3.1 INTRODUCTION

Observation of variation in human body build and interest in relation of such variation to temperament and disease susceptibility are as old as science. Earlier studies on review of the history of human classification defined constitution as the sum total of the morphological, physiological and psychological characters of an individual, in large part determined by heredity but influenced in varying degrees by environmental factors or simply the total biological make-up of an individual. Physique which refers to individual body form is probably the single aspect of constitution.

Somatotype refers to a quantified expression and description of the present morphological conformation or physique of a person and the process of appraising and defining it is known as somatotyping.

3.2 CONCEPT OF SOMATOTYPE

History of somatotyping can be traced back to the fifth century BC, when Hippocrates offered two fold classification of physique:

Habitus phthisicus, long and thin individuals considered susceptible to tuberculosis.
Habitus apoplecticus, short and thick build individuals susceptible to vascular disease leading to apoplexy.

Ever since that time, there have been several attempts to describe and classify the humans. All the efforts ultimately lead to a common conclusion of describing human body forms in two or three major types: lateral (round), muscular and linear.

The study of physique has pivotal role to play in understanding growth, maturation and performance. During the growth phase, it is clear that in childhood and adolescent phase the genesis of the variation which is observed in adulthood takes place. Somatotyping is an outstanding tool to explore the spatial temporal variations and observe the changes occurring as a result of physical exercise on human physique. Moreover it combines an appraisal of relative adiposity, musculoskeletal robustness and linearity into a three scale rating. The development of anthropometry added new dimensions to the study of morphology. Somatotype distribution in various ethnic groups are markedly more restricted and dominated by extreme somatotype than the nationality samples. Studies reveal that Eskimos (Alaska) are primarily endo-mesomorphic, Manus (Papua New-Guinea) and Caingang (Brazil) presents conspicuously mesomorphic somatotypes with extremes towards mesomorphy. Strikingly, extreme ectomorphic somatotype is shown by Nilotes of the Nile valley in Africa and many population groups living in hot environments of the tropics.

3.3 METHODS IN THE ASSESSMENT OF PHYSIQUE

As mentioned, there are different conventions which have described human forms and nearly all categorize physiques into three categories corresponding to lateral, musculature and linear types.

3.3.1 Viola’s Method (1921)

Viola, an Italian physician proposed a classification of biotype (physique) based on a comprehensive system of anthropometric measurements. For general purposes, he took ten measurements:

a) Sternum length
b) Upper abdominal height
c) Lower abdominal height
d) Length of the arm
e) Length of the leg
f) Transverse thoracic diameter
g) Antero-posterior thoracic diameter
h) Transverse hypochondric diameter
i) Antero-posterior hypochondric diameter
j) Bi-iliac or transverse pelvic diameter
Three compound measurements namely stature, trunk height and total abdominal height were also considered. By manipulating these measurements he derived a measure of trunk volume and four morphological indices namely thoracic index, upper abdominal index, lower abdominal index and total abdominal index. He differentiated three morphological types:

1) **Longytype**: The longytype had long limbs relative to their trunk volume, large thorax relative to their abdomen, a large transverse diameter relative to anterior posterior diameter.

2) **Brachitype**: The brachitype was characterised by massiveness and robustness of body, the reverse of longytype. They had short limb relative to trunk, short transverse diameter relative to the antero-posterior diameter, short thorax relative to the abdomen.

3) **Normatype**: The normatypes were in between longytype and brachytype characterised by normally proportional limbs versus trunk, thorax versus abdomen, transverse versus antero-posterior widths.

4) **Mixed**: Mixed type shows disproportion in human body. It lacks uniformity in the physique.

The four indices failed to agree amongst themselves, one placing the individual in one category and another else where. It is obvious that Viola’s biotypology based on anthropometric measurements is morphological in orientation.

### 3.3.2 Kretschmer’s Method

Kretschmer was a German psychiatrist. His system of classification relied entirely on anthroposcopic inspection. He illustrated four physical and psychic types derived from his clinical observations and minimum measurements:

1) **Pyknic**: The pyknic was broad, round and fat, sturdy and stocky.

2) **Athletic**: The athletic was heavily muscled with large thorax and shoulders and narrow hips.

3) **Asthenic**: The asthenic was long, thin and linear.

4) **Dysplastic**: It denoted the incompatible mixture of different types in different parts of the body.

Later he substituted the word leptosome for asthenic.

### Criticism

This system is now entirely outdated.

a) It supposed that it was possible to classify people into separate discrete types. This assumption was widespread up to about the 1930’s. The later practitioners had to admit that most people fell in between the established and obviously fairly extreme types.

b) It had also been criticized of limited sampling, scanty measurements, lack of indices, subjective estimates, and failure to classify data according to age, sex and social status.
3.3.3 Sheldon’s Method

William Herbert Sheldon (1898-1977) was an American psychologist and physician. He introduced the concept and word ‘somatotype’ in ‘The Varieties of Human Physique’ (1940). He defined somatotype as ‘quantification of three primary components determining the morphological structure of an individual expressed as a series of three numerals, the first referring to endomorphy, the second to mesomorphy, and the third to ectomorphy’. The conceptual approach is based on the premise that continuous variation occurs in the distribution of physique and thus the variation is related to differential contributions of three specific components, named on the basis of three embryonic germ layers:

- **Endomorphy**: It is characterised by the predominance of the digestive organs and softness and roundness of contours throughout the body. In other words, with increased fat storage, a wide waist and a large bone structure. Endomorphs are referred to as fat.

- **Mesomorphy**: It is characterised by the predominance of muscle and bone, skin is made thick by heavy connective tissue. The physique is normally heavy, hard and rectangular in outline. In other words, with medium bones and solid torso, low fat levels, wide shoulders with a narrow waist. Mesomorphs are referred to as muscular.

- **Ectomorphy**: It is characterised by linearity and fragility of build; with limited muscular development and predominance of surface area over body mass in other words, with long and thin muscles or limbs or low fat storage. Ectomorphs are referred to as slim.

The contribution of the three components defines an individual’s somatotype.

**Method**

Sheldon’s method of estimating somatotype utilises height and weight and three standardised photograph of front, side and rear views of the nude subjects i.e., 4000 college men standing before a calibrated grid. He summarized his photoscopic (he called it anthroposcopische) somatotype method as follows:
Human Constitution and Physique

Source: www.Sports.jrank.com

a) Calculation of height/³√weight ratio (HWR) or reciprocal ponderal index

b) Calculation of ratios of 17 transverse measurements/diameters (taken from photographic negatives) to stature.
   1) Four on head and neck
   2) Three on the thoracic trunk
   3) Three on the arms
   4) Three on the abdominal trunk
   5) Four on the legs

c) Inspection of the somatotype photograph, referring to a table of known somatotypes distributed against the criterion of HWR, comparing the photograph with a file of correctly somatotyped photographs, and recording the estimated somatotype.

d) Comparison of the 17 transverse measurements ratios with the range of scores for each ratio, to give final score

Each component of physique is assessed individually. Rating are based on a 7-point scale, with 1 representing the least expression, 4 representing moderate expression and 7 representing the fullest expression of that particular component.
being assessed. The rating of each component determines the somatotype which is expressed by three numerals to sum of no less than 9 and no more than 12. The first number refers to endomorphy, second to mesomorphy and third to ectomorphy. Sheldon identified 76 different somatotype and most common are 3-4-4, 4-3-3 and 3-5-2.

The extreme somatotypes are:

1) **Endomorphy**
   a) Various parts of the body are soft and round
   b) Head is round
   c) Abdomen is flat
   d) Arms and legs are weak and fatty
   e) Upper arms and thighs are fatty
   f) Wrist and ankles are splendidly built
   g) Less linearity and less muscularity
   h) More fat deposition
   i) Somatotype rating is 7-1-1

2) **Mesomorphy**
   a) Bony and Muscular
   b) Heavy, coarse physique with rectangular contour
   c) Their head is massive and cubical
   d) Shoulder and chest broad
   e) Less fat and less linearity
   f) Somatotype rating is 1-7-1

3) **Ectomorphy**
   a) Typical characteristic is linearity
   b) Face is thin
   c) Forehead is high
   d) Chin is receding
   e) Chest and abdomen is thin and narrow
   f) Less fat and less muscularity
   g) Somatotype rating is 1-1-7

*Source: [www.ratemyarms.com](http://www.ratemyarms.com)*
Criticism

- The somatotype changes: Sheldon stated that the somatotype is a trajectory along which an individual under average nutritional condition and absence of major illness is destined to travel. He used the word ‘morphophenotype’ to refer to the present physique and ‘morphogenetic’ to refer to genetically determined physique. He maintained that somatotype do not change throughout because it does not change significantly for any measurements except where the fat is deposited.

- Somatotype is not objective: Sheldon claimed that making measurements on photographs has raised the subjective technique to strictly scientific and objective level. He developed his own anthropometric method which depends upon soft part outline in the photograph more than osseous landmark.

- There are two, not three primary components, for endomorphy and ectomorphy are essentially the inverse of each other.

- Somatotyping omits the factor of size: In original method somatotype measured only body shape independent of body size.

- The method of somatotyping was developed on adult males. Criteria for defining somatotype components in children or females were not published.

- He used arbitrary scale that permitted no rating more than 7 or less than 1 in any component and their sum is limited by the numbers 9 and 12.

*Sheldon’s objective method*

**Source:** www.innerexnloration.com

To meet these criticisms Sheldon described a ‘new’ Trunk Index method derived from the ratio of the areas of the thoracic and abdominal trunk measured on somatotype photograph.

- This index is assumed to be constant throughout life. It is possible that in the succession of the life phases the area ratio of thoracic trunk to abdominal
trunk remains constant, that the two area increase and decrease in the size in relation to one another.

- He asserted that the new system provided a measure of massiveness (HWR), a separator for the kinds of mass into endomorphy and mesomorphy (The trunk index) and finally a measure of degree of stretching out into space (height). When the other two parameters are known, this is precisely what ectomorphy is.

- In this new method height was used as a measure of size, and substituted for ectomorphy.

- As a result of these changes, the sum of the somatotype components no longer need be limited to sum of 9 to 12 but now can extend to sums of 7 to 15.

- The original matrix of 76 somatotypes expanded to 88. The trunk index matrix gives 267.

Areas to measure when determining the trunk index

Source: www.innerexploration.com
Heath-Carter Method

Heath (1963) described certain limitations in Sheldon’s method and suggested the following modifications to overcome them:

- Opening the component rating scales to accommodate a broader range of variation by replacing the arbitrary 7-point scale with a rating scale of equal appearing intervals. Beginning theoretically with zero (in practical beginning with one half) and having no arbitrary end point.
- Eliminated the unjustified restrictions of sums of components to between 9 to 12.
- Construct a table that preserves a logical linear relationship between somatotype rating and HWRs.
- Adopt a single table of HWRs (Height-Weight Ratios) and somatotype suitable for both sexes at all ages.

Heath and Carter combined both photoscopic and anthropometric procedures to estimate somatotype. Somatotype is defined as representing the individual’s “present morphological conformation; expressed in a three numeral rating of primary components of physique that identify individual features of morphology and body composition”. In practice, the Heath-Carter method of somatotyping is primarily in its anthropometric form. Anthropometry is more objective and obtaining standardised somatotype photographs is difficult and costly.

The somatotype components and the dimensions used in the Heath-Carter anthropometric protocol to derive each component are as follows:

1) **Endomorphy** (1/2-16\textsuperscript{th} scale): The first component, endomorphy, is described from the sum of three skinfolds namely the triceps, subscapular, and suprailiac. It refers to relative fatness of a physique.
2) **Mesomorphy** (up to 17th scale): The second component, mesomorphy, refers to relative musculoskeletal development adjusted for stature. It is described as expressing fat-free mass relative to stature. Mesomorphy is derived from biepicondylar breadths of the humerus and femur, flexed-arm circumference corrected for the thickness of triceps skinfold and calf circumference corrected for the thickness of the medial calf skinfold. Correcting the circumferences is simply a matter of subtracting the skinfold thickness from circumference. These four measurements are then adjusted for stature.

3) **Ectomorphy** (up to 9th scale): The third component, ectomorphy, is the relative linearity of build. It is based on the reciprocal ponderal index.

There are three methods for obtaining a Heath-Carter somatotype. They are as follows:

1) The photoscopic somatotype
2) The anthropometric somatotype
3) The anthropometric plus photoscopic somatotype

The anthropometric somatotype can be calculated from the 10 anthropometric dimensions viz. height, weight and skinfolds (triceps, subscapular, supraspinale, and medial calf), two girths (flexed upper arm and calf) and biepicondylar breadths (humerus and femur). The algorithms for estimating a somatotype with the Heath-Carter anthropometric protocol are as follows:

a) **Endomorphy** = -0.7182 + 0.1451 (X) - 0.000068(X²) + 0.0000014(X³)
   Where, X = Σ3 skinfolds viz. triceps, subscapular and supraspinale skinfolds; and adjustment for stature is made where X is multiplied by 170.18/height (cm).

b) **Mesomorphy** = (0.858 × humerus breadth + 0.601 × femur breadth + 0.188 × corrected arm girth + 0.161 × corrected calf girth) - (0.131 × stature) + 4.50
   Where, corrected arm girth = Arm girth - triceps skinfold in cm and corrected calf girth = calf girth - medial calf skinfold in cm.

c) **Ectomorphy** = 0.732 × HWR - 28.58 (If HWR > 40.75)
   = HWR × 0.463 - 17.63 (If HWR > 38.25 but < 40.75)
   = 0.1 (If HWR = 39.25)
   Where HWR = stature / \( \sqrt[3]{\text{weight (kg)}} \).

The advantages of anthropometric somatotype are it provides

1) an objective method of somatotyping.
2) the best estimate of a criterion somatotype in the absence of a photograph.

**Limitations**

1) The first component endomorphy represents the fat free mass and second mesomorphy components reflect the fat mass. The body components present specific body composition concepts, which means it partitions body weight
into its lean and fat components. Sheldon’s original somatotype concept however refers only to body shape and not to body composition. Although, both methods use the term somatotype, but it has different meaning in each.

2) Endomorphy has been found to correlate moderately well in terms of body fat, though fat free mass correlates rather poorly with mesomorphy. Moreover, the association of mesomorphy and limb muscularity is generally low in athletes based on dual energy X-ray absorptiometry. This needs the validation of relationship implied in the concepts used to define physique.

3) The variation in the reproducibility of somatotype components in the Heath-Carter anthropometric protocol is guided by intra-observer and inter-observer measurement. An error of 0.5 somatotype units is there when the body dimensions are measured by experienced technicians.

4) The validity of this method for children 6 years and below has not been established. This could be one of the factors attributed to studies projecting high ratings of mesomorphy in young children.

3.4 SUMMARY

Human variability in body size, shape, and proportions due to age, sex, nutrition, physical activity and environment are topics that are of considerable interest to physical anthropologists and human biologists for a long time. Somatotypes change due to growth or reduction of body constitution at differential rate. Somatotyping, an index of physique/human variability has sought to identify physical adaptations to environmental conditions such as heat, humidity, and altitude. Furthermore, discerning the associations between fitness and physical performance, and different somatotypes has been an important research task. Anthropometric approaches are, of most part non-invasive methods that assess the size, shape or body composition of an individual. Somatometry is considered as one of the best tool for growth studies as these values are closely related to nutrition, genetic makeup, environment, social and cultural condition, lifestyle and functional status. Assessment of physique derived from different methods viz Viola’s Method, Kretschmer’s Method, Sheldon’s Method and Heath-Carter Method incorporates the terms endomorphy, mesomorphy and ectomorphy. Somatotyping recognise continuous variation in the distribution of the components of the physique. Finally, somatotyping is considered to be reasonably good method for quantification of current shape and composition of the human body and has been subject to continuous improvement in respect of its methodological issues.

References


Suggested Reading


Sample Questions

1) What do you understand by the term “physique”? Give an account on different methods of classifying human physique.

2) Critically examine the various methods of studying human physique?

3) Briefly describe Heath-Carter method of assessing human physique and how does it differ from Sheldon’s method?

4) What is somatotyping? Explain various methods of assessing somatotype and give its significance.

5) What are different classification of constitutional types and body physique given by different scholars?