

EVALUATION OF THE STATURE HEIGHT IN THE MAHARASHTRA POPULATION BY USING ARM SPAN USING REGRESSION EQUATION

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Abstract

Measurement of body size such as height and weight are required for assessment of growth and nutritional status of person, determination of basic energy requirements, standardization of measures for physical capacity, for adjusting drug dosage and for identifying an unknown cadaver. However, in some situations it is not possible to measure the stature of a person because of deformities of the limbs, in person who have undergone amputations or in unknown cadavers where lower limb (s) and / or trunk is mutated / absent. In such cases, stature has to be estimated using other body parameters. These estimations are also of prime importance in predicting the age-related loss in stature, identifying individuals with disproportionate growth abnormalities, skeletal dysplasia, medico-legal cases or height loss during surgical procedures on the spine. These measurements also have found application in normalizing pulmonary function in scoliosis. Hence based on these findings the present study was planned for evaluation of the stature height in the Maharashtra population by using arm span using regression equation.

The present study was planned in Department of Forensic Medicine, Dr. Panjabrao Alias Bhausaheb Deshmukh Memorial Medical College, Shivaji Nagar, Amravati. The total 50 cases of the age group from 20 - 45 years were enrolled in the present study. This age group was chosen because the growth of an individual ceases by this age and there is no age related loss in body height at this age.

Arm span measurement can serve as one of the most reliable body parameter to determine stature of an individual. It is useful in determining related loss in stature and in identifying individuals with disproportionate growth abnormalities. The data generated from the present study concludes that arm-span and hand length can be used in estimation of the height of both males and females. The regression equations so derived can be used in cadavers or an amputee with fairly accurate results. This can be helpful in medico- legal cases as well as in study of anthropology.

Keywords: Stature Height, Arm Span, Maharashtra Population, etc.

Introduction:

Anthropometry refers to the measurement of the human individual. An early tool of physical anthropology, it has been used for identification, for the purposes of understanding human physical variation, in paleoanthropology and in various attempts to correlate physical with racial and psychological traits. Anthropometry involves the systematic measurement of the physical properties of the human body, primarily dimensional descriptors of body size and shape.[1]

Today, anthropometry plays an important role in industrial design, clothing design, ergonomics and architecture where statistical data about the

distribution of body dimensions in the population are used to optimize products. Changes in lifestyles, nutrition, and ethnic composition of populations lead to changes in the distribution of body dimensions (e.g. the rise in obesity) and require regular updating of anthropometric data collections.

Human height varies greatly between individuals and across populations for a variety of complex biological, genetic, and environmental factors, among others. Due to methodological and practical problems, its measurement is also subject to considerable error in statistical sampling.

The average height in genetically and environmentally homogeneous populations is often proportional across a large number of individuals.

Exceptional height variation (around 20% deviation from a population's average) within such a population is sometimes due to gigantism or dwarfism, which are caused by specific genes or endocrine abnormalities.[2] It is important to note that a great degree of variation occurs between even the most 'common' bodies (66% of the population),[3] and as such no person can be considered 'average'.

Anthropometric studies today are conducted to investigate the evolutionary significance of differences in body proportion between populations whose ancestors lived in different environments. Human populations exhibit climatic variation patterns similar to those of other large-bodied mammals, following Bergmann's rule, which states that individuals in cold climates will tend to be larger than ones in warm climates, and Allen's rule, which states that individuals in cold climates will tend to have shorter, stubbier limbs than those in warm climates.

On a microevolutionary level, anthropologists use anthropometric variation to reconstruct small-scale population history. For instance, John Relethford's studies of early 20th-century anthropometric data from Ireland show that the geographical patterning of body proportions still exhibits traces of the invasions by the English and Norse centuries ago.

Similarly, anthropometric indices, namely comparison of the human stature was used to illustrate anthropometric trends. This study was conducted by Jörg Baten and Sandew Hira and was based on the anthropological findings that human height is predetermined by the quality of the nutrition, which used to be higher in the more developed countries. The research was based on the datasets for Southern Chinese contract migrants who were sent to Suriname and Indonesia and included 13,000 individuals.[4]

Forensic anthropologists study the human skeleton in a legal setting. A forensic anthropologist can assist in the identification of a decedent through various skeletal analyses that produce a biological profile. Forensic anthropologists utilize the Fordisc program to help in the interpretation of craniofacial measurements in regards to ancestry or race determination.

One part of a biological profile is a person's racial or ancestral affinity. People with significant European or Middle Eastern ancestry generally have relatively

no[clarification needed] prognathism; a relatively long and narrow face; a prominent brow ridge that protrudes forward from the forehead; a narrow, tear-shaped nasal cavity; a "silled" nasal aperture; tower-shaped nasal bones; a triangular-shaped palate; and an angular and sloping eye orbit shape. People with considerable African ancestry typically have a broad and round nasal cavity; no dam or nasal sill; Quonset hut-shaped nasal bones; notable facial projection in the jaw and mouth area (prognathism); a rectangular-shaped palate; and a square or rectangular eye orbit shape. A relatively small prognathism often characterizes people with considerable East Asian ancestry; no nasal sill or dam; an oval-shaped nasal cavity; tent-shaped nasal bones; a horseshoe-shaped palate; and a rounded and non-sloping eye orbit shape.[5] Many of these characteristics are only a matter of frequency among particular races: their presence or absence of one or more does not automatically classify an individual into a racial group.

Today, ergonomics professionals apply an understanding of human factors to the design of equipment, systems and working methods to improve comfort, health, safety, and productivity. This includes physical ergonomics in relation to human anatomy, physiological and bio mechanical characteristics; cognitive ergonomics in relation to perception, memory, reasoning, motor response including human-computer interaction, mental workloads, decision making, skilled performance, human reliability, work stress, training, and user experiences; organizational ergonomics in relation to metrics of communication, crew resource management, work design, schedules, teamwork, participation, community, cooperative work, new work programs, virtual organizations, and telework; environmental ergonomics in relation to human metrics affected by climate, temperature, pressure, vibration, and light; visual ergonomics; and others.[6-7]

Measurement of body size such as height and weight are required for assessment of growth and nutritional status of person, determination of basic energy requirements, standardization of measures for physical capacity, for adjusting drug dosage and for identifying an unknown cadaver. However, in some situations it is not possible to measure the stature of a person because of deformities of the limbs, in person who have undergone amputations or in unknown cadavers where lower limb (s) and / or trunk is mutated / absent. In such cases, stature has

to be estimated using other body parameters. These estimations are also of prime importance in predicting the age-related loss in stature, identifying individuals with disproportionate growth abnormalities, skeletal dysplasia, medico-legal cases or height loss during surgical procedures on the spine. These measurements also have found application in normalizing pulmonary function in scoliosis. Hence based on these findings the present study was planned for evaluation of the stature height in the Maharashtra population by using arm span using regression equation.

Methodology:

The present study was planned in Department of Forensic Medicine, Dr. Panjabrao Alias Bhausaheb Deshmukh Memorial Medical College, Shivaji Nagar, Amravati. The total 50 cases of the age group from 20 - 45 years were enrolled in the present study. This age group was chosen because the growth of an individual ceases by this age and there is no age related loss in body height at this age.

All the patients were informed consents. The aim and the objective of the present study were conveyed to them. Approval of the institutional ethical committee was taken prior to conduct of this study.

Following was the inclusion and Exclusion criteria of the study:

Inclusion Criteria: Undergraduate students from the different medical courses like MBBS, BDS & Nursing were included in the study.

Exclusion Criteria: Subjects possessing skeletal deformities, physical disabilities, past history of skeletal injuries or diseases affecting bones and joints and subjects who are on any form of hormonal medications.

Results & Discussion:

All the human beings belong to the same species, that is, *Homo sapiens*. No two individuals are exactly alike in all their measurable traits, even genetically identical twins (monozygotic) differ in some respects. These traits tend to undergo change from birth to death, in health and disease, and since skeletal development is influenced by a number of factors producing differences in skeletal proportions between different geographical areas. This explains the difference in anthropometric measurements in different geographical areas.

The interest in the estimation of stature for identification already existed in antiquity. The skeleton is one part of the body that resists all environmental insult for maximum time and thus, can be a valuable tool in identification. Stature is a parameter that can be estimated even in mutilated and dismembered bodies, as well as in fragmentary remains.

Identification of human remains recovered from disasters or crime scenes is important for both legal and humanitarian reason. In the process of personal identification, estimation of stature is used along with age, sex and ethnicity to construct the biological profile of the individual in question. Estimation of stature has also an important role to play in identification of decomposed or mutilated bodies. [8] Assessment of stature is also closely associated with predication and standardization of physiological parameters such as lung volumes, muscle strength, glomerular filtration, basal metabolic rate and for adjustment of drug dosage in humans. [9] Human stature reaches its maximum at the age of 21 to 25 years, after which it starts to decline by about 2.5 cm every 25 years. [10] Along with the effect of aging, decline in stature also takes place due to certain conditions like famine.

Table 1: Height & Hand length

	Male	Female
Height cm	153.7 – 184.9	142.3 – 173.8
Right Hand cm	17.1 – 21.5	15.8 – 21.3
Left Hand cm	19.9 – 21.8	15.9 – 21.6

Table 2: Regression Coefficient

Gender	Side	Correlation coefficient (r)	r ² (coefficient of determination)	P values
Male	Right	0.62	0.41	<0.05
	Left	0.62	0.39	<0.05
Female	Right	0.72	0.53	<0.05
	Left	0.71	0.50	<0.05

Mohanty et al [11] and Shahar & Pooy [12], have shown significant strong positive linear relationships between arm span and stature. Similar higher correlations were shown in the present study too. Thus it is clearly evident that the arm span can be used as the predictor of stature, but it should be borne in mind that ethnic specific equations should be derived for a specific ethnicity. [13]

According to Ashutosh N, et al, arm span exceeded height in 82.6% subjects. Mean height to arm span

ratio was 0.9711 and 0.9816 in males and females respectively. [14]

Datta SB in his study found that males were taller and had longer arms spans than females. The height-arm span ratio was 0.98–0.99, indicating height to be slightly less than an arm span in both sexes. [15]

A study by Mohanty et al showed significant correlation between arm span and height of individual. [16] Similarly, observations were made by Patel et al where they found highest correlation between stature and arm span ($r=0.908$). [17]

Steele and Chenier, in a study on black and white women in the age group 35–89, reported correlations of arm span and stature of 0.852 and 0.903 for black and white women respectively. In a similar study of blacks of both sexes in the age group 22–49, a correlation of 0.87 was observed between arm span and stature. These results are similar to the correlation obtained in the present study ($r=0.93$). In Steel and Chenier's study, arm span was nearly 8.3 cm more than stature for blacks, whereas for whites, this difference was only 3.3 cm. [18]

In Korean children, arm span to stature ratio is almost equal to 1.0 in the age groups 1 to 8 years. The arm span exceeds height at the age of 9 years and increases faster than height during puberty in both boys and girls. [19]

Estimation of height using various physical measurements has been attempted previously by many authors. Mitchell used arm length to estimate the height [20], while Chumlea estimated stature from knee height. [21] Steele and Chenier in a study on black and white women in the age group 35–89 reported correlations of arm span and height of 0.852 and 0.903 for black and white women, respectively. [22]. All the previous studies use any one physical parameter to determine the height. However, here, we have used two physical parameters to estimate the height of person using both the upper limbs.

Conclusion:

Arm span measurement can serve as one of the most reliable body parameter to determine stature of an individual. It is useful in determining related loss in stature and in identifying individuals with disproportionate growth abnormalities. The data generated from the present study concludes that arm-span and hand length can be used in estimation of the height of both males and females. The

regression equations so derived can be used in cadavers or an amputee with fairly accurate results. This can be helpful in medico-legal cases as well as in study of anthropology.

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