Anthropometry: A General Introduction
· Featuring Rosscraft Innovations Instruments ·

Brian D. Johnston

Introduction to Anthropometry

The intention of this paper is to provide the reader a general overview of the complexity of anthropometry, from land marking and taking a skinfold measurement to implementing data into complex studies (e.g., somatotyping), and a look at quality instruments and software for these purposes.

Anthropometry is the science of measuring the human body, and takes into account components of body build such as:

- Surface body measurements (muscle girth, limb lengths, and structural breadths of different aspects, height and weight, and land marking specific sites in order to obtain many of these measurements);
- Body Composition (skin-fold evaluation for subcutaneous fat estimation); and
- Photographic evidence within a standardized environment.

The various aspects measured then could be accrued to obtain a comprehensive profile on a person, to give a description of the body as a whole. This profile may be **restricted** (required measurements and land marking to enable the most basic computations for somatotype [to be addressed in greater detail later], proportionality, relative fat, indices of body surface area, waist-to-hip ratio, fat patterning, and skinfold-corrected girths). A **full profile** would require additional measurements for computations to be made in estimates of relative body fat, calculations of skeletal mass, and calculation of bone, muscle, adipose and residual masses using fractionation of body mass techniques. The chart on the next page details a full profile with restricted aspects check-marked, from ISAK's *International Standards for Anthropometric Assessment*.

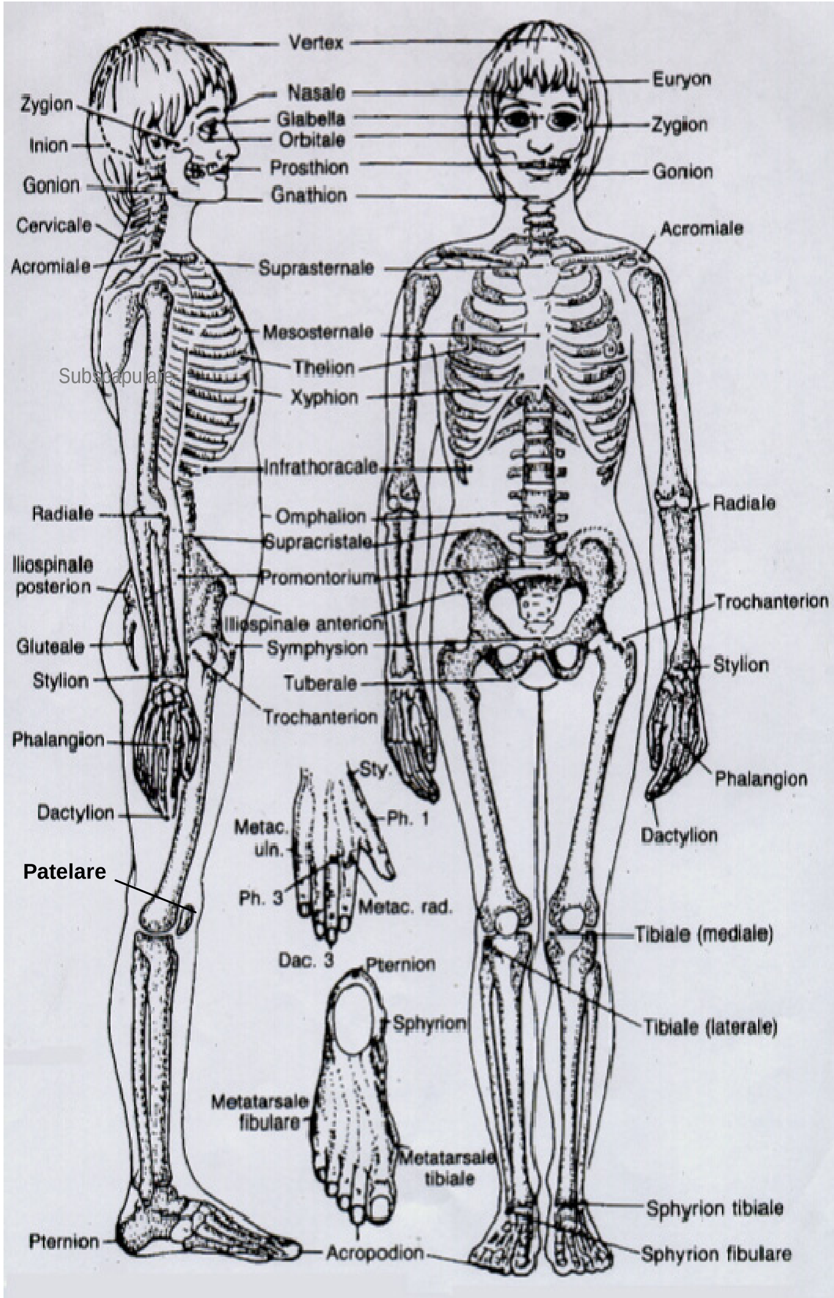
When profile information is used for advanced computations, we then speak of the field of *kinanthropometry,* which is the scientific specialization dealing with the measurement of people in a variety of morphological perspectives. An overview of kinanthropometry can be viewed as such:

Identification	Specification	Application	Relevance
Kinanthropometry… Human Movement Measurement *…with precision and accuracy*	*Study of human…* Size Shape Proportion Composition Maturation Gross Function	*Help understand…* Growth Aging Exercise Performance Nutrition	*Areas of…* Health Education Government Commerce *…with respect for individual rights*

It is obvious how complex and detailed the studies and applications of anthropometry and kinanthropometry can be. And it should be further obvious among fitness clinicians and practitioners the role and value of acquiring regular measured data of a human subject while undergoing a fitness regimen. Fundamentally, it is necessary to determine the changes taking place in order to quantify the effectiveness of the fitness program relative to the individual's goals, with that effectiveness being reflective of his or her needs, abilities, and limitations. With regular assessment, it then can be determined the extent of the current fitness program's value, and what changes need occur to match the subject better.

For example, an initial girth measurement of 40-inches of a woman's hips, followed by a measurement of 39-inches one month later indicates a loss of 1-inch in circumference, and that the fitness program (both exercise and nutrition) had that measure of value and in that particular regard. The extent of the value would depend on what was typical among female clients, across a broad spectrum, and relative to the client's somatotype, motivation, and whether the loss was all adipose tissue or a combination of adipose/muscle/water. Perhaps the client could have done better than a one-inch loss, or perhaps the client was satisfied regardless of what may be 'ideal' or possibly achieved.

Type of Measurement	No.	Site	Restricted
Basic	1	Mass	✓
	2	Stature	✓
	3	Sitting height	
Skinfolds	4	Triceps	✓
	5	Subscapular	✓
	6	Biceps	✓
	7	Iliac Crest	✓
	8	Supraspinale	✓
	9	Abdominal	✓
	10	Front thigh	✓
	11	Medial calf	✓
Girths	12	Head	
	13	Neck	
	14	Arm (relaxed)	✓
	15	Arm(flexed and tensed)	✓
	16	Forearm (maximum)	
	17	Wrist (distal styloids)	
	18	Chest (mesosternale)	
	19	Waist (minimum)	✓
	20	Gluteal (hips)	✓
	21	Thigh (1 cm gluteal)	
	22	Thigh (mid-troch-tib. lat.)	
	23	Calf (maximum)	✓
	24	Ankle (minimum)	
Lengths	25	Acromiale-radiale	
	26	Radiale-stylion	
	27	Midstylion-dactylion	
	28	Iliospinale height	
	29	Trochanterion height	
	30	Trochanterion-tibiale laterale	
	31	Tibiale laterale height	
	32	Tibiale laterale-sphyrion tibiale	
Breadths	33	Biacromial	
	34	Biilocristal	
	35	Foot length	
	36	Transverse chest	
	37	A-P chest depth	
	38	Humerus	✓
	39	Femur	✓



L A N D M A R K S

Vertex (V)

***Suprasternale (SST)**

***Mesosternale (MST)**

***Thelion (TH)**

***Omphalion (OM)**

***Acromiale (A)**

***Radiale (R)**

***Stylion (STY)**

****Dactylion (DA)***

****Iliocristale (IC)***

****Iliospinale (IS)***

****Trochanterion (TRO)***

****Patelare (PAT) seated***

****Tibiale Mediale (TM)***

****Tibiale Laterale (TL)***

****Sphyrion Mediale (SM)***

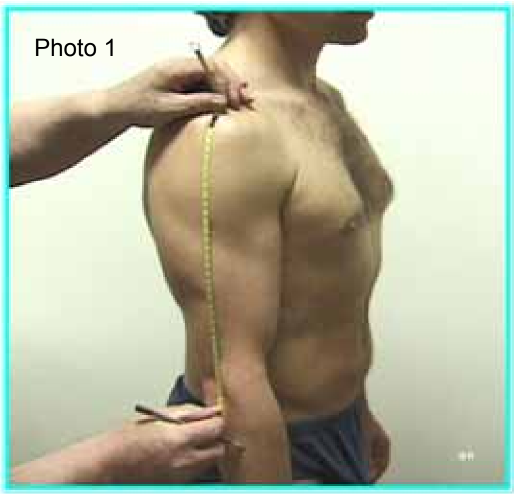
****Subscapulare (SS)***

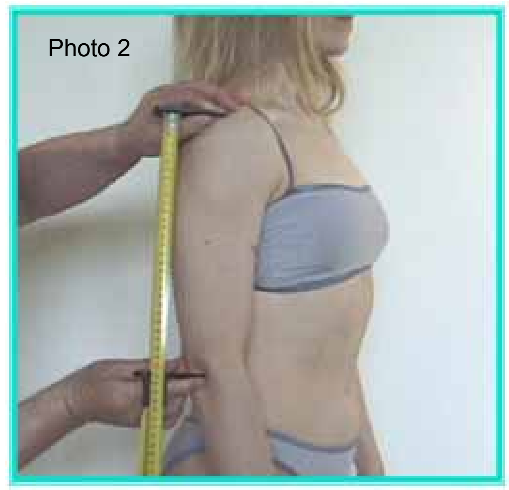
****Pternion (PTE)***

****Acropodion (AP)***

Fundamentally, it is evident as to why we take physical measurements, whether in an attempt to improve the design of an automobile to reduce wind resistance, or to guide us in determining the efficacy of a fitness program and its future direction. Unfortunately, many fitness professionals underestimate the value of measurements, and even fewer uphold quality standards in the study of anthropometry.

Consider the measuring of a triceps skinfold, whereby most fitness practitioners simply ‘eyeball’ where the skin should be grabbed. Rather, to maintain consistency and standardization, it is necessary to landmark the superior lateral border of the acromion process and the superior head of the radius. From there the clinician landmarks the halfway point of the Acromiale-Radiale distance, either with a measuring tape (photo 1) or better yet, a segmometer with slider indicators (photo 2).[1]





The halfway point is marked with a pencil (photo 3), a tape measure is wrapped around the arm at that mark (photo 4), the triceps horizontal mark is plotted (photo 5),[2] and a skinfold measurement then is taken at the marked midpoint (and one centimeter down from the area pinched; photo 6).

[1] Photographs and instruction courtesy of www.Rosscraft.ca

[2] A horizontal mark also is plotted on the biceps brachii, for purposes of taking a skinfold measurement at that point. Furthermore, the plotted line halfway along the acromiale-radiale distance serves as the landmark for taking both relaxed and flexed upper arm circumference measurements, and diameter measurements if desired.

Such strict standardization of taking measurements and collecting data is vital, to make comparisons across time and space in any country and with any anthropometry professional. The **International Society for the Advancement of Kinanthropmetry (ISAK)** has members in 50 countries and has worked since 1986 to develop such standards, which are presented in detail in its manual *International Standards for Anthropometric Assessment* (www.ISAKonline.com), a recommended and affordable resource that any fitness professional should have in his or her arsenal.

Besides the above example of land marking and measuring the triceps brachii skinfold, here are some other standards of excellence as espoused by ISAK, to provide the reader further consideration of the scientific precision necessary in this discipline:

- A flexible steel tape of at least 1.5 m in length is recommended for girths. This should be calibrated in centimeters with millimeter gradations. If fiberglass tapes are used, regular calibration against a steel tape is required as these non-metal tapes may stretch over time.
- Skinfold calipers require a constant tension closing compression of 10 $g.mm^{-2}$ throughout the range of measurements. They should ideally be calibrated to at least 40 mm in 0.2 mm divisions.
- If possible, 2-3 measurements should be taken at each site with the mean value being used in any further calculations if two measurements are taken, and the median value used if three measurements are taken. Sites should be measured in succession to avoid experimenter bias. That is, a complete set is obtained before repeating the measurements for the second and then third time.
- The most stable values are those obtained routinely in the morning twelve hours after food and after voiding. Since it is not always possible to standardize the measurement time, it is important to record the time of day when measurements are made. Generally, subjects are taller in the morning and shorter in the evening. A loss of about 1% in stature is common over the course of the day.
- When taking a skinfold measurement, the nearest edge of the contact faces of the caliper are applied 1 cm away from the edge of the thumb and finger. If the caliper is placed too deep or too shallow incorrect values may be recorded. As a guide, the caliper should be placed at a depth of approximately mid-fingernail. Measurement is recorded two seconds after the full pressure of the caliper is applied. Skinfold sites should be measured in succession to avoid experimenter bias. That is, a complete data set is obtained before repeating the measurements for the second and then third time. This may also help to reduce the effects of skinfold compressibility.

- When measuring girths, constant tension is achieved by ensuring that there is no indentation of the skin, yet the tape holds its place at the designated landmark. While constant-tension tapes may be available, non-tension tapes are preferred since they allow the anthropometrist to control the tension. When reading the tape the measurer's eyes must be at the same level as the tape to avoid any error of parallax.
- When measuring the flexed and tensed arm girth, the anthropometrist measures at the level of the peak of the contracted biceps. If there is no obvious peak of the biceps, this girth should be measured at the level of the mid-acromiale-radiale landmark (see the photos presented on the preceding page).

ISAK Anthropometric Assessment Standards manual available at *www.ISAKonline.com*

Somatotyping

In this section we will look at one sophisticated application for anthropometric data: Somatotyping. Most fitness professionals and clinicians are aware of this categorization of the human body, as it relates to a person's fatness, muscularity and thinness. Consequence, it likely is the most relevant area of interest to the fitness audience when addressing advanced anthropometry.

History of Somatotyping

In 1940, William H. Sheldon, S.S. Stevens and W.B. Tucker published the book *The Varieties of Human Physique,* whereby they described and coined the term "somatotype" and the three categories: "endomorphy," "mesomorphy" and "ectomorphy."[3] Sheldon published other books on the subject, but a foundation was established in which the components were rated on 7-point scales,[4] derived from embryonic layers and that a person's somatotype was a *permanent morphogenotype*. Sheldon's direction for the three components of physique to be rated on scales from 1-7 was both unique and allowed for more defined categorization of physiques into a wide variety of possible somatotypes beyond the few categories then used. The three-number rating provided for a wide variety of possible somatotypes, yet there remained persistent criticisms from biologists who believed that a person's somatotype was a morphophenotype - something that could change.

Since then somatotyping has improved in its science, to the point of providing medical direction. For instance, one study concluded: "*It is possible to differentiate healthy adolescent subjects, patients with nonprogressive adolescent idiopathic scoliosis, and patients with progressive idiopathic scoliosis by using anthropometric measurements and morphologic classification. These findings may be useful in the early detection of children at risk for progression of scoliosis and may allow earlier application of treatment methods without waiting for a significant increase in the curve."*[5] The most commonly used method of somatotyping today is the Heath-Carter method[6], which may implement various measurements (anthropometric method), standardized photographs (photoscopic method) or a combination of the two. The use of photographs is uncommon since it takes far greater practice to distinguish the many somatotype categories. For the anthropometric method, I recommend the reader download *The Heath-Carter Anthropometric Somatotype Instruction Manual* at www.somatotype.org.

The information found in that manual is very useful, with some of its content integrated into this part of the report. However, unless one has the time to apply the extensive mathematical formulae, and to plot results on a graph, the practice can be tedious.

Fortunately, the makers of the *Somatotype Calculation and Analysis* software, at www.SweatTechnologies,com performs all the hard work for the fitness clinician. After a few minutes of acquiring the necessary data (background information, skinfold measurements, joint diameter measurements, etc.), very pertinent and useful information is provided the clinician that supports body fat percentage and general physical structure, which then can be tracked over time and even related to similar or dissimilar individuals for comparative purposes.

---

[3] Based on photoscopic ratings and various indices derived from the photos of 4,000 college men. Another book served as a reference work for somatotyping men, *Atlas of Men*, but a companion *Atlas for Women* was never published.

[4] Hence, *a somatotype is a numerical descriptor of overall physique in terms of body shape and composition, and is independent of age, size or gender.* The numbers tell the observer about the relative adiposity (endomorphy), musculo-skeletal robustness (mesomorphy), and linearity (ectomorphy) of the physique. (from Anthropometry Illustrated, William Ross, et. al.).

[5] LeBlanc, R., Labelle, H., Forest, F., and Poitras, B. *Morphologic Discrimination Among Healthy Subjects and Patients With Progressive and Nonprogressive Adolescent Idiopathic Scoliosis.* Spine. 23(10):1109-1115, May 15, 1998.

[6] Carter, J.E.L. & Heath, B.H. (1990) *Somatotyping: Development and Applications*. Cambridge: Cambridge University Press.

Somatotype and Metabolic Rate

Improvement of physical fitness and various systems of the human organism varies. Individual energy expenditure, for example, has a bearing on individual body composition, wherein some people expend many calories while others expend few calories, even when undertaking extensive exercise. The extent to which a person expends calories is due to:

- Basal metabolic rate (BMR), which refers to the metabolic rate as measured under basal conditions, i.e., 12 hours after eating, after a restful sleep, no exercise or activity preceding the test, elimination of emotional excitement, and in a comfortable temperature. BMR is affected partly by, and increases as a result of, fat-free mass; these factors decrease with age, from infancy through adolescence and into adulthood, and are influenced further by sex with resting rates lower in women than in men. It should be noted that BMR testing is conducted no longer because of more accurate *thyroid function tests*, but a metabolic rate at rest (now termed *resting metabolic rate [RMR]*) still exists with each individual.
- Thermic effect of food. This refers to the integrated increase in energy expenditure after food ingestion over the energy expended at rest before the meal. Some foods require more calories for digestion. Also, requirements for specific nutrients "at the time" result in more efficient metabolism, such as carbohydrate intake immediately after exercise, when muscles are insulin resistant and more permeable.
- Energy requirements of specific activities.
- Growth, through maturation or muscle building.

It is important to realize that two individuals of the same sex and age can have the same body composition, including the same amount of fat free mass, yet they can have different RMRs and experience different thermic effects of food. These variances in metabolic expenditure are associated with genetic factors unique to the individual. Similarly, two individuals can have the same arm size and biceps brachii mass, but lift different weights because of other genetic factors.

Patterns in RMRs, thermic effects, energy requirements and growth potential can be determined through observation. Alterations in diet and exercise can then be made based on the collected data of individual characteristics.

Another influence of metabolic rate is that of somatotype. As stated, there are three main categories of somatotypes, being endomorph, mesomorph, and ectomorph (refer to the diagrams on the following page). Establishing a somatotype classification for an individual creates a ballpark representation to help determine exercise and nutrition protocol prescription, as explained under each category next page. However, somatotyping should be viewed merely as one aspect of individualism.

NOTE: RMR differences among active and inactive women do not show much variation. The opposite is true of men. There are two reasons for this. First, men carry much more muscle tissue and are apt to increase lean muscle mass dramatically, as opposed to women; this greatly alters RMR. Second, women are more apt to maintain body fat stores because of estrogen levels and as a means for survival – necessary for motherhood and pregnancy – thus keeping metabolism regulated within normal values regardless of the circumstances. Hence, trainability expectations must be relative to what is possible based on sex. Greater change, as a result of exercise and proper nutrition will be more noticeable and marked in males than in females on the average. As a result, women who tend to be fat, even if not eating much, have low lean muscle mass and an inability to gain much muscle mass. This person would have a predominance of endomorphy, and with less ectomorphy and mesomorphy respectively. This body-type combination results in a slow metabolism, necessitating higher volume and lower intensity of training than what may be appropriate for other women of a different body type.

Somatotype Categories[7] and Exercise & Nutrition Directions

Endomorph

Endomorphs are those with a body build marked by predominance of tissues derived from the endoderm. The *endoderm* is the innermost of the three primary germ layers of a developing embryo that gives rise to the epithelium of the digestive tract and its associated glands, the respiratory organs, bladder, vagina, and urethra. Endomorphs are large framed, heavy-set individuals with relatively low metabolic rates who find it extremely difficult to lose adipose tissue. They require fewer calories to maintain lean tissue and have a need for more rest days since the breakdown and rebuilding of muscle tissue does not occur as readily as for the other two somatotypes. True endomorphs consume few calories and should not be mistaken with those who over consume. Because calorie intake generally is low for this group, it is vital that endomorphs consume quality calories from relatively low-fat sources for muscle repair and growth to occur, but without increasing fat stores further.

A predominant endomorph is characterized with a round face, short, thick neck, deep, thick chest relative to width, thick legs and buttocks, and a stomach that may protrude more than the chest. Body mass is centered in the lower abdomen and hip region, having a pear-shaped appearance. The predominant endomorph finds it difficult to sustain endurance activity as a result of oxygen consumption per pound of body weight.

Mesomorph

Mesomorph refers to a body build characterized by predominance of tissues derived from the mesoderm. The *mesoderm* is a primary germ layer of the embryo, lying between the ectoderm and endoderm. From it arises all connective tissues; muscular, skeletal, circulatory, lymphatic, and urogenital systems; and the linings of the body cavities.

This body type often is referred to as “well proportioned” both because of its appearance and because its structure is neither thin nor fat. Mesomorphs are average to large framed individuals with normal metabolisms. They can appear rugged naturally, and perhaps stocky even without exercise. The predominant mesomorph has well-defined muscles, broad thick chests, sloping shoulders, flat abdomen, and usually v-shaped.

Predominant mesomorphs have no trouble with body weight fluctuations and are stronger and more robust than ectomorphs or endomorphs, and their oxygen consumption per pound of body weight measures somewhere between the endo and ecto somatotypes. They have higher body fat stores and require fewer calories to maintain muscle mass than predominant ectomorphs. Since predominant mesomorphs have a high ratio of fast twitch fibers, these people require more rest days between workouts and modest levels of volume and frequency (although the superior genetics of mesomorphs often allow them to produce results on higher volume routines more suitable for ectomorphs). Successful bodybuilders, powerlifters, and Olympic weight lifters frequently have a high inclination toward mesomorphy.

Ectomorph

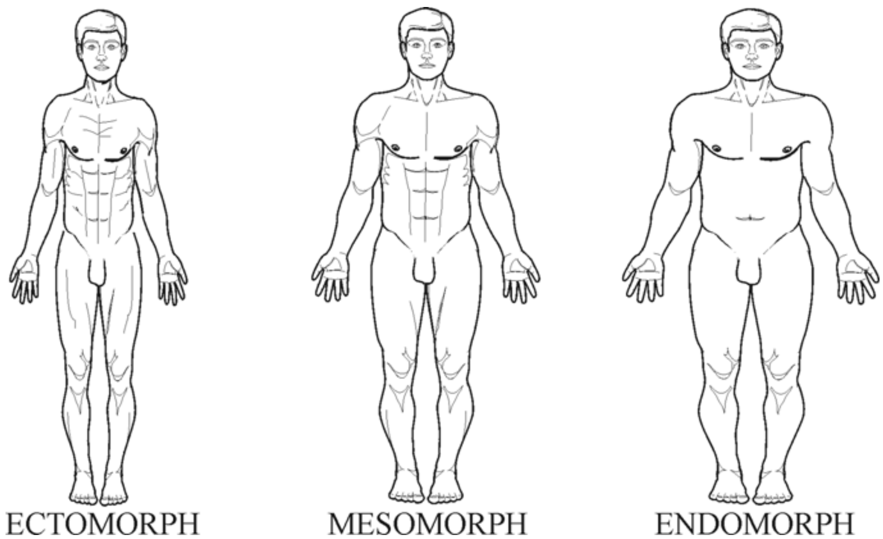
A predominant ectomorph is a person with a body build marked by tissues derived from the ectoderm. The *ectoderm* is the outer layer of cells in the developing embryo; it produces skin structures, the teeth and glands of the mouth, the nervous system, organs of special sense, part of the pituitary gland, and the pineal and suprarenal glands.

Ectomorphs are small framed, low fat individuals who find it extremely difficult to gain weight. Other characteristics include a thin bony face, fairly undefined musculature, long thin trunk with a flat (and even sunken) chest, slender arms, narrow hips, and small joints.

---

[7] Somatotype descriptions obtained in part from *Taber’s Cyclopedic Medical Dictionary, 18th Edition*. Clayton L. Thomas, M.D., M.P.H. (ed). F.A. Davis Company. 1993.

They have fast metabolisms and usually low amounts of fast twitch fibers throughout their bodies. Both factors allow for quick recovery after workouts and a need for greater volume and frequency than the other somatotypes. Although ectomorphs require fewer rest days after workouts, their bodies do necessitate the need for a large volume of kcal to help sustain and gain muscle tissue. If sufficient quality kcal are not ingested, ectomorph systems catabolize muscle tissue for recovery energy. The predominant ectomorph has an exercise advantage in terms of oxygen consumption per pound of body weight, and is suited best for endurance-based activities.



Generally, during childhood, there is a predominance of ectomorphy (much of the obesity we see in Western children is forced endomorphy via overeating and lack of activity, which are not their bodies' natural state). During the teen years there is a natural inclination toward mesomorphy in boys and endomorphy in girls. As boys mature there is a more noticeable splitting among endomorphy, mesomorphy, and ectomorphy whereas females typically do not experience such divergence (at least not to the same extent). Most important, the measure and character of each somatotype within each individual vary across a broad spectrum throughout the population and will change relative to the organism's genetics as influenced by his or her environment, e.g., exercise and nutritional habits.

Somatotype Rating

Somatotype categorization is the appraised phenotypical rating or qualification of the body's geometrical size-dissociation… of shape and composition. It is expressed in a three-number rating system that represents the general 'types' of endomorphy, mesomorphy and ectomorphy, and always in that order.

A rating of 5-8-2, for example, would give a magnitude of an individual's somatotype and would suggest a very high inclination toward mesomorphy (8), a moderately high rate of endormorphy (5) with little ectomorphy (2) characteristics. A rating of ½ to 2½ is considered low, 3-5 is moderate, 5½-7 is high, and 7½ and above are very high.[8]

[8] Carter, J.E.L. & Heath, B.H. (1990) *Somatotyping: Development and Applications*. Cambridge: Cambridge University Press.

The 13 categories are based on the areas of the 2-D somatochart (chart shown on page x)[9]:

1. Central: no component differs by more than one unit from the other two.
2. Balanced endomorph: endomorphy is dominant and mesomorphy and ectomorphy are equal (or do not differ by more than one-half unit).
3. Mesomorphic endomorph: endomorphy is dominant and mesomorphy is greater than ectomorphy.
4. Mesomorph-endomorph: endomorphy and mesomorphy are equal (or do not differ by more than one-half unit), and ectomorphy is smaller.
5. Endomorphic mesomorph: mesomorphy is dominant and endomorphy is greater than ectomorophy.
6. Balanced mesomorph: mesomorphy is dominant and endomorphy and ectomorphy are equal (or do not differ by more than one-half unit).
7. Ectomorphic mesomorph: mesomorphy is dominant and ectomorphy is greater than endomorphy.
8. Mesomorph-ectomorph: mesomorphy and ectomorphy are equal (or do not differ by more than one-half unit), and endmorphy is smaller.
9. Mesomorphic ectomorph: ectomorphy is dominant and mesmorphy is greater than endomorphy.
10. Balanced ectomorph: ectomorphy is dominant and endomorphy and mesomorphy are equal (or do not differ by more than one-half unit).
11. Endomorphic ectomorph: ectomorphy is dominant and endomorphy is greater than mesomorphy.
12. Endomorph-ectomorph: endomorphy and ectomorphy are equal (or do not differ by more than one-half unit), and mesomorphy is lower.
13. Ectomorphic endomorph: endomorphy is dominant and ectomorphy is greater than mesomorphy.

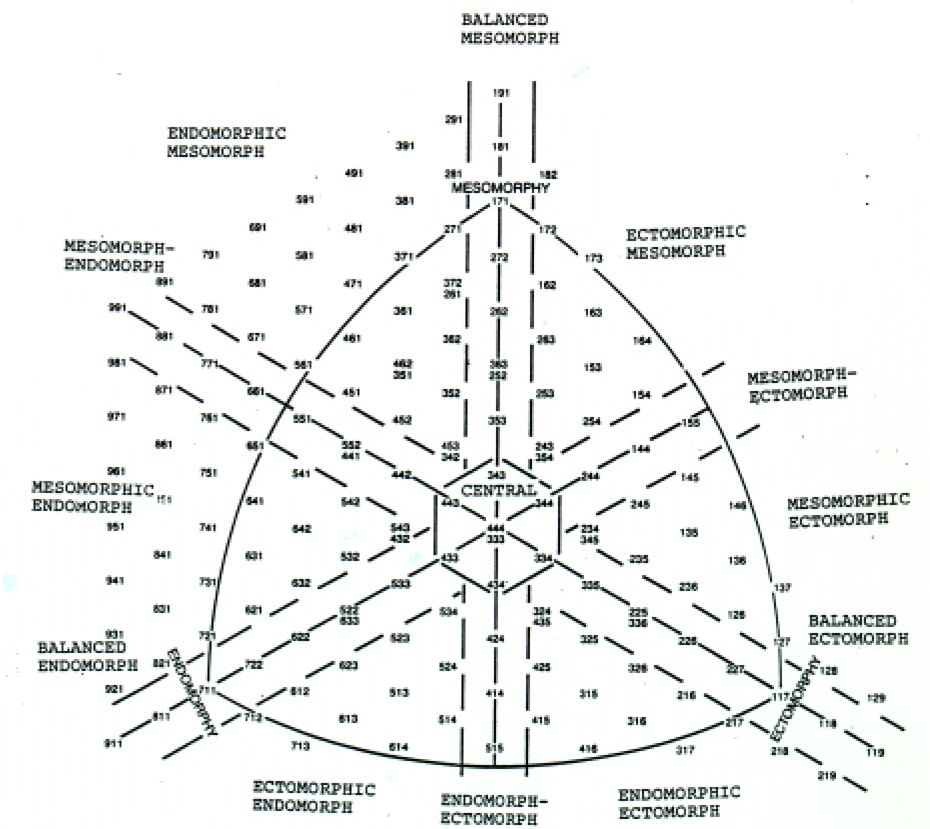
The thirteen categories can be simplified (and often is done) into four larger categories:

1. Central: no component differs by more than one unit from the other two.
2. Endomorph: endomorphy is dominant, mesomorphy and ectomorphy are more than one-half unit lower.
3. Mesomorph: mesomorphy is dominant, endomorphy and ectomorphy are more than one-half unit lower.
4. Ectomorph: ectomorphy is dominant, endomorphy and mesomorphy are more than one-half unit lower.

[9] Carter and Heath

Plotting a Somatotype

Somatotypes with similar relationships between the dominance of components are grouped into categories named to reflect those relationships. The two-dimensional graph[10] below shows somatotype categories across X and Y coordinates, whereby the numbers on the chart suggest the three-number rating system. For instance, over to the far bottom left is the number 931. This would indicate a rating of endomorphic (9), mesomorphic (3), and ectomorphic (1). In effect, a person who has a high predominance of endomorphy, some mesomorphic qualities, but very little ectomorphy would be a mesomorphic endomorph. The general plan for plotting can be seen, by following the somatotypes along each axis (endo, meso and ecto), starting at the one rating and moving along to the higher numbers on each axis, and that the other two components change as you move along the lines. And although the graph is represented in two-dimensions, it must be remembered that somatotypes exist in three dimensions.



Let us return to the Somatotype Calculation and Analysis software, by Sweat Technologies. The following three pages consists of one report (of four possible types) of Matt Brzycki, a 'balanced mesomorph,' internationally recognized author and strength and conditioning expert and former competitive powerlifter. Moreover, Matt is compared to several of the male Olympic weightlifters at the 1976 Montreal Olympic games. The blue circle on the graph shows the mean of all individuals, whereas the solid blue dot depicts Matt's location on the somatoplot.

[10] Courtesy of Lindsay Carter, from the book *Somatotyping: Development and Applications*.

Compare a profile to its document

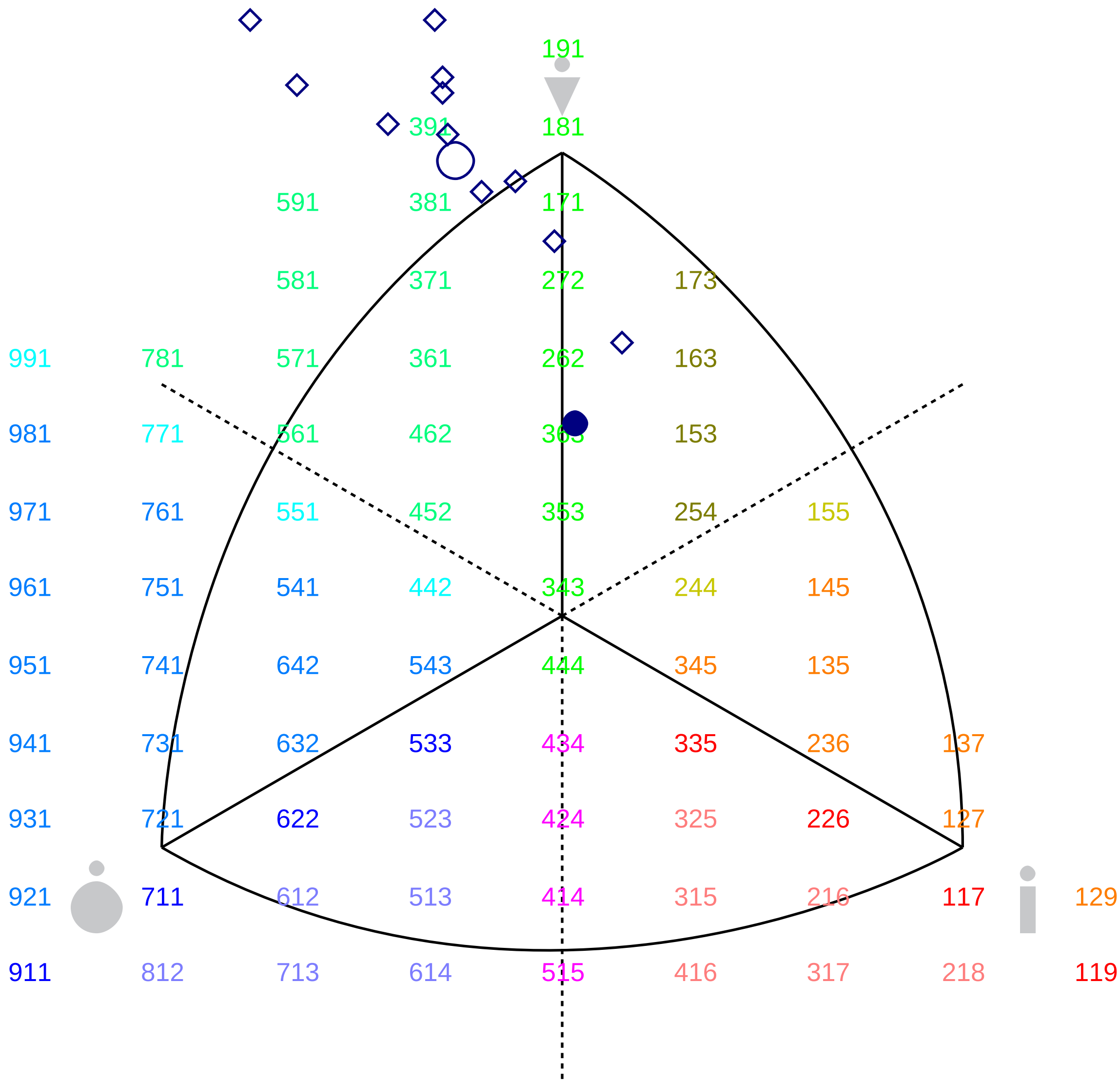
Report Explanation

This report compares a single profile (the Comparison Profile) to all other profiles in a Somatotype document. It includes
• a Somatochart showing all the profiles from each of the documents (Note: if you have chosen "plot means only" in the Report Wizard, only the mean somatotypes for each of the groups will be shown);
• a Comparison of Variables Table with statistics for the Comparison Profile relative to the group.

On the Somatochart, the Comparison Profile is indicated by a black dot. The mean somatotype for all the profiles in the document is shown by the profile marker inside an empty circle. Below the Somatochart is a brief description of the Somatotype document.

The Comparison of Variables Table shows the Comparison Profile value, and the median, mean and SD for all profiles in the document for a range of variables. Also shown is the percentile rank of the Comparison Profile relative to all the profiles in the document. The Comparison Profile is compared to all profiles for the following variables:
• somatotype components (endomorphy, mesomorphy, ectomorphy);
• SAD (Somatotype Attitudinal Distance), the three-dimensional distance from a profile to the mean of all profiles;
• HWR (height-weight ratio), calculated as height in cm divided by mass in kg raised to the power 1/3, ie HWR = Height/(Mass)^1/3;
• age, and
• the ten anthropometric variables required to calculate somatotype: height and mass; triceps, subscapular, supraspinale and calf skinfolds; flexed arm and calf girth; biepicondylar humerus and femur breadth.

Somatoplot



Subject: Matt Brzycki

Soma Document: Matt Brzycki

Mean profile of document:

Profile To Document Comparison

Subject: Matt Brzycki

Somatotype Document: Matt Brzycki

Comparison of Variables Table

Variable	Profile	Median	Mean	SD	Percentile Rank
Endomorphy	1.8	2.15	2.39	1.06	29.2%
Mesomorphy	4.4	7.80	7.49	1.61	4.2%
Ectomorphy	2	0.45	0.78	0.76	87.5%
SAD	3.37	1.22	1.65	1.15	87.5%
HWR	41.81	39.06	39.17	1.96	87.5%
Age	47.94	29.25	29.98	6.53	95.8%
Height	179.7	173.50	171.30	9.47	87.5%
Mass	79.38	81.14	86.27	24.68	45.8%
Triceps SF	3	6.20	7.37	3.36	4.2%
Subscapular SF	12	10.00	10.72	4.01	70.8%
Supraspinale SF	4	5.45	6.38	3.22	12.5%
Calf SF	10	6.20	6.99	3.10	79.2%
Arm Girth	37	37.90	38.50	5.36	45.8%
Calf Girth	38.86	39.80	39.36	3.92	29.2%
Humerus B	6.35	7.35	7.27	0.66	12.5%
Femur B	8.38	9.88	9.77	0.68	4.2%

Rosscraft Innovation Instruments

Thus far a general overview of anthropometry was provided, together with an example of precision standards in landmarking and taking a triceps skinfold, and how measurements integrate into the more complex field of study of somatotyping. The next important issue to this paper is the quality of instruments used to acquire data, which instruments must be reliable, i.e., reproducible and accurate.

A standard anthropometry kit would include a stadiometer or height scale and headboard (unless the weighing scale has a built-in height rod), a weighing scale, a small sliding caliper for biepicondylar breadth measurements of the humerus and femur (elbow and knee joints), a flexible steel or fiberglass tape measure, skinfold calipers, and anthropometer (a device for measuring the human body and its parts).

Statures/heights and girths are to be recorded to the nearest mm, biepicondylar diameters to the nearest 0.5 mm, and skinfolds to the nearest 0.1 mm (Harpenden caliper) or 0.5 mm on other calipers.[11]

The I.A.R.T.'s testing and performance center, *Fitness Logistics*, implements the Rosscraft Innovations **Centurion Kit**. Rosscraft Innovations instruments are of the highest caliber, and have been designed to ISAK standards for gathering anthropometric data, for general measurement comparison, as well as somatotyping as presented in the previous section. The Centurion Kit includes the following items and features.

The **Campbell 20**[12] (54 cm wide) double-sliding patent designed, non-binding caliper with AP branches can be calibrated and provides a reading to the nearest 0.01 cm; a reading to the nearest 0.1 cm, is sufficient for most scientific and clinical applications. Based on a design by Robert Campbell, the Campbell 20 calipers' straight branches are used to measure torso breadths such as biacromial, transverse chest, and biiliocristal (see top photo right). AP Chest, and some head measurements are made using the AP Extensions or Branch Pointers (see bottom photo right), which pointers are exactly 10 cm each (and can be calibrated using an adjustable screw and lock nut). Thus, the caliper reading from AP branch tips is 20 cm too large, easily corrected by subtracting 20 cm constant in the data entry program or spread sheet.

Rosscraft Innovations Campbell 20 Wide Sliding Torso Caliper (top) with AP branches (bottom)

These calipers have other uses for fitness clinicians, such as measuring and tracking the changes made in shoulder, waist, and hip widths at their widest points, to be coordinated with girth measurements of the same parts.

These calipers are machined from aluminum, with a satin black anodized finish and a contrasting white laser engraved scale. The Campbell Caliper 20 replaces the traditional anthropometer and widespreading caliper for breadths, AP chest depth and other diameters. A serif zero indicator provides for reading to 0.1 cm with interpolation to 0.05 cm.

[11] The Heath-Carter Anthropometric Somatotype Instructional Manual.

[12] The Rosscraft Innovations line of Campbell calipers are named after the late Mr. Robert Campbell, the inventor of the double siding branch principle, an exclusive Rosscraft Innovations design feature under US patent No. 4265021. The Campbell 20 is the only caliper that has long branches that do not bind under pressure at the tips.

Campbell 10 small bone caliper

Also based on a patented design by Mr. Robert Campbell, the **Campbell 10** (18 cm) double sliding small bone caliper can be calibrated and provides a reading to the nearest 0.01 cm. Standards dictate that the caliper branches must extend to 10 cm,[13] whereas Rosscraft Innovations calipers extend to 18 cm. The Campbell 10 Caliper assures parallel measuring faces and does not bind while applying firm pressure.

The caliper is machined from aluminum, and has a satin black anodized finish with a contrasting white laser engraved scale. Double serif zero indicators provide for upper or lower scale orientation. Reading is made to 0.1 cm with interpolation to 0.05 cm.

Industry standards recommend that skinfold calipers have an upscale interjaw pressure of 10 gm/mm^2 over the full range of the openings.[14] Although Lange and Lafayette calipers are considered 'standard' among fitness professionals, they tend to produce higher readings than other calipers.[15] Rather, recommended by industry standards[16,17] are the Harpenden and **Slim Guide Calipers** available through Rosscraft Innovations, the latter of which are part of the Centurion Kit.

Slim Guide Skinfold Caliper
and Harpenden Skinfold Caliper

The Slim Guide skinfold caliper, with a similar dynamic action to calipers costing over ten times as much, is an inexpensive alternative to the Harpenden caliper. The Slim Guide yields approximately similar results and its rugged ABS plastic construction, with high quality springs, guarantees a long life of usage.

In the hands of a trained anthropometrist, industry standard recommended skinfold calipers have a technical error of measurement for a single replication as low as 5%, depending on training and technique (and accuracy may be interpolated to 0.5 mm). The scale of 0 to 85 mm of the Slim Guide is especially useful in assessing skinfolds at the upper ranges that are not accommodated by most other calipers and when working with the obese.

---

13 Schmidt, P.K. & Carter, J.E.L. (1990). *Static and dynamic differences among five types of skinfold calipers.* Human Biology, 62, 369-388.

14 Standard weights should be an investment for the calibration of weighing scales. Likewise, smaller standard weights are necessary for the calibration of skinfold calipers, accomplished by fixing the instrument in a vice and suspending weights from the lower jaw. The caliper should be adjusted so that the jaws remain open in any position when the appropriate calibration weight is used (e.g. 10 g mm^{-2} surface area of a pressure plate).

15 Schmidt, P.K. & Carter, J.E.L. (1990). *Static and dynamic differences among five types of skinfold calipers.* Human Biology, 62, 369-388.

16 Schmidt & Carter.

17 The Heath-Carter Anthropometric Somatotype Instructional Manual.

Proper measuring technique using the
Rosscraft Innovations Anthropometric Tape

The Rosscraft Innovations Centurion Kit includes two easy-to-read **Anthropometric Tapes**[18], 6 mm wide, one steel and one fiberglass in two-meter lengths, calibrated in centimeter and millimeter gradations. Both tapes are flexible with 8 cm end tabs/stubs before the zero marking for easier manipulation. The aluminum model has a filed notch and patch zero indicator to provide a better reading interface than a single zero line since the interface has no area. The notch helps orient the tape and align on the interface.

Rosscraft Innovations tapes are enclosed in a metal case with a spring for automatric retraction, although the tension is not so great as to cause compression of the skin.

Recommended are flexible steel tape measures since other materials stretch or expand with use and depending on environmental conditions, such as humidity; other tapes should be compared to steel tapes to ensure accurate readings. In fact, it was discovered that in evaluating tapes for the *Canada Fitness Survey*[19] two supposedly reputable brands were incorrectly calibrated and one appeared to be stretchable.

The Rosscraft Innovations **Headsquare** is a portable, practical alternative to a stadiometer for measuring stature and sitting height. The headsquare consists of a horizontal plane and a triangle, as shown in the photo below.

Techniques for orientation of the head, in the *Frankfort Plane*, marking heights and measurement are described fully in the ISAK standards manual and various publications including the ***Anthropometry Fundamentals*** CD that comes with the Centurion Kit, and *Anthropometry Illustrated*.

Rosscraft Innovations Headsquare

[18] Technical note: in the preferred technique, the tape is always held in right hand by digits 4 and 5; digits 1 and 2 are the snubbers; digit 3 for pinning, leveling or and adjusting tape perpendicular to the long axis.

[19] Ross, Carr, and Carter. *Athropometry Illustrated*. www.rosscraft.ca

Rosscraft Innovations Segmometer 4

The Rosscraft Innovations **Segmometer 4** is required for direct measures of segmental lengths and projected heights from a measuring box (a less expensive, yet just as accurate alternative to the anthropometer). Its design evolved from a prototype retractable carpenter or engineer's tape for use in Nigeria by Dr. Linda Blade. Rosscraft Innovations discovered that even the crude prototype was as good or better than the classical anthropometer for obtaining projected heights and direct segmental lengths. The Rosscraft Innovations models dispense with the housing using only a 105-cm flexible tape (that remains rigid throughout its length) so that it could be easily folded and transported in the Centurion case.

Its precision-machined base and slider indicators easily replicate measures, and have become a new standard for precision. The Segmometer 4 provides added value over and above regular tapes for measuring segments lengths, as the slider indicators make it easy to landmark and measure, particularly for a sole clinician who needs to hold both ends of the implement.

An option (not found in the Centurion Kit) is the Rosscraft Innovations portable **AnD Weight Scale**, a true strain gauge digital scale that can be set for kilograms or pounds, and for any latitude and altitude. It has a zero feature that permits infant weighing in a mother's arms, and it has several electronic memory functions.

A second option provided by Rosscraft Innovations is the **Grip Strength Tester** (smedley III, analog, kg, with case).

The Rosscraft Innovations Centurion Kit

www.Rosscraft.ca