual maturation secular trend).

- Do I have at my disposal data on menarche (or first nocturnal emission in boys) or am I conducting a questionnaire survey (or semi-structured interviews) with a sufficient number of girls/women (men; and, do I have their informed consent, or an informed consent of their parents, approved by the ethical committee? If so, puberty onset can be assessed based on the date of menarche of first nocturnal emission. An alternative in boys would be testicular volume measurement, albeit the ethical side of the problem is quite limiting.

- To assess sexual development and maturity also a visual assessment according to secondary sexual traits visual schemes (so called Tanner scale) can be employed. Regarding the highly sensitive ethical aspect this approach is not currently only scarcely used for biological estimation (aside from the subjective nature of the method). This method finds limited use as a supporting criterion in forensic anthropology in age estimation cases of actors in suspected child pornography cases (as puberty onset and secondary sexual traits development is individually highly variable this method is considered to be an auxiliary tool. The main reason for caution is however the fact that this method assesses biological age which can be significantly different from chronological age upon which the coming of majority is based and therefore the usage of this method can be justified only by non-existence of an alternative). The assessment is performed by comparing the status quo of the observed individual with illustrated scales and text description of the pubic hair development in boys and girls, breast development in girls and external genital organ development in boys. (See Marshall WA, Tanner JM (February 1970). "Variations in the pattern of pubertal changes in boys". Arch. Dis. Child. 45 (239): 13–23. doi:10.1136/adc.45.239.13.; Marshall WA, Tanner JM (June 1969). "Variations in pattern of pubertal changes in girls". Arch. Dis. Child. 44 (235): 291–303. doi:10.1136/adc.44.235.291).

4. In order to make an approximate biological age estimation linked to a target body height approximation the so called “growth age” can be used.

- A measured value of body height can be implemented in a growth (percentile) chart (and then the intersection of the measured body height and observed calendar age determine the individual’s position on the chart which can be used for biological age assessment – in broad terms of “within population-specific normal range”, “retarded growth/biological age” or “accelerated growth/biological age”
- The estimate can be made more accurate by plotting the measured value on the 50th percentile curve on the growth chart (population-specific) and then reading the corresponding value on the “calendar age” axis. In a sufficiently large sample the correlation between biological and calendar age is high enough so that we can acquire an approximate assessment of the individual’s biological age.
- The above mentioned steps can be also carried out with weight-to-height ratio instead of using plain body height – makes it possible to evaluate also the individual’s body build type.
- All such assessments are approximate estimations; it is better to take into account the parent’s body height
- Further accuracy improvement can be obtained by using parental body height data in the analysis
- Even better accuracy of the assessment can be obtained by using the following growth assessment formulas by Riegorová (1982) or Przeweda (1981).

$$RV = \frac{a+b+2c}{4} \text{ (Riegerová 1982)}$$

$$RV = \frac{a+b+c}{3} \text{ (Przeweda, 1981)}$$

Percentile charts: PŘIDALOVA, Miroslava a Marie ULBRICHOVA. *Aplikace fyzické antropologie v tělesné výchově a sportu: (functional anthropology handbook)*. Edited by Jarmila Riegerová. 3. vyd. Olomouc: Hanex, 2006.

The estimation of attained adult height

Body height is a quantitative trait with polygenic heredity which is significantly modulated by external – environmental factors. There is no clear understanding among experts as to the percentage influence of genetic and external factors on the resulting phenotypic trait – final attained or “target” body height in adulthood. Adult height estimation for children and adolescents has marked relevance in several disciplines – in clinical and functional anthropology, with especial importance in anthropology of sports. For the coaches and parents of young athletes and especially for the athletes themselves the time and financial investment spent from the beginning of training until the peak of sports performance is substantial. Especially in the case of sports where extreme body-build types are preferred (or, on the contrary, in case of sports where somatic parameters can prove to be limiting factors of performance development) an accurate estimate/prediction of their development is crucial.

In order to theoretically introduce the below stated practical procedures used to estimate attained height at adulthood two important notions need to be mentioned – acceleration and secular trend. Population studies and their results show that today children are generally taller and heavier than in the past. The experts agree that the whole growth process is accelerated – the observed individual approaches adult body size at a faster rate – thanks to improved nutritional, hygienic, health-care and other external factors. A phenomenon termed secular trend describes the overall increase in the adult population body height compared to the populations in the past (hundred years ago – secular means long-term, centennial).

To estimate attained adult body height various methods were developed and these can be divided into the following fundamental groups: predictions based on one-time measurement; predictions based on the biological age of an individual; predictions based on repeated measurements, using growth rate; predictions based on repeated measurements, using PHV (Peak Height Velocity); predictions regarding the height of the parents. A comprehensive overview of the methods can be found in Riegerová, Přidalová and Ulbrichová (2006). See below a flowchart of the decision-making process (when taking into consideration the most widespread methods).

1. For use in anthropology of sports – when evaluating talent and assessing somatic traits development in adulthood

- Do I have access to an x-ray of the left hand and the distal part of the forearm of the examined individual? (The legislation in effect does not allow taking x-rays of the research sample members without (medical cause) indication; ethical committee approval and parents’ informed consent are necessary). Is the TW2 publication/TW3 software available to me? The method of adult height estimation based on TW2 method (biological age) is considered the most reliable (Tanner JM, Whitehouse RH, Cameron N, Marshall WA, Healy MJR, Goldstein H. Assessment of skeletal maturity and prediction of adult height, 2nd ed. London: Academic Press, 1983). It is recommended to use the formulas stated in the following paper: Prediction of adult height from height and bone age in childhood. A new system of equations (TW Mark II) based on a sample including very tall and very short children. J M Tanner, K W Landt, N Cameron, B S Carter, J Patel. Arch Dis Child 1983;58:10
- If x-rays are unavailable, a method from step 2. can be selected.

2. To create an estimation for the needs of interested parents or to estimate genetic growth potential the following methods of prediction using one-time measurement can be used

- In our country the method of adjusted mid-parental height is often used:
  Target height boys = (father's height+(mother's height + 13 cm))/2 ± 10 cm
  Target height girls = (mother's height+(father's height - 13 cm))/2 ± 10 cm
- An updated BP (Bayley-Pinneau method) can be used (VIGNEROVÁ, Jana; BLÁHA, Pavel. Sledování růstu českých dětí a dospívajících. Norma, vyhublost, obezita. 1. vyd. Praha: Státní zdravotní ústav, 2001; in this monograph also the calculation of the P value is described):
  Predicted body height = (current body height of the child)*100/P

3. To evaluate individual growth/development and predict body height of longitudinally monitored children (therefore based on repeat measurements)

- the model approach Dynamic Phenotype can be used; this approach is based on physiological principles of growth. Detailed information is located here or in a paper of the authors Čuta M., Kukla L., Novák L. Modelování vývoje tělesné délky a výšky dětí s pomocí údajů o výšce rodičů. *Čes.-slov. Pediat.*, 2010, roč. 65, č. 4, s. 159–166.

Sex assessment

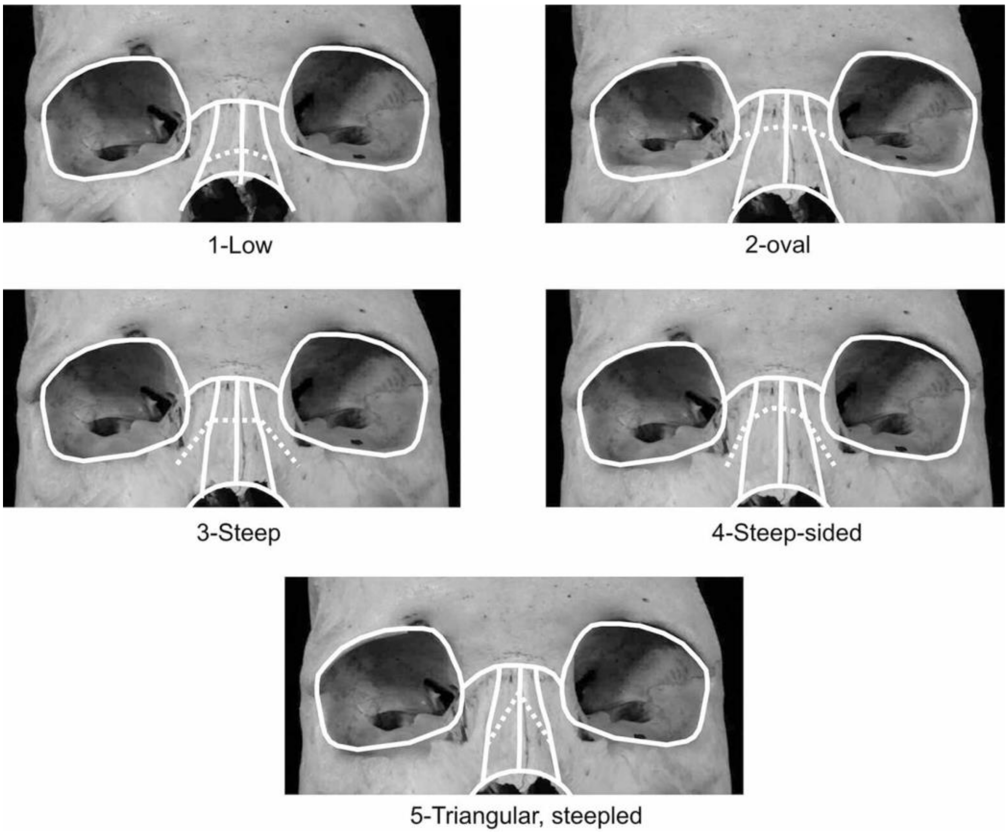
	Original study	Validation	Method	Variables	Statistics	Skeletal part	Equipment	Continent	Origin	Collection	Time	Groups	Sc P	Sc P m	Sc P f	Sc P	Sc P m	Sc P f
Os coxae	Novotný 1986	/	metric	2 dimensions		os coxae	caliper	Europe	Czech, German	Pachner, Brno MU	* 19th & 20th century	M/F	97 %	/	/	/	/	/
		/	metric	4 dimensions		os coxae	caliper, camera, image processing software	Europe	Czech, German	Pachner, Brno MU	* 19th & 20th century	M/F	1	/	/	/	/	/
	Acsádi & Nemeskéri 1970		visual	10traits		pelvis	/	Europe	Hungary	NS	NS	M/F						
	Brůžek 2002	/	visual	5 traits		os coxae	/	Europe	Portuguese, French	Coimbra / Paris	* 1820-1950	M/F	93.3 / 96.2	94.2 / 96.8	95.2 / 92.6	/	/	/
	Phenice 1969	/	visual traits	3 traits		os pubis	/	North America	US european	Terry	* ca 1828-1943	M/F	96.55	95.5	100	/	/	/
		/	visual traits	3 traits		os pubis	/	North America	US african	Terry	* ca 1828-1943	M/F	94.44	95	94.23	/	/	/
		Ubelaker & Volk 2002	visual traits	3 traits		os pubis	/	North America	US african, US european, US Hi	Terry	* ca 1828-1943	M/F	/	/	/	88.4	79.8	97
		Lovell 1989	visual traits	3 traits		os pubis	/	North America	US	cadavers (Cornell university)	recent	M/F	/	/	/	83	/	/
		MacLaughlin & Bruce 1990	visual traits	3 traits		os pubis	/	Europe	UK	cadavers (University of Aberdeen)	recent	M/F	/	/	/	58.6	46.4	70.8
		MacLaughlin & Bruce 1990	visual traits	3 traits		os pubis	/	Europe	UK	St. Bride	ca 1701-1900	M/F	/	/	/	82.5	71.7	93.7
		MacLaughlin & Bruce 1990	visual traits	3 traits		os pubis	/	Europe	UK	cadavers (University of Leiden)	recent	M/F	/	/	/	68	68	68.7
		Sutherland & Suchey 1991	visual traits	ventral arch		os pubis	/	North America	US	cadavers (Los Angels coroner)	recent	M/F	/	/	/	96	/	/
		McBride et al. 2001	visual traits	3 traits		os pubis	/	North America	US African, European? asian	Terry (European, African, Asian)	* ca 1828-1943	M/F	/	/	/	89.2	/	/
		Kelley 1978	visual traits	3 traits		os pubis	/	North America	US native	California, Berkley and Sacramento Univ	not specified	M/F	99.98					
	Murail et al. 2005	/	Metric	10 dimensions		os coxae	calieper	Europe, Africa,North Americ	worldwide	Olivier, Spitalfields, Tamagnini, Garmus, Dart, Hammann-Todd, Terry, cadavers (Asia)	1700 – 2000	M/F	99.63 (among 90.71 %)	/	/	/	/	/
		Chapman et al. 2014	Metric	10 dimensions		os coxae	caliper + CT	Europe	Belgium (NS)	Universite ´ Libre de Bruxelles	recent (NS)	M/F	/	/	/	81.81-100	/	/
		Mesteková et al. 2015	Metric	10 dimensions		os coxae	CT	Europe	France (NS)	University North Hospital Marseilles	recent (NS)	M/F	/	/	/	/	100 % from 92.3 %	100 % from 97.
	Steyn & Patriquin 2009	/	Metric	7 dimensions		os coxae		Africa	SA african	Dart & Pretoria collections	* ca 1827 - recent	M / F	94.5	96	93	93.5	94.9	92
		/	Metric	7 dimensions		os coxae		Africa	SA european	Dart & Pretoria collections	* ca 1827 - recent	M/F	94.5	94.1	94.9	94	93.1	94.9
		/	Metric	7 dimensions		os coxae		Europe	Greece	Cretan collection	+ 1968 - 1998	M/F	94.8	97.7	91.9	94.1	97.7	90.5
	HIP (Jungerová et al. 2015)	/	Metric	2D coordinates		os coxae	scanner, laptop	Europe	Czech Republic, Greece	Pachner collection; Brno MU; Athens	N / A	M/F				97.6	98.8	96
	Klales et al. 2012	?	Metric	3 traits (modified Phenice)		os pubis		North America	US African, US European, US hi	Bass, Hamman-Todd		M/F	/	/	/	86.2	98	74.4
Sacrum	Fordisc 3	/	Metric	3 distances		os sacrum	caliper	North America	US white	FDB	* 1930 -	M/F	/	/	/	75	73.1	79.3
		/	Metric	3 distances		os sacrum	caliper	North America	US black	FDB	* 1930 -	M/F	/	/	/	75	78.7	67.6
Cranium	Acsádi & Nemeskéri 1970	/	visual	8 traits		cranium		Europe	Hungary	NS	NS	M/F						
		Ramsthaler et al. 2007	visual	multiple traits		cranium	CT	Europe	Germany	CT Hamburg University	recent	M/F	/	/	/	94	96.9	87.9
	Novotný et al. 1993	/	visual	9 traits		cranium	/	/	/	/	/	M/F	98.2	97.2	100	/	/	/
	Walrath et al. 2004	/	visual	10 traits		cranium		North America	US native	University of Pennsylvania	* 500-900	M / F	/	/	/	/	/	/
	Walker 2008	/	visual	Multiple traits, logistic regression		cranium	/	North America, Europe	US African, US European, UK	Hamann-Todd, Terry, St´Bride church	1750 – 1900	M/F	N/A	88.4	86.4	/	/	/
		Lewis & Garvin 2016	visual	Multiple traits, logistic regression		cranium	/	North America	US african, US european	Hamann-Todd	+ 1893-1938	M / F				76.7-90		
	Williams & Rogers 2006	/	visual	multiple traits		cranium	/	North America	US African, US European, US Hi	N/A	1900 – modern	M/F	N/A	0.92	0.926	N/A	N/A	N/A
	Kajanoja 1966	/	metric	8 distances		cranium	caliper, spreading caliper	Europe	Finland	Deparment of anatomy, University of He	* ca 1900 - 1950 (NS)	M / F	/	0.794	0.791	/	/	/
	3D-ID - Slice & Ross 2009	/	metric	3D coordinates		cranium	digitizer, 3D Scanner	multiple	mupltiple	14 populations	NS	/	/	/	/	/	/	/
		Urbanová et al. 2014	metric	11-14 landmarks		cranium	digitizer	South America	Br. African	USP	* ca 1850-1950	M/F	/	/	/	63	59.3	68.4
		Urbanová et al. 2014	metric	11-14 landmarks		cranium	digitizer	South America	Br. Euroepan	USP	* ca 1850-1950	M/F	/	/	/	74.6	79.6	63.6
		Urbanová et al. 2014	metric	11-14 landmarks		cranium	digitizer	South America	Br. Asian	USP	* ca 1850-1950	M/F	/	/	/	75	93.3	44.4
		Urbanová et al. 2014	metric	11-14 landmarks		cranium	digitizer	South America	Br. Admixed	USP	* ca 1850-1950	M/F	/	/	/	63..6	74.5	50
	Osipov et al. 2013	/	metric	distances, indices and angles		temporal bone, bony laby	CT	Europe	Crete, Greece	Cretan collection	1867 - 1956	M/F	/	/	/	82.4	81.3	83.7
	Lynnerup 2006	/	Metric	diameter		os temporalis, ear canal	drills	Europe	Germany	forensic collection, SW Germany (NS)	recent (NS)	M/F	70.91	91.2	38.1	/	/	/
	Norén et al. 2005	/	Metric	Angle		os temporalis, inner audi	cast	Europe	Germany	Institute of Forensic Medicine, Tübingen	recent (NS)	M/F	83.2	77	88.3	/	/	/
		/	Metric	Angle		os temporalis, inner audi	cast	Europe	Sweden	Scania archeological sites	Early medieval, 8th-11th	M/F	86.6	91.2	76.2	/	/	/
		Gonçalves et al. 2011	Metric	Angle		os temporalis, inner audi	CT	Europe	Portugal	Lisbon collection	* ca 1880-1975 (NS)	M/F	/	/	/	62.9	54.5	76.9
		Morgan et al. 2013	Metric	Angle		os temporalis, inner audi	CT	Europe	Denmark	forensic cases, University of Coppenhag	recent (NS)	M/F	/	/	/	62.3	64.3	60
		Masotti et al. 2013	Metric	Angle		os temporalis, inner audi	cast	Europe	Italy	Ferrara crematorium	recent, +2010-2011	M/F	/	/	/	58.1	64.9	53.1
	Jantz & Ousley 2005 (Fordisc 3)	/	/	/		/	/	/	/	/	/	/	/	/	/	/	/	/
		Ramsthaler et al. 2007	Metric	12 distance		Cranium	CT	Europe	Germany	Frankfurt and Meinz Centrum of Forensi	recent (NS)	FDB white male / female	/	/	/	85.7	89.2	78.79
		Guyomarch Bruzek 2011	Metric	12 distances		Cranium	MicroScribe	Europe	French	George Olivier's collection	+ 1960-1969	FDB white male / female	/	/	/	77.8	70.8	85.7
		Guyomarch Bruzek 2011	Metric	12 distances		Cranium	caliper, sliding caliper	Asia	Thailand	Department of Anatomy, University of Cl	recent (NS)	FDB asiatic male / female	/	/	/	58.9	80.4	36.4
		Urbanová et al. 2014	Metric	12 distances		Cranium	MicroScribe	South America	Br. Asian	USP	+ 1917 - 1937	FDB	/	/	/	66.6	66.6	66.6
		Urbanová et al. 2014	Metric	12 distances		Cranium	MicroScribe	South America	Brazil	Europe	+ 1917 - 1937	FDB	/	/	/	57.7	46.9	81.8
		Urbanová et al. 2014	Metric	12 distances		Cranium	MicroScribe	South America	Brazil	Africa	+ 1917 - 1937	FDB	/	/	/	50	25.9	84.2
		Urbanová et al. 2014	Metric	12 distances		Cranium	MicroScribe	South America	Brazil	Admixed	+ 1917 - 1937	FDB	/	/	/	75,8	52,9	100
		Jurda et al. 2013	Metric	13 distances		Cranium	MicroScribe	Europe	Greece	Athens collection	+ 1960-1996	FDB	/	/	/	77,63	70,89	84,93
		Jurda et al. 2013	Metric	13 distances		Cranium	MicroScribe	Europe	Greece	Athens collection	+ 1960-1996	Howells	/	/	/	73,89	59,52	90,41
		Jurda et al. 2013	Metric	13 distances		Cranium	MicroScribe	Europe	Portugal	Coimbra collection	+ 1910-1936	FDB	/	/	/	71.43	97.67	43.9
		Jurda et al. 2013	Metric	13 distances		Cranium	MicroScribe	Europe	Portugal	Coimbra collection	+ 1910-1936	Howells	/	/	/	67.44	41.86	93.02
		Jurda et al. 2013	Metric	13 distances		Cranium	MicroScribe	Europe	Portugal	Lisbon collection	+ 1881-1975	FDB	/	/	/	67.74	45.1	95.24
		Jurda et al. 2013	Metric	13 distances		Cranium	MicroScribe	Europe	Portugal	Lisbon collection	+ 1881-1975	Howells	/	/	/	69.47	51.92	90.7
		Jurda et al. 2013	Metric	13 distances		Cranium	MicroScribe	Europe	Czech rep.	Institute of Criminalistic	recent	FDB	/	/	/	75	72.4	86.36
		Jurda et al. 2013	Metric	13 distances		Cranium	MicroScribe	Europe	Czech rep.	Institute of Criminalistic	recent	Howells	/	/	/	73.47	57.41	93.18
		Jurda et al. 2013	Metric	13 distances		Cranium	MicroScribe	Europe	Czech rep.	Pachner collection	recent	FDB	/	/	/	71.11	48.98	97.56
		Jurda et al. 2013	Metric	13 distances		Cranium	MicroScribe	Europe	Czech rep.	Pachner collection	recent	Howells	/	/	/	73.47	57.41	93.18
		Jurda et al. 2013	Metric	13 distances		Cranium	MicroScribe	South America	Br. European, Br. African, mixe	Pachner collection	recent	FDB	/	/	/	68.9	61	81.25
		Jurda et al. 2013	Metric	13 distances		Cranium	MicroScribe	South America	Br. European, Br. African, mixe	Pachner collection	recent	Howells	/	/	/	60.12	43.14	86.36
	Urbanová & Králík 2008 (COLIPR)	/	Metric	/		Cranium	/	Europe	Portugal, Czech republic	Coimbra, Lisbon, Prague	19th and 20th century	M/F	/	/	/	/	/	/
		Urbanová et al. 2014	Metric	7 distances		Cranium	Digitizer	South America	Br. asian	USP	NS	M/F, universal	/	/	/	87.5	86.6	88.8
		Urbanová et al. 2014	Metric	7 distances		Cranium	Digitizer	South America	Br. european	USP	NS	M/F, universal	/	/	/	60	58.7	63.2
		Urbanová et al. 2014	Metric	7 distances		Cranium	Digitizer	South America	Br. african	USP	NS	M/F, universal	/	/	/	83.1	83.7	81.8
		Urbanová et al. 2014	Metric	7 distances		Cranium	Digitizer	South America	BR. admixed	USP	NS	M/F, universal	/	/	/	84.4	76.5	93.3
	Giles & Elliot 1963	/	Metric	4-8 distances		cranium	caliper	North America	US european	Terry & Hammann Todd	1893-1965 (NS)	M/F, multiple functions poc	82-88	/	/	78.4-91.9	/	/
		/	Metric	4-8 distances		cranium	caliper	North America	US african	Terry & Hammann Todd	1893-1965 (NS)	M/F, multiple functions poc	82-86	/	/	80.3-88.7	/	/
		Guyomarch Bruzek 2011	Metric	5 distances		cranium	MicroScribe	Europe	French	George Olivier's reference collection	1960-1970	DF19 - US european	/	/	/	60	/	/
		Guyomarch Bruzek 2011	Metric	5 distances		cranium	MicroScribe	Asia	Thailand	Department of Anatomy, University of Cl	Recent	DF19 - US european	/	/	/	51.6	/	/
		Guyomarch Bruzek 2011	Metric	5 distances		cranium	MicroScribe	Europe	French	George Olivier's reference collection	1960-1970	DF20 - US african	/	/	/	80	/	/
		Guyomarch Bruzek 2011	Metric	5 distances		cranium	MicroScribe	Asia	Thailand	Department of Anatomy, University of Cl	Recent	DF20 - US african	/	/	/	62.6	/	/
		Kajonaja 1966	Metric	5 distances		cranium	Caliper	Europe	Finland	Deparment of anatomy, University of He	* ca 1900 - 1950 (not spec	DF19 - US european	/	/	/	65	/	/
	Brůžek & Velemínský 2006	/	metric	3-5 mesurements		cranium	caliper, spreading caliper	Europe	Czech Republic, Old Slavs	Mikulčice - Valy, Kostelisko	9th and 10th century	M/F	80.3-86.1	81.7-86.8	78-87.7	/	/	/
		/	metric	3-5 mesurements		cranium	caliper, spreading caliper	Europe	Czech Republic, Old Slavs	Prušánky	9th and 10th century	M/F	/	/	/	75-82	/	/
Vertebrae	Wescott et al. 2000	/	metric	8 distances		C2	caliper	North America	US european	Hammann- Todd & Terry	N/A	M/F, pooled sample functio	/	/	/	85-89.4	83.7-88.7	83.3-90.1
		/	metric	8 distances		C2	caliper	North America	US african	Hammann- Todd & Terry	N/A	M/F, pooled sample functio	/	/	/	78.4-81.5	76-78.1	79.8-84.9
Mandible	Loth & Hennenberg 1996	/	visual	1 trait		ramus mandibulae	/	Africa	RSA african	Dart collection	*1827-1980 (NS)	M/F	99	99.1	98.8	/	/	/
		/	visual	1 trait		ramus mandibulae	/	Africa	RSA african, pathologic	Dart collection	*1827-1980 (NS)	M/F	/	/	/	91	91.7	90
		/	visual	1 trait		ramus mandibulae	/	North America	US european	Terry & Hammann Todd	+ 1893-1965 NS)	M/F	/	/	/	91.7	91.5	92.1
		/	visual	1 trait		ramus mandibulae	/	North America	US african	Terry & Hammann Todd	+ 1893-1965 NS)	M/F	/	/	/	92.4	91.2	93.8
		/	visual	1 trait		ramus mandibulae	/	North America	US natives	Terry & Hammann Todd	+ 1893-1965 NS)	M/F	/	/	/	90.6	89.6	90.6
		Balci et al. 2005	visual	1 trait		ramus mandibulae	/	Europe	Turkey	forensic cases, Council of Forensic Medic	recent	M/F	/	/	/	85.8	92.6	60
		Balci et al. 2005 - modified	visual	1 trait		ramus mandibulae	/	Europe	Turkey	forensic cases, Council of Forensic Medic	recent	M/F	/	/	/	90.9	95.5	60
Scapula	Jantz & Ousley 2005 (Fordisc 3)	/	metric	2 distances		postcranial	caliper	North America	US african	FDB	1930 - recent (NS)	black M/F	/	/	/	*93.8*	*93.3*	*94.7*
		/	metric	2 distances		postcranial	caliper	North America	US european	FDB	1930 - recent (NS)	white M/F	/	/	/	*92.3*	*91.7*	*93.7*
	Dabbs & Moore-Jansen 2010	/	metric	5 distances		scapula	caliper	North America	US african+european	Hammann-Todd	+ 1893-1938	M/F	*95.8*	*94.9*	*97.1*	*92.5*	*89.8*	*96.8*
		/	metric	5 distances		scapula	caliper	North America	US (NS)	Wichita State University	recent	M/F	/	/	/	*84.4*	*88.9*	*78.6*
Clavicle	Jantz & Ousley 2005 (Fordisc 3)	/	metric	3 distances	CVA	clavicle	caliper	North America	US african	FDB	1930 - recent (NS)	black M/F	/	/	/	94	92.8	96.3

		/	metric	3 distances	CVA	clavicle	clavicle	North America	US european	FDB	1930 - recent (NS)	white M/F	/	/	/	92.1	90.9	94.7
	Králík et al. 2014	/	metric	2-4 distances		clavicle	clavicle	Europe	Greeks (NS)	Athens collection	+ 1960-1996	M /F	/	/	/	92.2	92.4	92
	Tise et al. 2013	/	metric	1 distance	DFA	clavicle	osteometric board (NS)	North America	US hispanic	FDB, Pima County Office of the Medical Examiner	recent	M/F	/	/	/	87.29	93.33	81.25
	Spradley & Jantz 2011	/	metric	3 distances	DFA	clavicle	caliper	Nort America	US european	FDB	* 1930 - recent	white M/F	/	/	/	93.6	90	97.2
	Alcina et al. 2015	/	metric	3 distances	DFA	clavicle	caliper	Europe	Spain (NS)	UCM collection	+ 1975-1985 (NS)	M/F	85.7-94.8	/	/	/	/	/
Humerus	Mall et al. 2001	/	metric	3 distances		humerus	caliper, osteometric board	Europe	Germany (NS)	Anatomical Institute Munich	recent	M/F	93.15	/	/	/	/	/
	Jantz & Ousley 2005 (Fordisc 3)	/	metric	5 distances		humerus	caliper	North America	US european	FDB	1930 - recent (NS)	black M/F	/	/	/	94.8	94.4	95
		/	metric	5 distances		humerus	caliper	North America	US african	FDB	1930 - recent (NS)	white M/F	/	/	/	95.9	93.8	94.5
	Tise et al. 2013		metric	3 distances	DFA	humerus	caliper	North America	US hispanic	FDB, Pima County Office of the Medical Examiner	recent	M/F	/	/	/	88.96	87.5	90.41
	Černý & Komenda 1980																	
	Spradley & Jantz 2011		metric	4 distances		humerus	calliper	Nort America	US european	FDB	* 1930 - recent	white M/F	/	/	/	93.06	95.2	90.91
Radius	Jantz & Ousley 2005 (Fordisc 3)	/	metric	3 distances	CVA	radius	caliper	North America	US european	FDB	1930 - recent (NS)	white M/F	/	/	/	92.9	92.3	94.2
		/	metric	3 distances	CVA	radius	calipers	North America	US african	FDB	1930 - recent (NS)	black M/F	/	/	/	91.1	90.7	92
	Mall et al. 2001	/	metric	3 distances	DFA	radius	caliper, osteometric board	Europe	Germany (NS)	Anatomical Institute Munich	recent	M/F	94.93	/	/	/	/	/
	Tise et al. 2013	/	metric	2 distances	DFA	radius	calliper	North America	US	FDB, Pima County Office of the Medical Examiner	recent	M/F	/	/	/	89.43	81.82	97.04
	Spradley & Jantz 2011	/	metric	3 distances	DFA	Radius	caliper	Nort America	US european	FDB	1930 - recent (NS)	white M/F	/	/	/	94.34	92.24	96.43
Ulna	Jantz & Ousley 2005 (Fordisc 3)	/	metric	5 distances	CVA	ulna	caliper	North America	US european	FDB	1930 - recent (NS)	white M/F	/	/	/	92.7	92.3	93.6
		/	metric	5 distances	CVA	ulna	caliper	North America	US african	FDB	1930 - recent (NS)	black M/F	/	/	/	94.7	92.5	100
	Mall et al. 2001	/	metric	3 distances	DFA	ulna	caliper, osteometric board	Europe	Germany (NS)	Anatomical Institute Munich	recent	M/F	90.58	/	/	/	/	/
Femur	Seidemann 1998	/	metric	1 distance		os femoris, femoral neck	caliper	North America	US european	Hammann-Todd	+ 1910-1940 (NS)	caucasian M/F	92	90	94	92	90	94
		Stojanowski & Seidemann 1999	metric	1 distance		os femoris, femoral neck	caliper	North America	US european	University of New Mexic	* after 1900	caucasian M/F	/	/	/	83	83	83
	Stojanowski & Seidemann 1999	/	Metric	1 distance		os femoris, femoral neck	caliper	North America	US european	University of New Mexico	* after 1900	caucasian M/F	84	80	91	84	80	91
	Jantz & Ousley 2005 (Fordisc 3)	/	Metric	9 distances		os femoris	caliper	North America	US african	FDB	1930 - recent (NS)	black M/F	/	/	/	92.7	91	97.1
		/	Metric	9 distances		os femoris	caliper	North America	US european	FDB	1930 - recent (NS)	white M/F	/	/	/	91.9	90.7	94.6
	Spradley & Jantz 2011	/	metric	3 distances		os femoris	caliper	North America	US european	FDB	1930 - recent (NS)	white M/F	/	/	/	93.54	95.87	91.21
Tibia	Kranioti & Apostol 2015	/	metric	3 distances		tibia	caliper	Europe	Greece, Cretans	Cretan collection	+ 1968-1998 (NS)	Crete M/F	85.9-88.5	88.2-89.4	83.1-87.3	85.9-87.8	88.2-89.4	83.1-87.3
		/	metric	3 distances		tibia	caliper	Europe	Spain (NS)	Madric (UCM)	+ 1975 – 1985 (NS)	UCM M/F	86-93.5	84.8-95.2	87-92.5	85-93.8	82.6-95.3	87-92
		/	metric	3 distances		tibia	Caliper	Europe	Italy (NS)	Flaminio cemetery	+ 1970-1990	M/F	85.1-88.2	82.7-85.2	86.9-91.4	85.1-88.2	82.7-85.2	86.9-91.4
		Kotěrová et al. 2016	metric	3 distances		tibia	CT	Europe	Czech (NS)	CT examination	recent (NS)	M/F	/	/	/	55.4 –	100	3.9 – 11.5
	Kotěrová et al. 2016	/	metric	9 distances	LDA	tibia	CT	Europe	Czech (NS)	CT examination	recent (NS)	M/F	/	/	/	83.9 – 87.5	83.3 – 90	84.6
	Jantz & Ousley 2005 (Fordisc 3)	/	metric	6 distances	CVA	tibia	caliper	North America	US africa	FDB	* 1930 - recent (NS)	black M/F	/	/	/	94.5	92.4	100
	Jantz & Ousley 2005 (Fordisc 3)	/	metric	6 distances	CVA	tibia	caliper	North America	US european	FDB	* 1930 - recent (NS)	white M/F	/	/	/	92.5	91.5	94.7
Fibula	Jantz & Ousley 2005 (Fordisc 3)	/	metric	2 distances	CVA	fibula	caliper	North America	US european	FDB	1930 - recent (NS)	white M/F	/	/	/	81	81.4	80.3
Foot	Navega et al. 2015	/	metric	18 distances	decision tre	tarsal bones	caliper	Europe	Portugal (NS)	Coimbra collection	+ 1904 – 1939	M/F	/	/	/	88.3	92.6	84.8
	Jantz & Ousley 2005 (Fordisc 3)	/	metric	6 distances	CVA	calcaneus	caliper	North America	US european	FDB	* 1930 - recent (NS)	white M/F	/	/	/	92.5	91.5	94.7
Complexes	Albanese 2013	/	metric	3-6 distances	DFA	upper limb – clavicle, hur	caliper	North America, Europe	US (NS), Portugal (NS)	Terry & Coimbra collection	* 1835-1930	M/F	89.2-93	86.9-91.5	91.1-94.2	87.4-91.9	88.2-96.6	84.9-91.2
		/	metric	3-6 distances	DFA	upper limb – clavicle, hur	caliper	North America	US (NS)	Grant collection	+ ca 1900-1950	M/F	/	/	/	87.8-97.6	90-100	85.7-100
		/	metric	3-6 distances	DFA	upper limb – clavicle, hur	caliper	Europe	Portugal	Lisbon collection	+ 1880-1975 (NS)	M/F	/	/	/	77.8-88	88.9-100	55.6-75
	Albanese et al. 2003	/	Metric	3-5 distances	DFA	os femoris, os coxae	caliper	North America, Europe	US (NS), Portugal (NS)	Terry, Coimbra	* 1832 – 1930	M/F	93-98	92-97.9	93.6-98.1	91.8-98.5	91-98.5	89.5-98.5
		/																

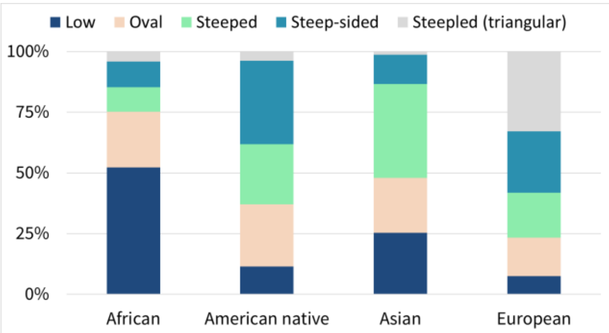
Population affinity assessment

Non-metric cranial traits – frequency among different populations

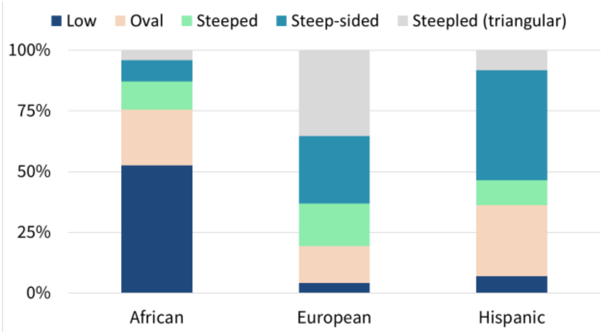
Nasal bone contour



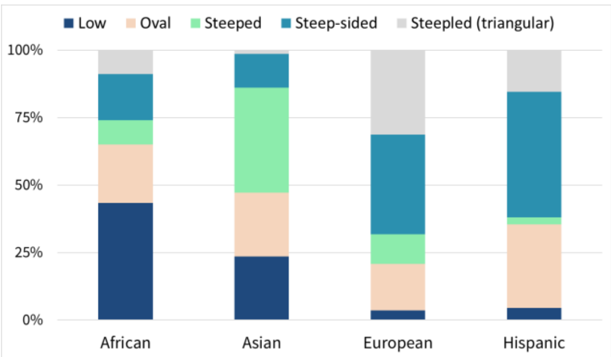
Hefner 2009



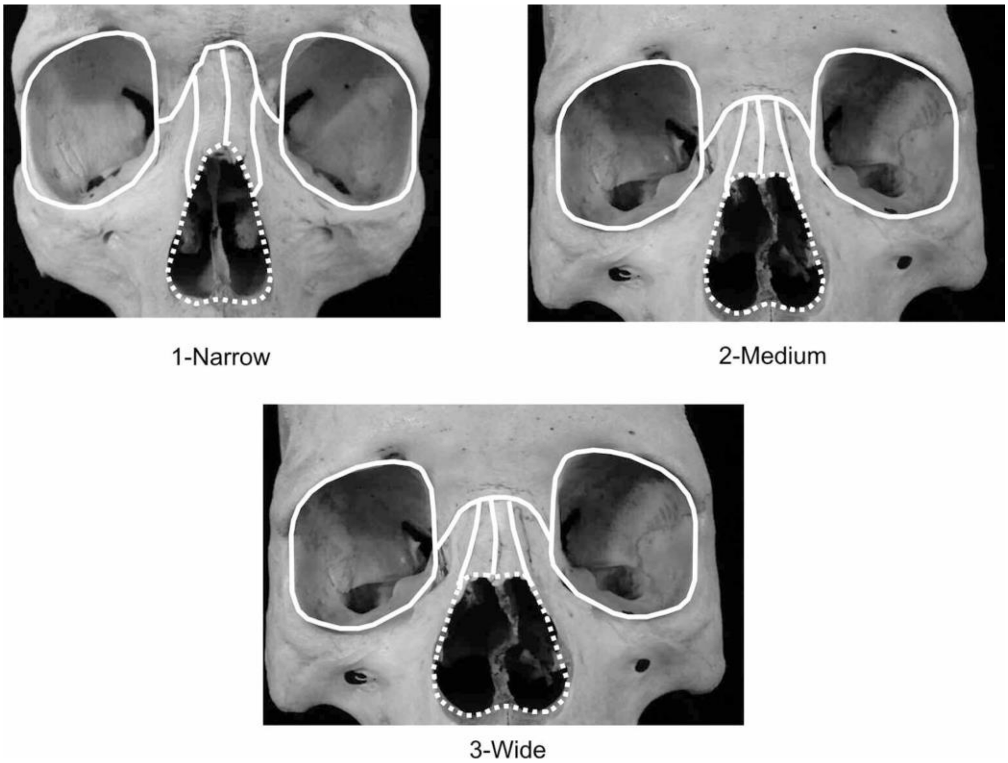
Hefner 2015



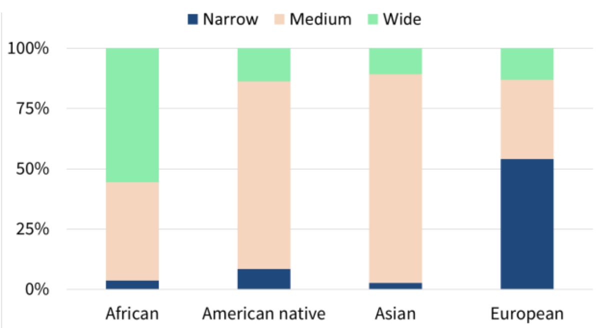
Hefner 2016



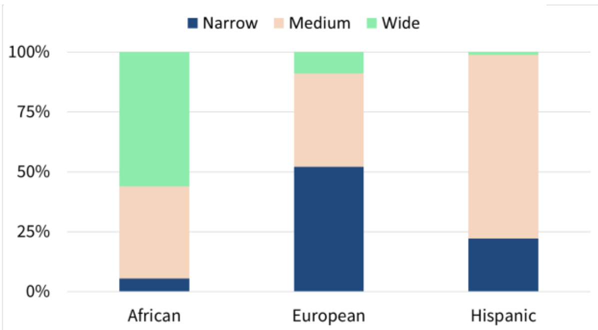
Nasal aperture width



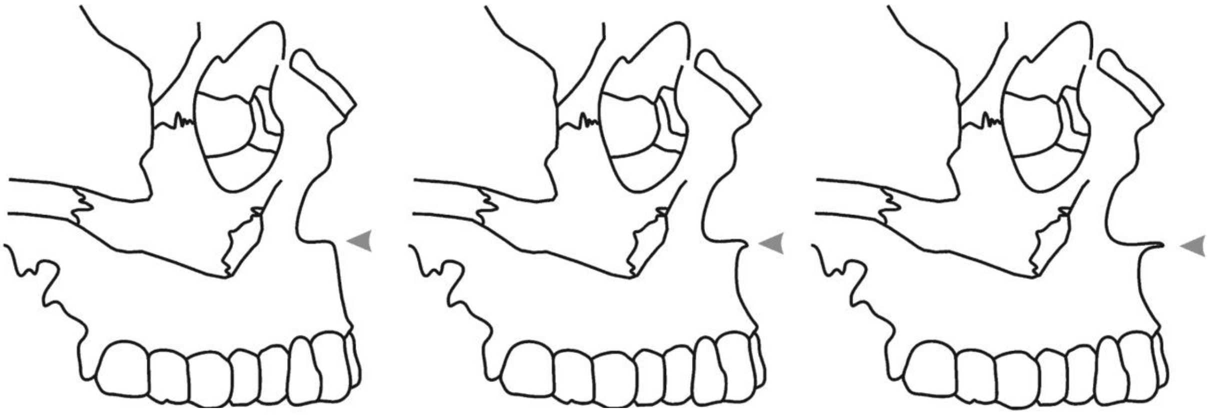
Hefner 2009



Hefner 2015

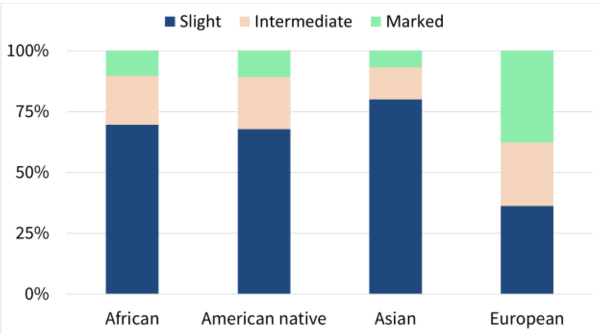


Anterior nasal spine

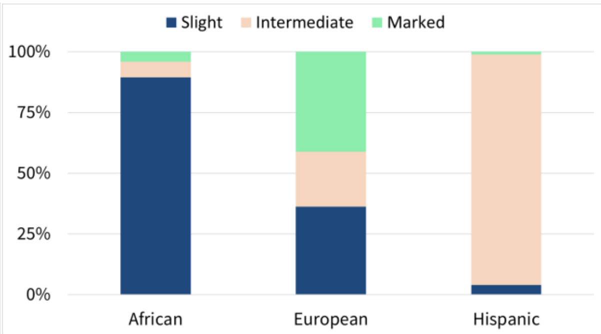


Slight | Intermediate | Marked

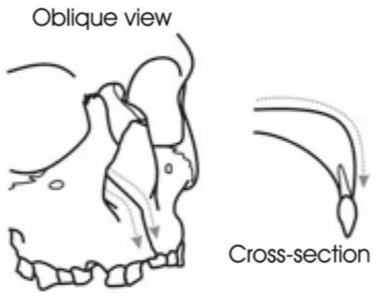
Hefner 2009



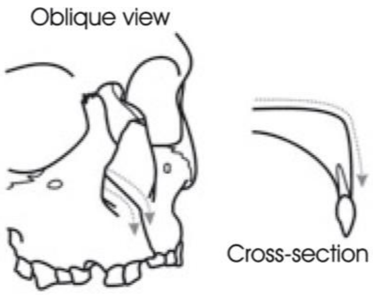
Hefner 2015



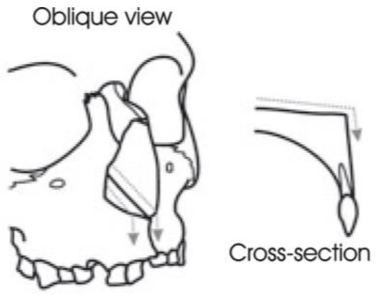
Nasal sill morphology



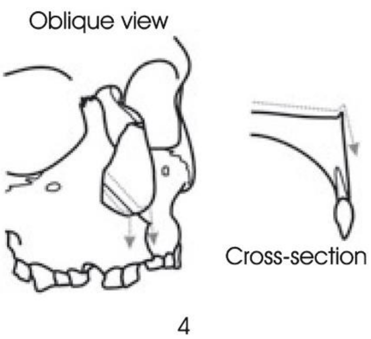
Guttered



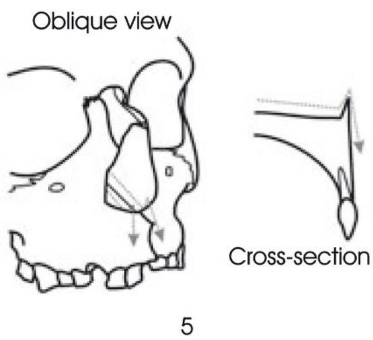
Incipient gutterung



Straight/Blunt

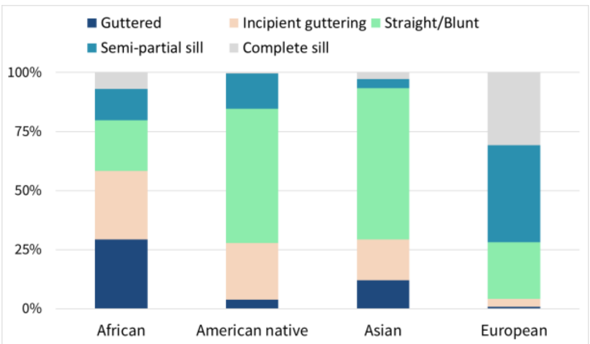


Semi-partial still

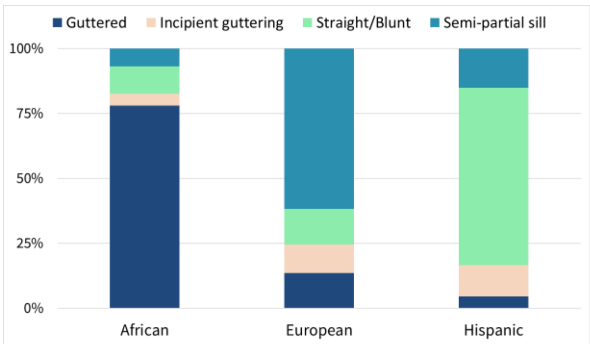


Complete still

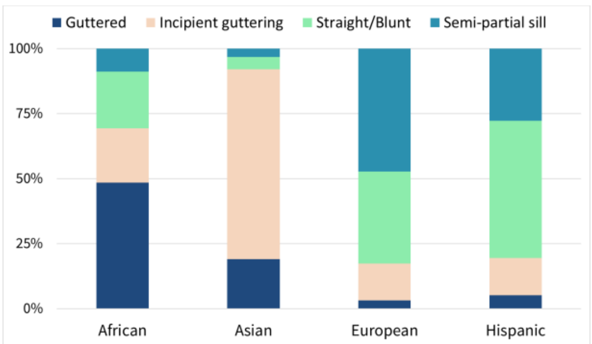
Hefner 2009



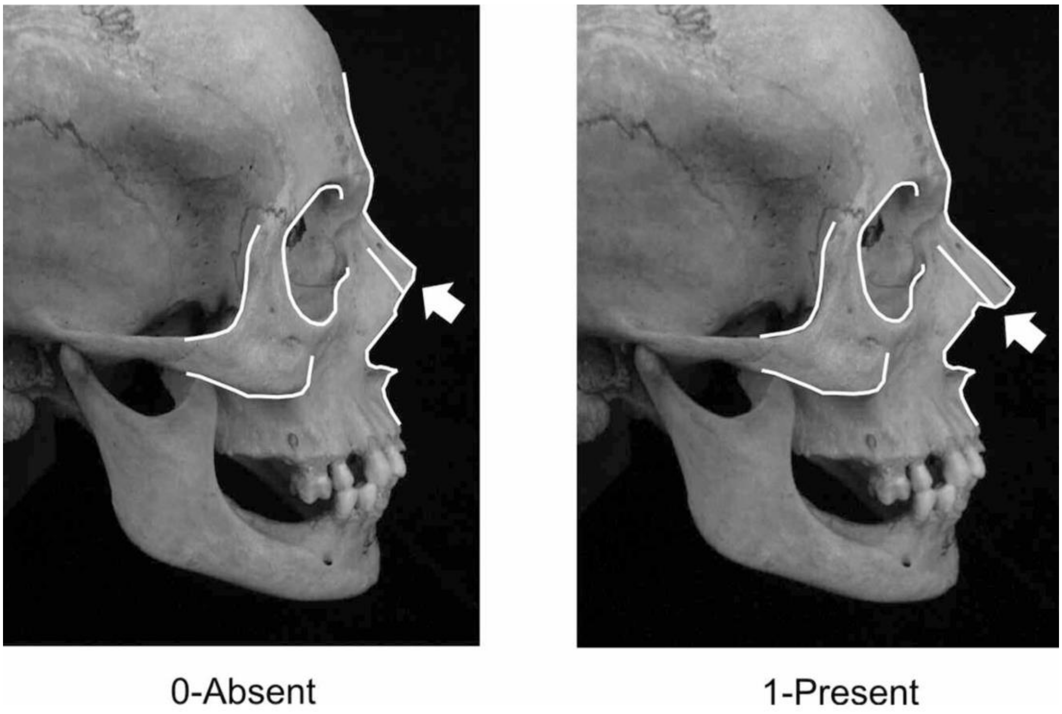
Hefner 2015

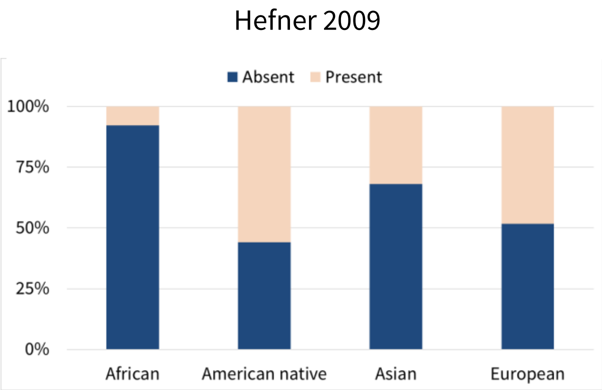


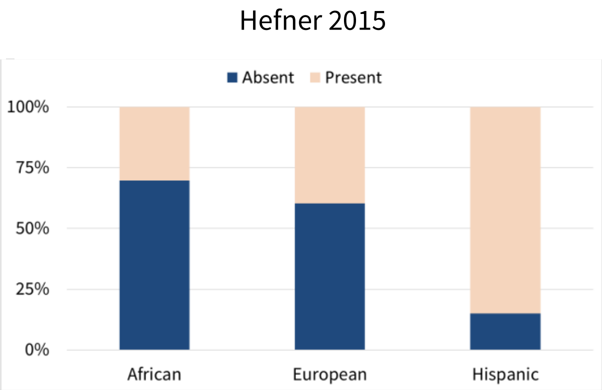
Hefner 2016



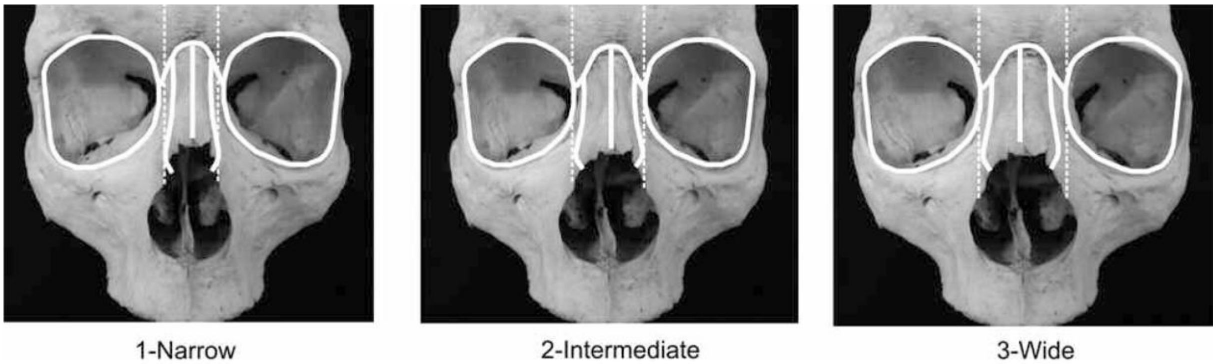
Nasal overgrowth



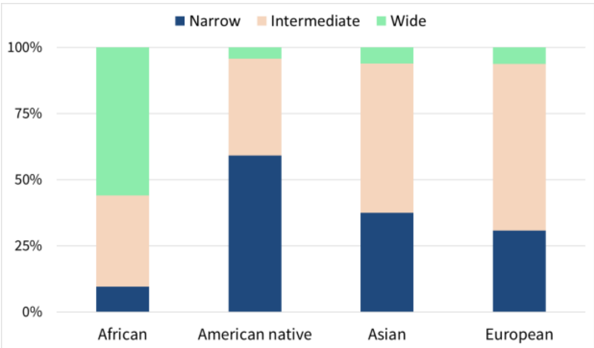




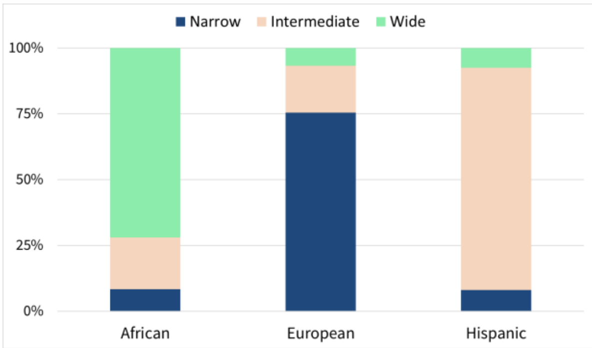
Interorbital breadth



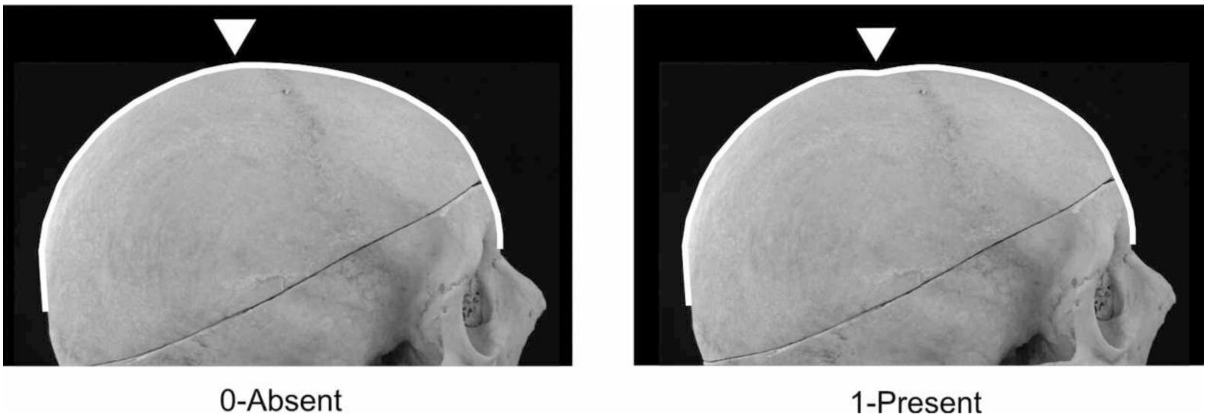
Hefner 2009



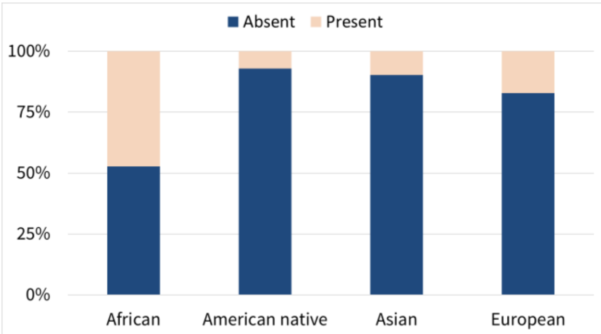
Hefner 2015



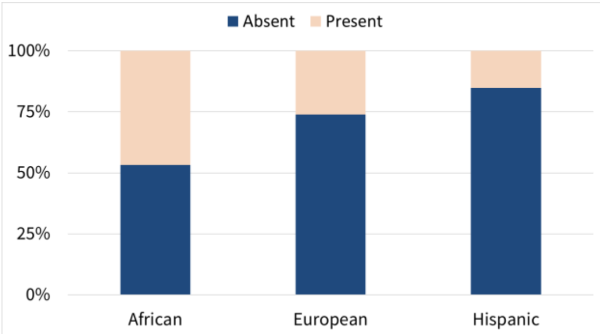
Postbregmatic depression



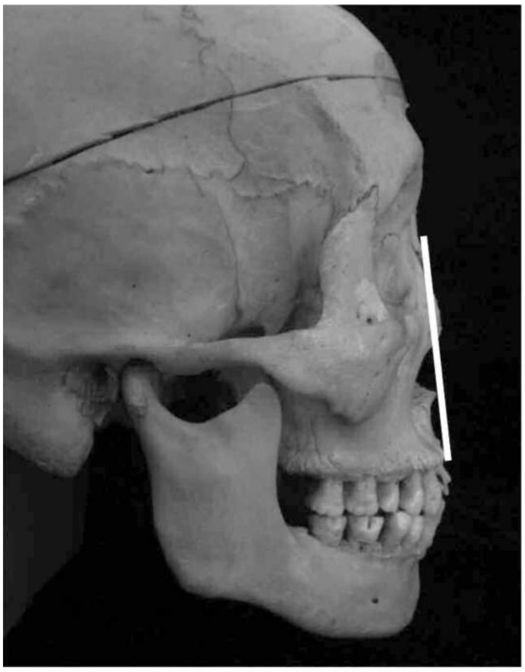
Hefner 2009



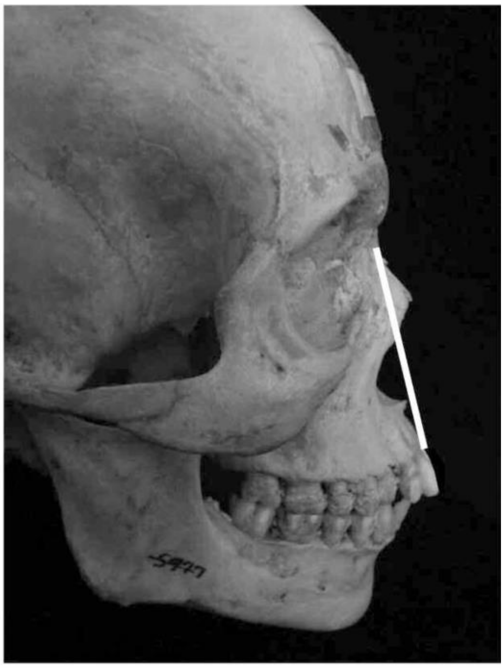
Hefner 2015



Alveolar proghnatism

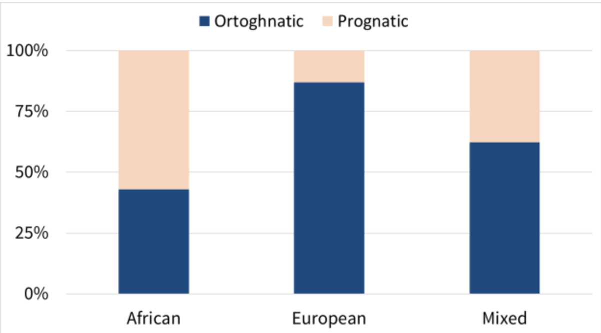


1-Orthognathic

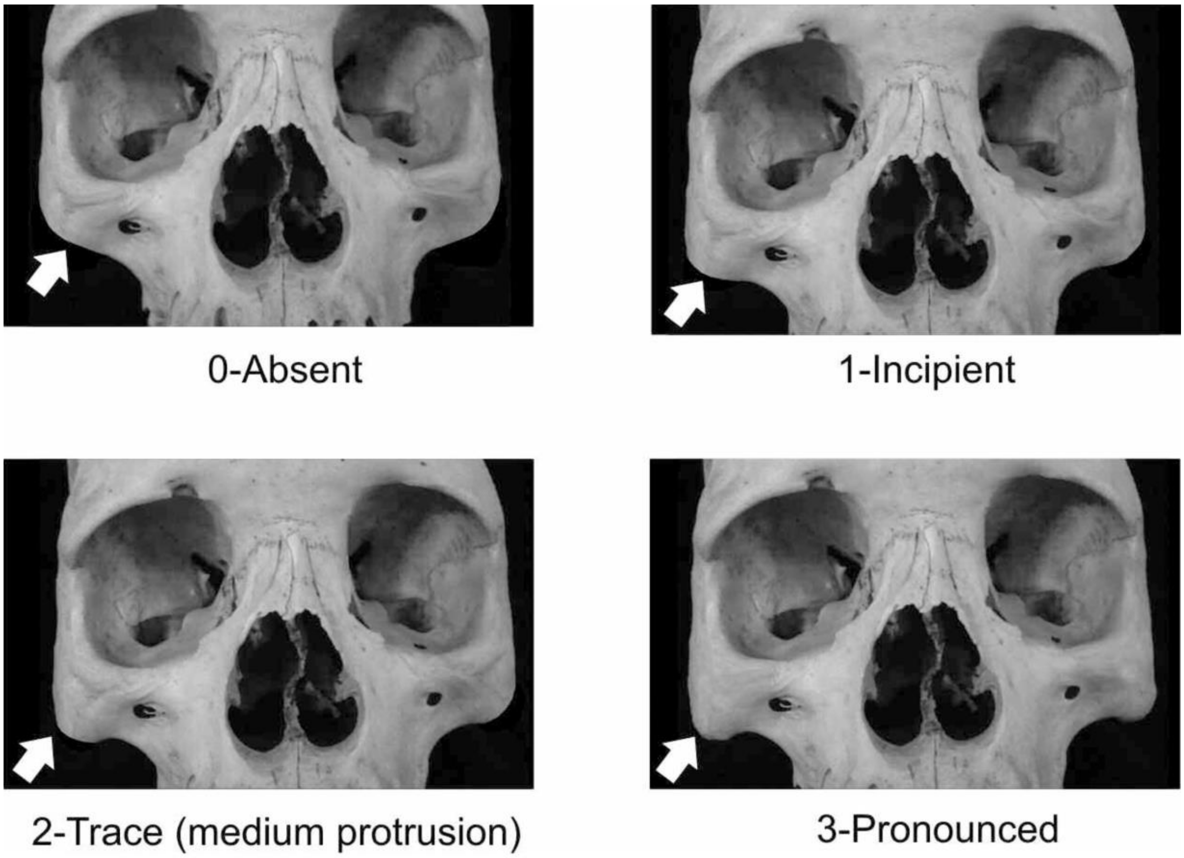


2-Prognathic

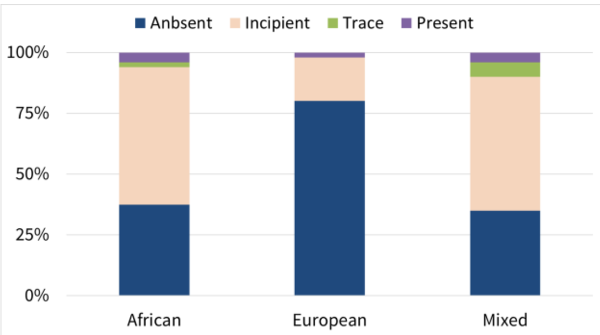
L´Abbé et al. 2011



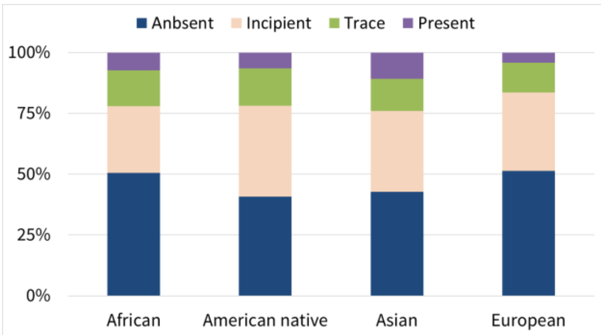
Expression of the malar tubercle



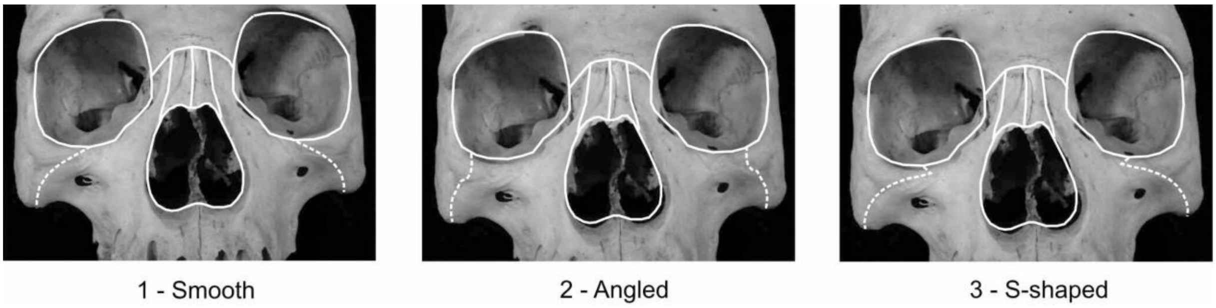
L´Abbé et al. 2011



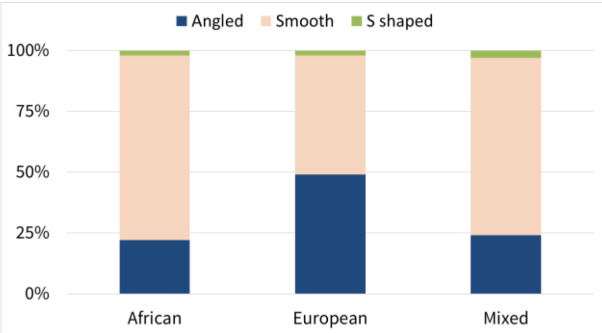
Hefner 2009



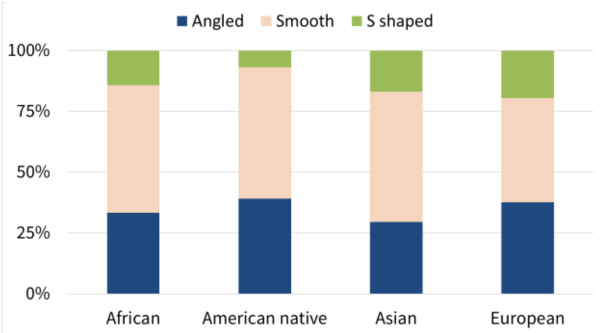
Zygomaxillary suture



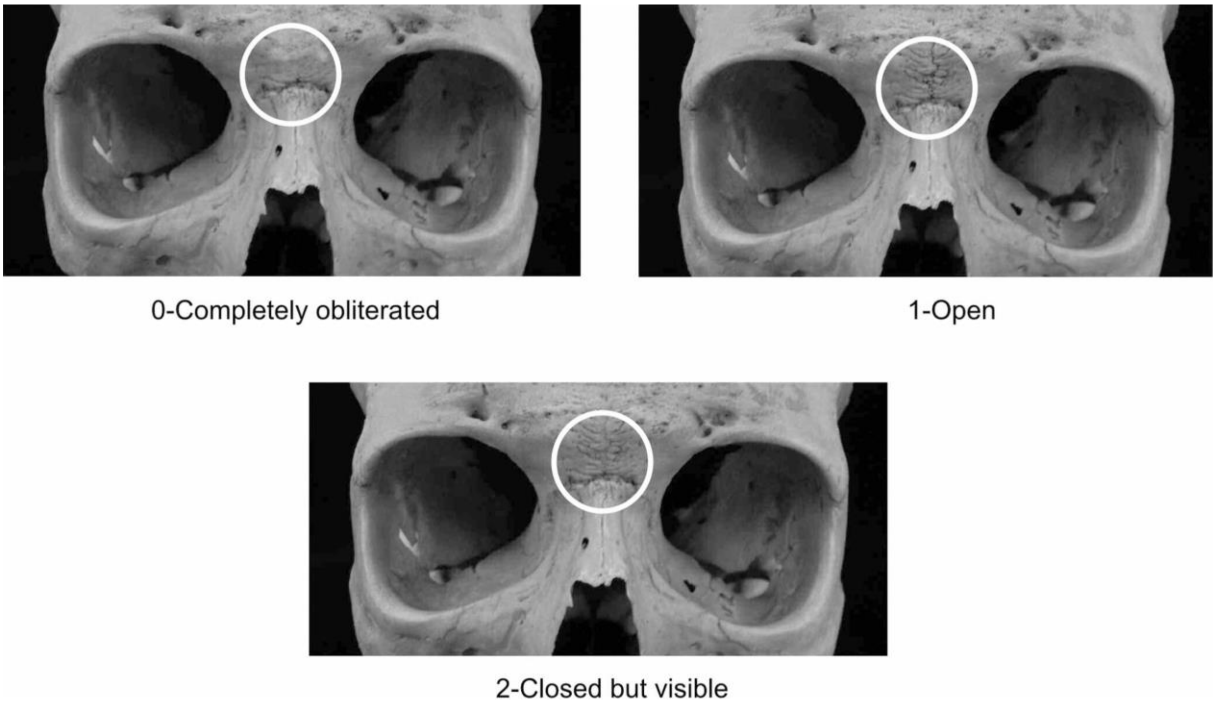
L´Abbé et al. 2011



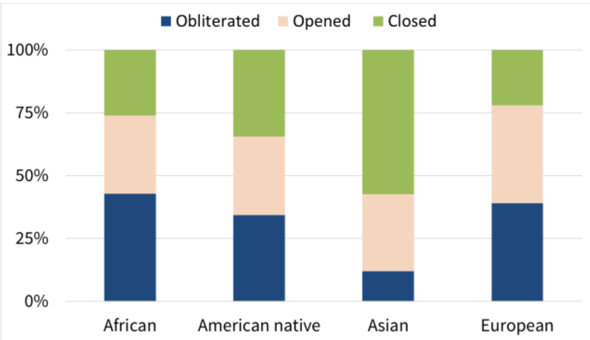
Hefner 2009



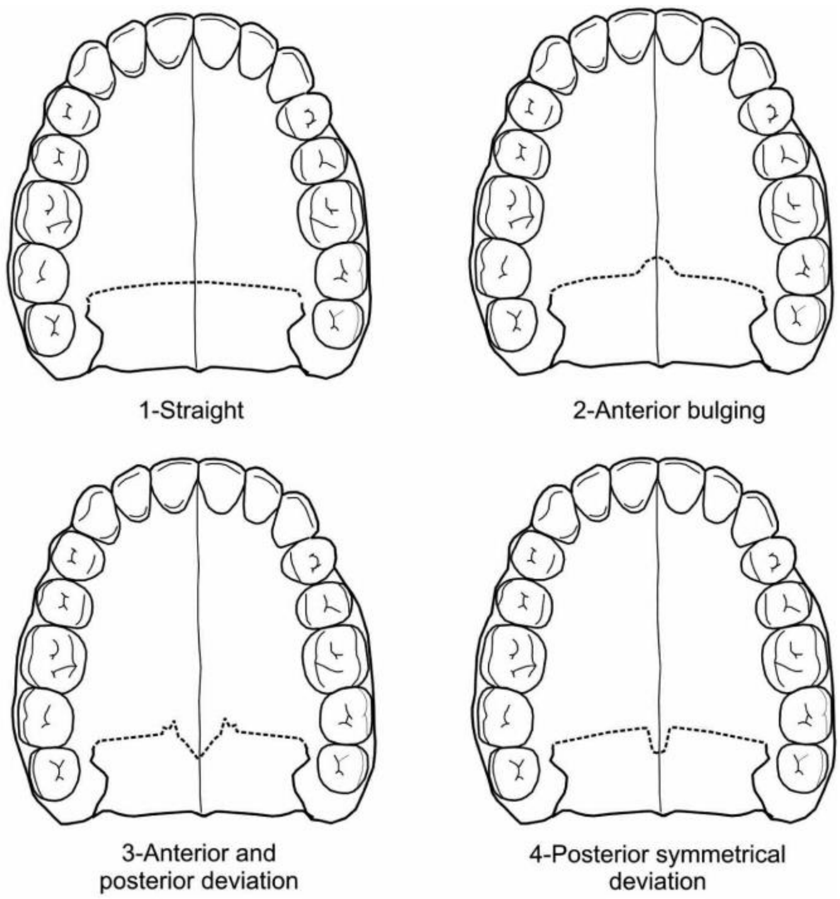
Supranasal suture



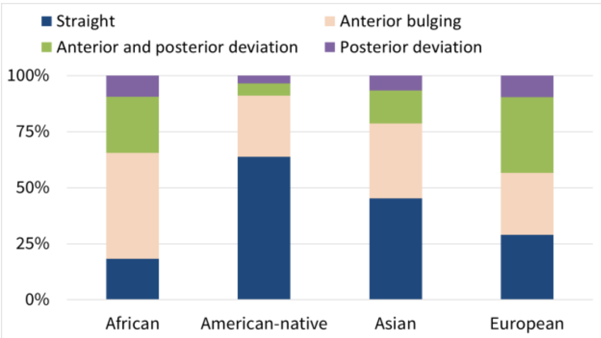
Hefner 2009



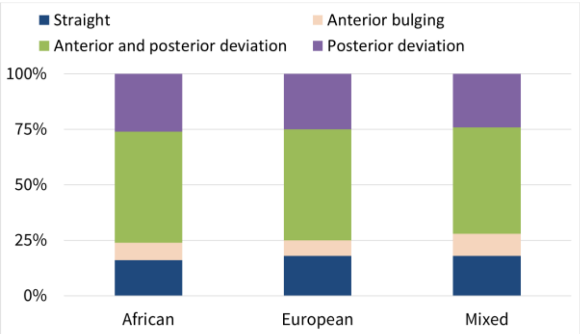
Palatine suture shape



Hefner 2009



L´Abbé et al. 2011



	Groups	Original study	Validation	Method	Variables	Statistics	Skeletal part	Equipment	Continent	Origin	Collection	Time	P		
													Black	Hispanic	White
cranium	Black, Hispanic, White	Hefner & Ousley 2014	/	visual	6 traits	decision tree	cranium	/	Africa, Europe, North America, Asia	US african, african, asian, US asian, european	multiple collections	Late 18th and early 20th century	91 %	58 %	80 %
cranium	multiple	Jantz & Ousley 2005 (Fordisc 3.0)	/	metric	multiple distances	CVA	cranium	caliper	multiple	multiple	/	/	/	/	/
	FDB; African, European, Asian		Urbanová & Jurda 2014	metric	12-14 distances	CVA	cranium	MicroScribe	South America	Br. european, Br. african, Br. asian	USP	+ 1917-1937	overall 50 %; Br. asian 68 %	/	/
	Howells; African, European, Asian		Urbanová & Jurda 2014	metric	12-14 distances	CVA	cranium	MicroScribe	South America	Br. european, Br. african, Br. asian	USP	+ 1917-1937	overall 44,5 %; Br. asian 65%	/	/
	Howells; Berg, Hokkaido, Santa Cruz, Tasmanians, Zulu		Elliott & Collard 2012	metric	10-56 distances	CVA	cranium	caliper	Europe, Asia, North America, Africa	Europe, Japan, Santa Cruz, Tasmania, Zulus	Howells database	-1600-20th century	under 40 %	/	/
	FDB		Ubelaker et al 2002 (Fordisc 2.0)	Metric	20 distances	CVA	cranium	caliper	Europe	Spain (NS)	UCM	1500-1700 (NS)	overall 53.68	/	/
													US european M/F	US african M/F	US natives M/F
cranium	3; US european, US african, US natives	Gilles & Elliot 1963	/	metric	8 distances	CVA	cranium	caliper	North America	US african, US European, US natives	Terry collection, Todd collection, Knoll site (natives)	1893-1965 (eur, afr); , 3 450 BC	80.0 / 88.8	85.3 / 88.0	94.7 / 93.3
	2; US european, US african		İşcan & Steyn 1999	metric	8 distances	CVA	cranium	caliper	Africa, Europe, North Amer	RSA african, RSA european	Dart collection, University of Praetoria collection	* 1827-recent	83 / 76	95.5 / 97.7	/
	3; US european, US african, US natives		Snow et al. 1979	metric	8 distances	CVA	cranium	caliper	North America	Oklahoma	Oklahoma forensic cases	+1976-1979	85 / 71.4	87.5 /	20 / 0
cranium	/	Slice & Ross 2009 (3DID	/	metric	landmark coordinates	CVA	cranium	digitizer	multiple	multiple	14 collections	NS	/	/	/
	multiple populations; African, European, Asian		Urbanová & Jurda 2014	metric	landmark coordinates	CVA	cranium	digitizer	South America	Br. european, Br. african, Br. asian	USP	+1917-1937	55 %; european 87%	/	/
													US African M/F	US European M/F	
postcrania	2; US european, US african	Holliday & Falsetti 1999	/	metric	7 distances		multiple bones	caliper	North America	US african, US european	Terry collection	+1920-1965 (NS)	88.4 / 100	85.7 /100	
	2; US european, US african		/	metric	7 distances		multiple bones	caliper	North America	US african, US european	Pound Human Identification Laboratory - Florida, Ma	recent	100 /	75 / 57.14	
cranium	African, Austro-Melanesian, East Asian, European, US Natives, Polynesian	Navega et al. 2015	/	metric	23 distances	machine lea	cranium	caliper	multiple	multiple	Howells database	NS	/	/	
													African (6 ref groups / 2 ref groups)	European (6 ref groups / 2 ref groups)	
	2-6 reference groups		/	metric	23 distances	machine lea	cranium	caliper	Africa, Europe	african, european	African slaves skeletal collection, Coimbra collection	ca 14th century (african); +1904-1938 (european)	75 / 93.75	79.17 / 93.75	
													African (CV)	African-European (CV)	
	2, Afr. european, African	İşcan & Steyn 1999	/	metric	17 distances		cranim + mandible	caliper	Africa	African, Afr. european	Dart collection, University of Praetoria collection	* 1863-1951	97.7 (95.3)	97.8 (93.5)	
													African M/F (CV)	African-European M/F (CV)	
	2, Afr. european, African	Patriquin et al. 2002	/	metric	13 distances		pelvis	caliper	Africa	African, Afr. european	Dart collection, University of Praetoria collection	* 1827-recent (NS)	89 (89) / 88 (88)	87 (86) / 82 (82	
													overall (observed)	overall (CV)	
	2, US European, US African	Holland 1986	/	metric	8 distances		cranial basis	caliper	North America	US african., US european	Terry collection	* 1828-1943 (NS)	70-86	75-90	
													male / female	male / female (CV)	
	2, Afr. european, African	Bidmos 2006	/	metric	8 distances		calcaneus	caliper	Africa	African, Afr. european	Dart collection	* 1827-1980 (NS)	87.8 / 81.1	86.7 / 80	
													US african + european M/F	US natives M/F	
	2; US european + US african, US native	Wescott & Srikanta 2008	/	metric, platymery index	/	/	os femoris	caliper	North America	US african, US european, US natives,	American Museum of Natural Histor, Terry collection, FDB, University of Tennessee/Smithonian institute	presumably 1830-1983, US natives ca 7000 BC	79 / 77	72 / 82	
														overall (observed)	
	3, US european, US african, US hispan	Hefner et al. 2015 (Taala)	/	visual	8 traits	SVM	Cranium	/	North America	US african, US american, US hispanics	Terry collection, Bass collection, PCOME Tucson	* 1800-recent		83.4	

Assessment of nutritional status

Nutritional status assessment has world-wide importance. Despite (or maybe because) the current extensive development of technology and the associated relative lifestyle improvement, the world population is threatened by malnutrition pandemics. The ever-increasing gap between the "west" and the "third" world manifests also in the nutritional status of these areas. On one hand an increase in the incidence of individuals with over-nutrition which manifests, in cooperation with insufficient amount of physical activity, as an epidemics of overweight and obesity in the countries of the "western" world. On the other hand, in the geopolitical areas of southeast Asia and sub-Saharan Africa up to 1 billion people suffer from chronical undernutrition. Both extremes on the scale of human nutrition status negatively affect the individual's quality of life and increase the population levels of morbidity and mortality.

To evaluate nutritional status several methods have been developed. When individual nutritional status, or, especially in cases of malnutrition risk situations, population samples nutritional status is assessed, adequate method choice is crucial not only from the practical (timewise) aspect, but also considering the aspect of results reliability and their comparability and correct diagnostics.

Nutritional status assessment methods can be divided into three fundamental categories: clinical methods, anthropometrical methods and methods evaluating alimentation (nutritional intake and habits). Clinical methods can further be divided into aspective and laboratory/onsite methods. Alimentation evaluation methods are based on a recapitulation or immediate recording of the type and amount of ingested food (dietary regimen evaluation). One of the recording options is a "continuous" recording into a diet diary, another option is a retrospective recording, utilizing the so called dietary recall (24 hour) repeated during several subsequent days. Anthropometric methods of nutritional status assessment utilize several somatic parameters (height/weight, circumferences and skinfold thicknesses) which are used to calculate basic indices or more complex body composition approximations.

Body composition assessment (body mass fractionation; practical applications include both anthropometrical and laboratory/onsite methods) plays an important role among nutritional status assessment methods. Model approaches of body mass fractionation (body composition assessment) can be historically speaking divided into two fundamental categories – a chemical model and an anatomical model. An up-to-date detailed categorization is used with respect to the practical application and according to respective model approach:

Atomic model is based on the human body being composed of individual chemical elements (98% body mass is composed of 6 elements – C, O, H, N, Ca, P).

Molecular model fractionates the total body mass into these components: lipids, water, proteins, minerals and glycogen.

Cellular model collates the total body mass from fatty tissue, muscle tissue, connective tissue, epithelia and nerve cells, extracellular fluid and inorganic matter.

Tissue-systemic model fractionates the total body mass into organ system parts – musculoskeletal, integument, nervous, respiratory, cardiovascular, digestive, urinary, reproductive and endocrine systems.

Whole-body model is primarily based on anthropometric measurements which enable the estimation of lean body mass and fatty tissue ratio to the total body mass. Today, biophysical and biochemical methods can be included into this category. The whole-body model can be subdivided into these categories:

Two-component model fractionates the human body mass into two components – body fat (FM – fat mass) and lean body mass – (FFM – fat free mass).

Three-component model fractionates the human body mass into three components – body fat, body water and dry matter (in practice, this fractionation can be simplified – the components represent body fat, muscle tissue and osseous tissue).

Four-component model fractionates the human body mass into four components – body fat, extracellular fluid, cells and minerals (Riegerová, Přidalová, Ulbrichová, 2006).

Despite the marked rise in advanced methods utilization in anthropological practice, anthropometrical methods are still frequently used to assess body composition: worth mentioning is certainly the three-component model based on height, breadth, circumference (corrected) somatic parameters (including 6 skinfold thicknesses acquired using caliperation method). This method is named after its author Jindřich Matiegka and fractionates the human body mass into the osseous component, muscular component, integument and a residue. Also, anthropometric methods include a variety of two-component models; particularly, these are regression formulas for body (subcutaneous) fat calculation which are based on the thickness of several skinfolds. These methods include for example Jackson-Pollock method based on three skinfolds (Jackson et al., 1980, Jackson, Pollock, 1978), Durnin-Womersley method based on four skinfolds (Durnin, Womersley, 1974) and in our country frequently used method by Pařízková (1962) based on 10 skinfolds.

In clinical practice, biophysical methods are most frequently used (the majority of them can be categorized as two-component models). These include radiological methods (CT, DEXA), densitometry, underwater weighing, plethysmography etc. Relatively low-cost and little time-consuming, bioelectric impedance method (or bioelectric impedance analysis – BIA) is used very frequently. Body composition approximation is generated with regard to the principle of different conductivities of body water and body fat. BIA apparatus measure the electric impedance of body tissues against a distribution of low voltage, high frequency electric current. Fat free mass with high water (and electrolyte) content is a good conductor (presents low impedance), fat mass with low water content acts as an insulator. Based on regression formulas, the overall impedance (or segmental impedance) is used to calculate the percentage of fat free mass and fat tissue. Biompedance apparatus can be divided into two basic categories: bipolar machines (the current passes only through the upper, or, in some cases, only through the lower, part of the body and tetrapolar machines which use 4 sensors with up to eight electrodes; 2 sensors to for the upper limbs, two sensors for the lower limbs.

When comparing the results obtained using various methods (or various machines makes), the following potential problems have to be taken into account: measurement errors when using BIA apparatus usually arise when the examination/operation conditions are not adhered to or when the electrodes are incorrectly located; in anthropometrical methods, the measurement error most frequently arises in insufficiently experienced examiners and the incorrect "lifting" (pinching) of the skinfolds. With regard to the results comparability potential problems can arise when bioimpedance machines with fix regression formulas are used inadequately (on a substantially distant population research sample). Another possible source of comparison-related problems (especially when comparing the results acquired through caliperation to the results acquired through BIA is the difference in measurement/estimation. Caliperation methods can provide results on the amount of subcutaneous fat while the bio-impedance machines operate with visceral fat also. Some authors do state that there is some evidence of the increase of visceral fat amount with the increase in subcutaneous fat percentage but that the relationship is affected by many confounding factors, especially age.

Nutritional assessment decision process flow

A nutritional status assessment is needed with regard to the evaluation of diet – nutritional values of ingested food and eating habits

- Some of the diet evaluation methods utilizing a diet diary or a questionnaire survey (recall method) can be used

Body composition/nutritional status needs to be assessed with highest possible accuracy, using a method considered a "gold standard", with application in clinical anthropology/medicine, eventually to verify a new method/method innovation.

- A DEXA (Dual Energy X-ray Absorptiometry) system evaluation can be used (access to these machines is limited due to their high cost; moreover, they emit ionizing radiation and therefore cannot be used without a physician's indication
- Alternatively, BOD POD system evaluation can be used. Air displacement plethysmography (air volume displaced by the mass of the human body in the closed space is measured). Again, the machines are usually available only in specialized institutions.
- Underwater weighing is also considered to be relatively accurate, although it also requires specific equipment.

Body composition/nutritional status needs to be assessed, using a quick method which utilizes widespread and quite readily available, easy-to-use machines. The aim of the assessment could be as an associated index in a complex anthropological examination or to assess the effect of a particular factor (change in one of the lifestyle characteristics) on the nutritional status of an individual or a group of individuals. Further, for inter-individual variation evaluation in body composition, if the machine used in the reference sample is known.

- Bioelectrical impedance analysis (BIA or bioimpedance) method can be used. It is required however that relatively strict conditions are adhered to (at least in some of the machines – fast, no strenuous physical activity 24 hours prior etc.). Also, pregnant women and patients with cardiac pacers can't be examined. It is also important for comparison reasons to take into account what type of machine is used – bipolar or tetrapolar.

Body composition/nutritional status needs to be assessed using a traditional method with wide range of comparison/reference samples available. A method which still is widespread and its usability is especially high when nutritional status needs to be assessed in less developed regions as it is low-cost and time-effective. The disadvantage of the method lies in relatively high requirements on the examiner's experience.

- An anthropometric – caliperation – method is the method of choice. Many approaches are available differing in the number of skinfolds (or other measured parameters) and resulting regression formulas. The majority are two-component – fractioning body mass into FM and FFM, but Matiegka's method is an example of a three-component approach.

Body type assessment

Typology (scientific method based on categorizing objects according to a generalized model or type) is applied in the anthropology of the living human basically in two forms. (Bearing in mind that it is crucial to differentiate between “scientific” typology and so called anthropological biotypology which, in short, is a pseudo-scientific, quasi-diagnostic approach. In part it is based on scientific methods from biological and psychological disciplines but it leads to a belief that conclusions about personality, intellectual, social and other traits, properties and skills can be made based on generalized and often only popular relationships between the appearance – shape and development – of the body and its parts and psychological properties).

Typology in anthropology of the living Man is utilized to evaluate individual and inter-population variation of somatic characteristics. One typology application encompasses the evaluation of non-metrical traits on the human body and head. Individual characteristics are visually assessed and verbally described based on the development of their size and shape, with the goal of individual description (which can be applied e.g. in criminology) or with the goal of assessing the distribution frequencies of said characteristics in the population. Some of the features (especially facial features) are adaptive traits and their frequency in particular ethnic groups or populations is very high. This chapter will, however, focus on the other typology application in the anthropology of the living human, which focuses on body type assessment. Similarly, as in the non-metric trait evaluation on the human head and body, body type assessment is utilized to evaluate individual variation and to categorize the body type continuum as body type is associated with many functional and physiological parameters.

Body type assessment methods

Body type is primarily assessed using traditional methods (aspective and metrical). Also advanced methods of virtual anthropology allow body type assessment (for example BVI – Body Volume Index method), it is however not their primary objective. These issues will be dealt with elsewhere.

Traditional methods of body type assessment underwent a complicated historical development. To simplify, the methods developed from a somatoscopic evaluation (two extreme types are established with a third type in between) to exact metric methods. Body build typology history dates back to Hippocrates who defined two basic types – habitus phthisicus (lean, slim) and habitus apoplecticus (rotund, short). Renewed interest in human body build type appeared after a long hiatus in the 19th century; the French school founded by Hallé (4 types – abdominal, thoracic, muscular and cranial), included authors Rostan, Sigaud, Viola and classified the human body types according to the organ system most implied in individual body build. Viola’s method is relatively complex and complicated (he introduced 18 body type categories), on the upside this method attempts to eradicate the somatoscopic parameters (burdened by a considerable amount of subjective error) from the evaluation. In anthropology of the living human we can also today encounter the use of aspective body type classification according to Kretschmer; to have an introductory understanding of the body type of individual participants in the majority of anthropometric surveys (the method contributes an additional information value for the practical measurement procedure). Kretschmer uses distribution into three body types (asthenic, athletic and pyknic); according to the author each type is associated with biological affinity to different psychological disorders (interestingly, Hippokrates himself named his types of body build according to their association to certain diseases – phthisis – consumption, apoplexy – bleeding). The reliability of his conclusion, however, remains unclear despite the efforts of other researchers.

Many subsequent studies focused on body type evaluation with regard to the relationship between body height and weight, with regard to body mass development (hyper-, hypo- and normoplasia) and with regard to the amount and distribution of body fat.

Anthropometric characteristics by themselves also provide information on body type. Without the use of advanced methods the traditional metric procedures are not sufficient for body type description purposes. For a basic idea some indices can be used which have a higher information value on body type than isolated measurements. BMI, WHR or various body segment indices can be used as an example.

A method called somatotype evaluation can be considered a “stand-alone” among the body type assessment methods as it differs from all of the above mentioned ones. Somatotype is unlike the other methods centered on individual body type description. The author of somatotype method was William Sheldon with collaborators who invented the method in 1940. Sheldon introduced three components of body composition to describe body type of each man/woman with maximum accuracy. Each component is based on one of the three germ layers (and tissues developing in them). The components are: endomorphy, mesomorphy and ectomorphy. The original Sheldon somatotype calculation was very complicated and even after modifications the major part of the body type assessment was affected by a high level of subjective error. Parnell modified the original Sheldon’s method and created a foundation for the current, wide-spread somatotype adaptation by Heath and Carter. This adaptation is bases exclusively on empiric data.

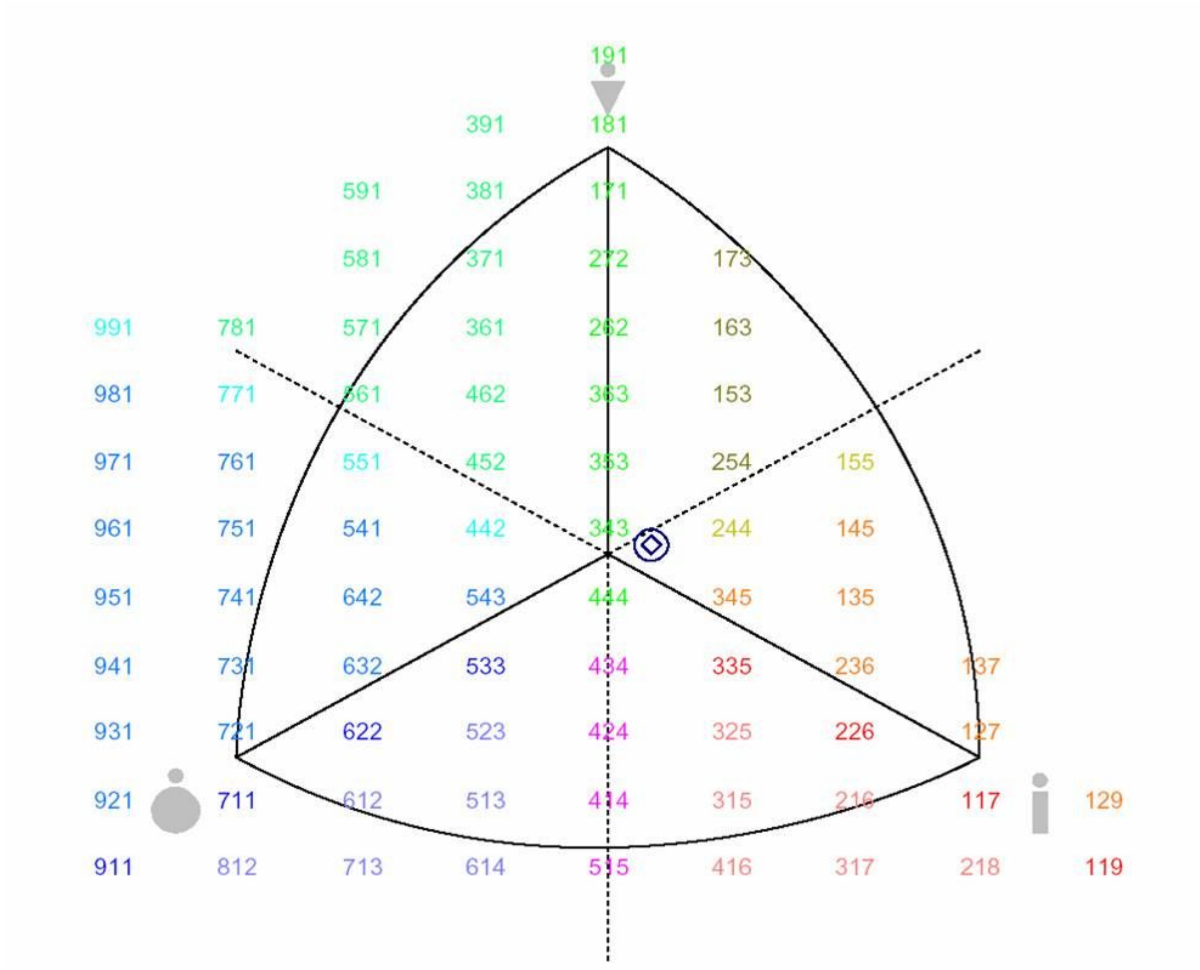
The up-to-date adaptation is based, of course, on the three original Sheldon’s components. The first component, endomorphy, is associated to the relative fatness or leanness of the individual, i.e. it evaluates the amount of subcutaneous fat. The second component, mesomorphy, relates the musculoskeletal development to body height; i.e. mesomorphy evaluates the body mass without the body fat to body height. The third component, ectomorphy, regards the relative length of individual body segments. Table 1 contains the anthropometric measurements which are necessary for somatotype evaluation.

Table 1

	Endomorphy	Mezomorphy	Ectomorphy
Measurements	Triceps skinfold	Arm circumference (flexed)	Body height
	Subscapular skinfold	Calf circumference (maximum)	Third root of body weight
	Suprailiac skinfold	Biepicondylar breadth of the humerus	
		Biepicondylar breadth of the humerus	
		Calf skinfold (II)	

The acquired data can be either input into the specific somatotype evaluation protocol (separate protocols exist for adults and children) or into a somatotype calculator (in form of paid SW – eg. Somatotype) or freeware, e.g. Biocalcul (available for download in IS study materials, course Methods of Anthropology II). Utilizing a simple procedure the resulting numeric values of each component can be extrapolated onto a somatograph (so called Sheldon’s triangle, fig. 1) for a visual idea of the complex body build.

Fig. 1 Somatograph (Sheldon’s triangle)



Somatotype evaluation not only has importance in human body variation description, but also in various practical applications. Somatotype evaluation has utmost importance in the anthropology of sport. In various sports disciplines specific somatotypes (body types) are preferred. In order to succeed in some of these disciplines “extreme” somatotype is basically a must. Somatotype evaluation is also utilized in clinical practice or in medical genetics; a close association of specific somatotypes to various hereditary diseases (e.g. Down syndrome or sclerosis multiplex) has been observed.

Body build assessment decision process flow

A basic introductory body type of an individual is needed (e.g. before an anthropometric examination or a somatic characteristics evaluation of any kind)

- One of the aspective/somatoscopic methods of body type assessment is the primary choice (often, Kretschmer’s method is used which categorizes individual body types into three categories – asthenic type: lean body proportion characteristics are predominant; athletic/midtype: predominant characteristics include well developed musculoskeletal system; pyknic type: markedly developed subcutaneous fat layer is the predominant characteristic

A numeric, precise description of body build, based on empiric somatic characteristics of an individual or a group of individuals is needed with application in sports or clinical anthropology/medicine; or, with the goal to evaluate inter-individual body type variation. Somatic parameters shown in Table 1 are available.

- Heath – Carter somatotype evaluation method is the method of choice.