ANTHROPOMETRY AND ITS HISTORICAL DEVELOPMENT

Kanwar A.R.

Department of Physical Education, Hislop College, Nagpur (M.S) India
Email: *amitrkanwar@gmail.com*

Abstract:

Introduction:

Anthropometry refers to the measurement of living human individuals for the purposes of understanding human physical variation.

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 life styles, nutrition and ethnic composition of populations lead to changes in the distribution of body dimensions (e.g., the obesity epidemic), and require regular updating of anthropometric data collections. Anthropometry demonstrated in an exhibit from a **1921** eugenics conference.

The French savant, Alphonse Bertillon (born in **1853)**, gave this name in **1883** to a system of identification depending on the unchanging character of certain measurements of parts of the human frame. He found by patient inquiry that several physical features and the dimensions of certain bones or bony structures in the body remain practically constant during adult life. He concluded from this that when these measurements were made and recorded systematically every single individual would be found to be perfectly distinguishable from others. The system was soon adapted to police methods, as the immense value of being able to fix a person's identity was fully realized, both in preventing false personation and in bringing home to any one charged with an offence his responsibility for previous wrongdoing. "Bertillonage," as it was called, became widely popular, and after its introduction into France in **1883**, where it was soon credited with highly gratifying results, was applied to the administration of justice in most civilized countries. England followed tardily, and it was not until **1894** that an investigation of the methods used and results obtained was made by a special committee sent to Paris for the purpose. It reported favourably, especially on the use of the measurements for primary classification, but recommended also the adoption in part of a system of "finger prints" as suggested by Francis Galton, and already practised in Bengal.

There were eleven measurements namely,

1) Height
2) Stretch: Length of body from left shoulder to right middle finger when arm is raised
3) Bust: Length of torso from head to seat, taken when seated
4) Length of head: Crown to forehead
5) Width of head: Temple to temple
6) Length of right ear
7) Length of left foot
8) Length of left middle finger
9) Length of left cubit: Elbow to tip of middle finger
10) Width of cheeks
11) Length of left little finger

From this great mass of details, soon represented in Paris by the collection of some **100,000** cards, it was possible, proceeding by exhaustion, to sift and sort down the cards till a small bundle of half a dozen produced the combined facts of the measurements of the individual last sought.

The whole of the information is easily contained in one cabinet of very ordinary dimensions, and most ingeniously contrived so as to make the most of the space and facilitate the search. The whole of the record is independent of names, and the final identification is by means of the photograph which lies with the individual's card of measurements.

Anthropometrics was first used in the **19**th and early **20**th century in criminalistics, to identifying criminals by facial characteristics. Francis Galton was a key contributor as well, and it was in showing the redundancy of Bertillon's measurements that he developed the statistical concept of correlation. Bertillon's system originally measured variables he thought were independent—such as forearm length and leg length—but Galton had realized were both the result of a single causal variable (in this case, stature).

A Bertillon record for Francis Galton, from a visit to Bertillon's laboratory in **1893.** Bertillon's goal was to use anthropometry as a way of identifying recidivists—what we would today call "repeat-offense" criminals. Previously, police could only record general descriptions and names, and criminals were fond of using alternative identities. As such, it was a difficult job to identify whether or not certain individuals arrested were "first offenders" or life-long criminals. Photography of criminals had become commonplace but it had proven ungainly, as there was no coherent way to arrange visually the many thousands of photographs in a fashion which would allow easy use (an officer would have to sort through them all with the hope of finding one). Bertillon's hope was that through the use of measurements of the body, all information about the individual criminal could be reduced to a set of identifying numbers which could be entered into a large filing system.

Bertillon also envisioned the system as being organized in such a way that even if the number of measurements was limited the system could drastically reduce the number of potential matches, through an easy system of body parts and characteristics being labeled as "small", "medium", or "large". For example, if the length of the arm was measured and judged to be within the "medium" range, and the size of the foot was known, this would drastically reduce the number of potential records to compare against. With more measurements of hopefully independent variables, a more precise identification could be achieved, which could then be matched against photographic evidence. Certain aspects of this philosophy would also go into Galton's development of fingerprint identification as well.

Anthropometry, however, gradually fell into disfavour, and it has been generally supplanted by the superior system of finger prints. Bertillonage exhibited certain defects which were first brought to light in Bengal. The objections raised were

1) the costliness of the instruments employed and their liability to become out of order;
2) the need for specially instructed measurers, men of superior education;
3) the errors that frequently crept in when carrying out the processes and were all but irremediable.

Measures inaccurately taken, or wrongly read off, could seldom, if ever, be corrected, and these persistent errors defeated all chance of successful search. The process was slow, as it was necessary to repeat it three times so as to arrive at a mean result. In Bengal, measurements were already abandoned by **1897**, when the finger print system was adopted throughout British India. Three years later England followed suit; and as the result of a fresh inquiry ordered by the Home Office, finger prints were alone relied upon for identification.

During the early **20**th century, anthropometry was used extensively by anthropologists in the United States and Europe. One of its primary uses became the attempted differentiation between differences in the races of man, and it was often employed to show ways in which races were "inferior" to others. The wide application of intelligence testing also became incorporated into a general anthropometric approach, and many forms

of anthropometry were used for the advocacy of eugenics policies. During the **1920**s and **1930**s, though, members of the school of cultural anthropology of Franz Boas also began to use anthropometric approaches to discredit the concept of fixed biological race. Anthropometric approaches to these types of problems became abandoned in the years after the Holocaust in Nazi Germany, who also famously relied on anthropometric measurements to distinguish Aryans from Jews. This school of physical anthropology generally went into decline during the **1940**s.

During the **1940**s anthropometry was used by William Sheldon when evaluating his somatotypes, according to which characteristics of the body can be translated into characteristics of the mind. Inspired by Cesare Lombroso's criminal anthropology, he also believed that criminality could be predicted according to the body type. This use of anthropometry is today also outdated. Because of his extensive reliance on photographs of nude Ivy League students for his work, Sheldon ran into considerable controversy when his work became public.

Modern Anthropometry and Biometrics

Anthropometric studies are today conducted for numerous different purposes. Academic anthropologists investigate the evolutionary significance of differences in body proportion between populations whose ancestors lived in different environmental settings. Human populations exhibit similar climatic variation patterns to 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 twentieth-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.

Outside academia, scientists working for private companies and government agencies conduct anthropometric studies to determine what range of sizes clothing and other items need to be manufactured in. A basically anthropometric division of body types into the categories endomorphic, ectomorphic and mesomorphic derived from Sheldon's somatotype theories is today popular among people doing weight training.

The US Military has conducted over **40** anthropometric surveys of U.S. Military personnel between **1945** and **1988**, including the **1988** Army Anthropometric Survey (ANSUR) of men and women with its **240** measures. Statistical data from these surveys, which encompassed over **75,000** individuals, can be found in.

Today people are performing anthropometry with three-dimensional scanners. The subject has a three-dimensional scan taken of their body, and the anthropometrist extracts measurements from the scan rather than directly from the individual. This is beneficial for the anthropometrist in that they can use this scan to extract any measurement at any time and the individual does not have to wait for each measurement to be taken separately.

A global collaborative study to examine the uses of three-dimensional scanners for healthcare was launched in March **2007.** The Body Benchmark Study will investigate the use of three-dimensional scanners to calculate volumes and segmental volumes of an individual body scan.

The aim is to establish whether The Body Volume Index has the potential to be used as a long-term computer based anthropometric measurement for healthcare. More conventional anthropometric measurements also have uses in medical anthropology and epidemiology, for example in helping to determine the relationship between various

body measurements (height, weight, percentage body fat, etc.) and medical outcomes.

Anthropometry and Physical Education

Anthropometry constitutes the earliest form of measurement in physical education, as one might surmise. Study of the human physique and its proportions began many centuries ago. The early beginnings can be traced to the remote civilization of India, where a treatise called "Silpi Sastri" analyzed the outline of the body by dividing it into **480** parts. Anthropometry evolved in the quest to determine the ideal body proportions, and artists and sculptors directed their study to it as shown by the artwork of early civilizations. Artists comprised the chief workers in anthropometry until **1835** when a mathematician in Brussels, Baron, Quetelet, applied purely mathematical methods to discover the physical constants of the human body and proved that the binomial law (law of chance) applies to human proportions. This finding was confirmed about **50** years later by Sir Francis Galton, who systematically analyzed measurements of certain physical constants of English men and women. In **1854**, a German named Carus proposed an anatomical basis to determine body proportions. Shortly after this, Zeissing in Belgium and Cromwell in England studied the growth of school children.

The first application of anthropometry in physical education began with Edward Hitchcock in **1861**, when he undertook a study of anthropometrical measurements of Amherst College men, leading to the publication of anthropometrical tables almost annually for **40** years. The aim of anthropometry was depicted by Hitchcock as ascertaining the ideal or typical man as a guide in fostering the development of normal individuals. He provided his students with a chart showing average results associated with different variables, against which the student might plot his own results. In **1886**, Sargent published an anthropometrical chart based on **6** years of examining Harvard students. Sargent included lung capacity and certain strength measurements along with various measures of physical proportion and expressed the results in percentiles.

From **1885** to **1900**, anthropometrical studies were conducted at different collegiate institutions involving close to **8,000** men and women. In **1890**, Seaver published what proved to be the pioneer American book on physical measurements of the body; it was subsequently revised twice.

Anthropometrical measurement for assessment of physical status was expanded quite naturally to include consideration of body types and the relation of physique to one's health, immunity from disease, posture, physical performance, and personality qualities. It soon became recognized that a single ideal physique was both impractical and unrealistic. Actually Hippocrates first realized this fact and classified human beings according to two basic physiques – long and thin, or short and thick. Kretschmer, the father of modern body – or somato - typing, defined three types by adding an in-between and referred to them as asthenic (lean), athletic, and pyknic (heavy).

Early attempts to ascertain the nutritional status of individuals consisted of giving a desired weight for a certain height and later included age and sex differentiations. Age-height-weight tables were utilized in some schools for the purpose of discovering malnourished and obese children. Perceiving the inadequacy of height as a basis for predicting body weight, further investigations have resulted in methods of assaying weight that utilize skeletal dimensions and consider the gross proportion of bone, muscle, and fat.

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