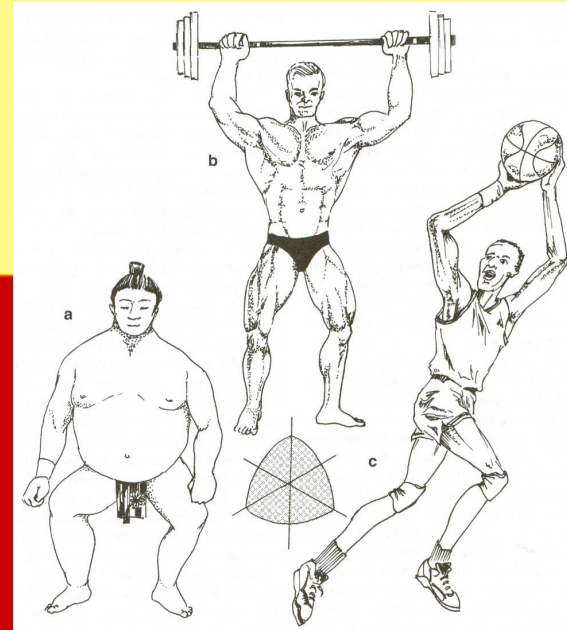




ESTIMATING BODY COMPOSITION



What is Body Composition?

Refers to the relative amounts of the different compounds in the body

Why Study Body Composition?

- 🔥 Overweight vs. Over fat vs. Obesity
- 🔥 Risk for various diseases
- 🔥 Monitor change from an intervention
- 🔥 Some job requirements involve body composition standards
- 🔥 Athletic/sports prowess

BODY MASS INDEX (BMI)

The ratio of mass to height²

$$\text{BMI} = \text{body mass (kg)} / \text{body height (m)}^2$$

for example

$$\text{BMI} = 80 \text{ (kg)} / 1.7^2 \text{ (m)} = 27.68 \text{ kg/m}^2$$

BMI < 20.0 is considered underweight

A BMI > 30 is associated with greater prevalence of mortality from heart disease, cancer, and diabetes

BMI**Disease Risk****Classification**

<20.00

Moderate to
Very High

Underweight

20.00 to 21.99

Low

Acceptable

22.00 to 24.99

Very Low

25.00 to 26.99

Low

Overweight

27.00 to 29.99

Moderate

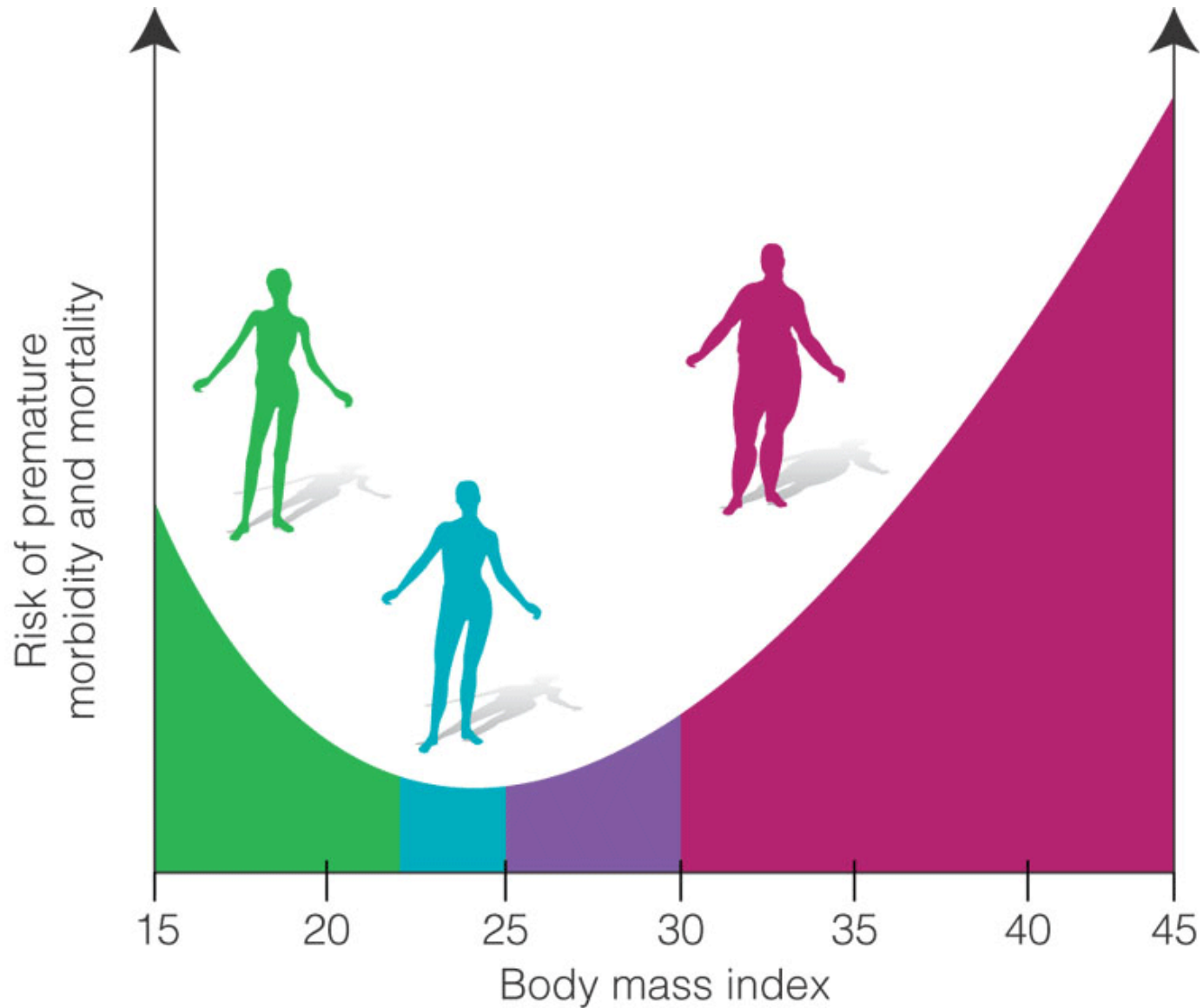
30.00 to 39.99

High

Obese

 \geq 40.00

Very High



- Underweight
- Overweight
- Recommended weight
- Obesity

Elementary parameters

- HEIGHT
- BODY MASS
- BODY SURFACE



Body surface S (m²) - DuBois:

$$S = W^{0,425} \cdot L^{0,725} \cdot 0,007184$$

W – body mass (kg); L - height (cm)

MEN mean CZ 179 cm

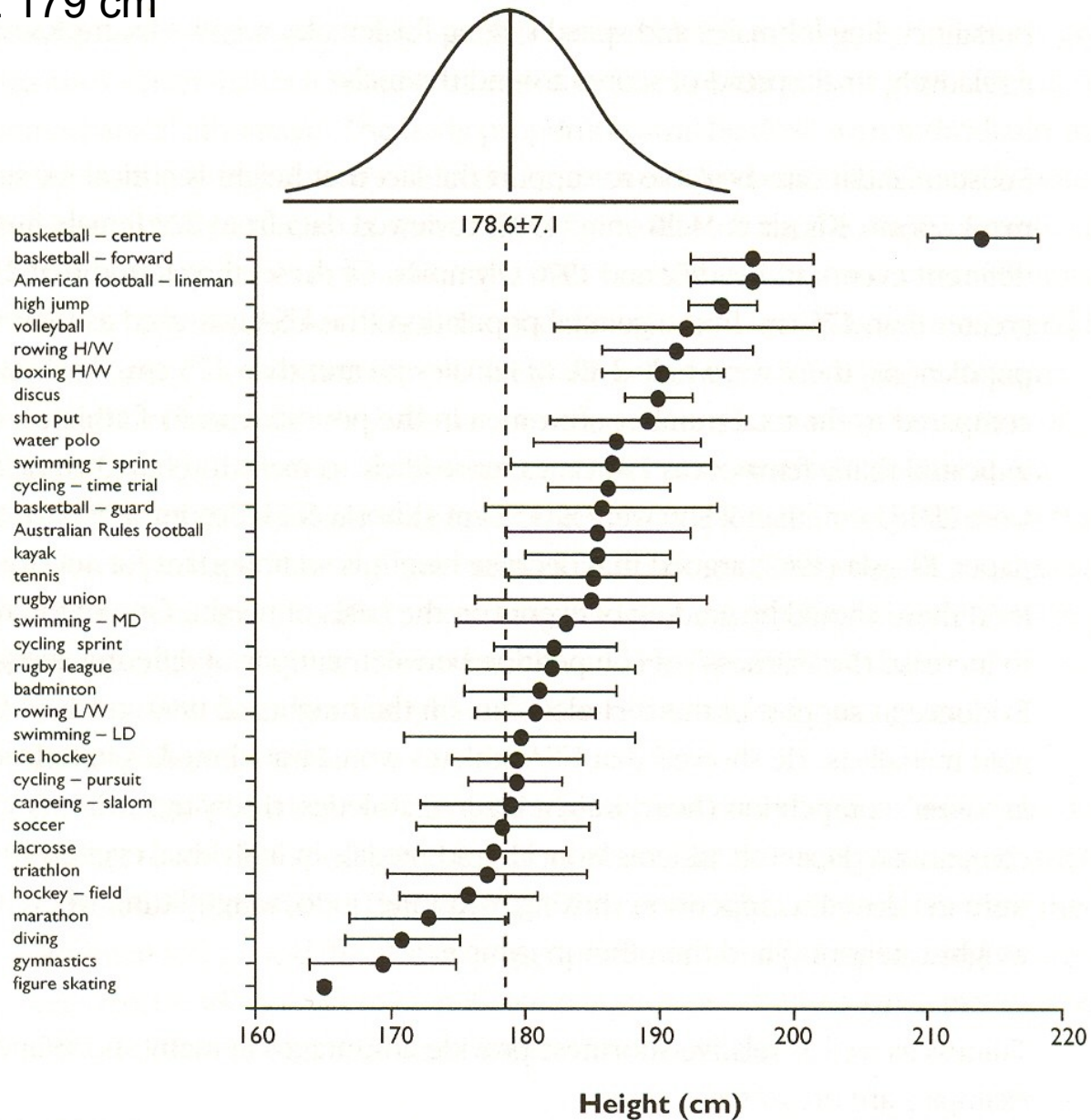


Figure 4 Plot of mean (\pm SD) heights for male athletes in different sports relative to a reference population of non-athletes.

WOMEN mean CZ 166 cm

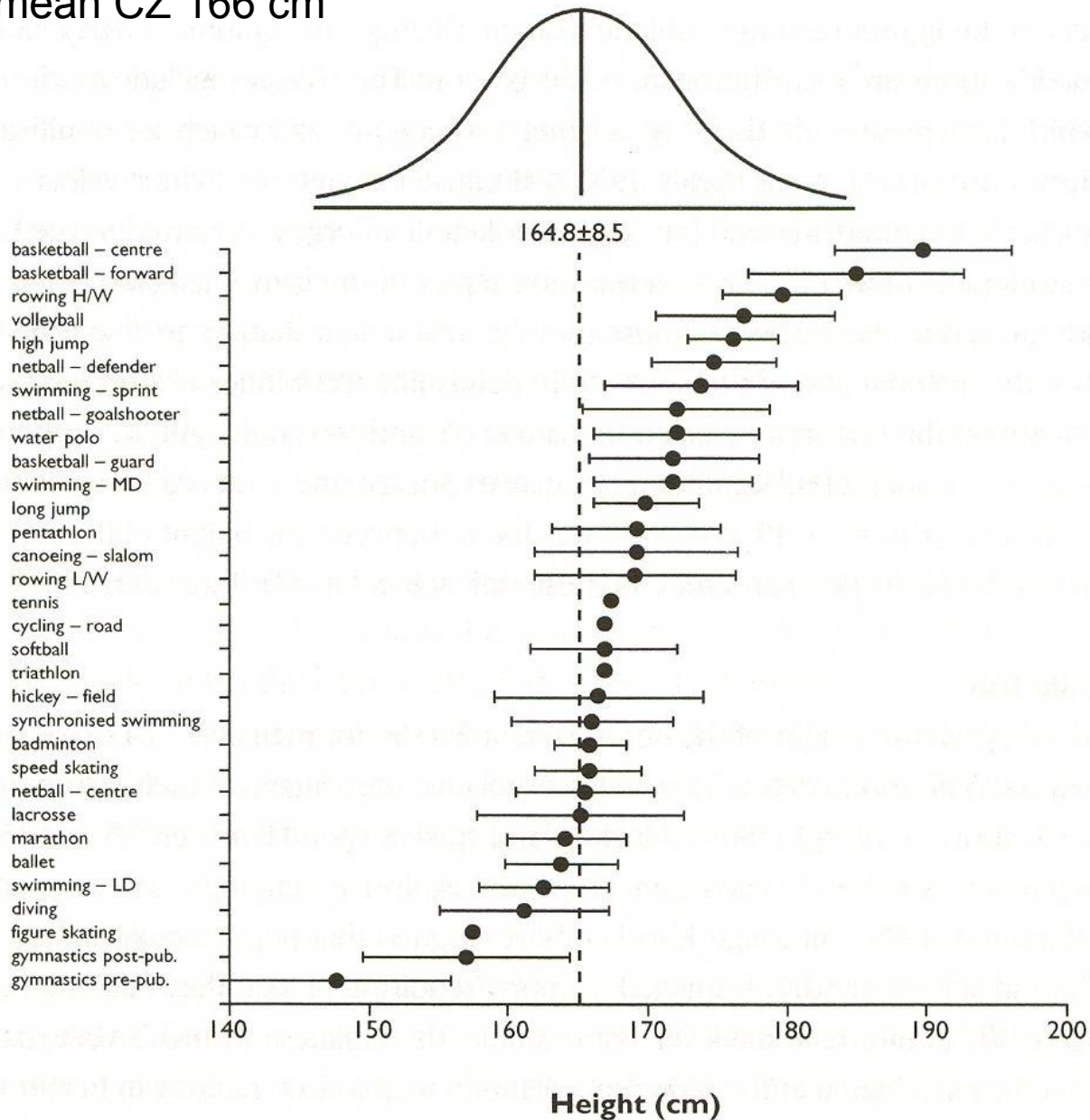


Figure 5 Plot of mean (\pm SD) heights for female athletes in different sports relative to a reference population of non-athletes.

MEN mean CZ 75 kg

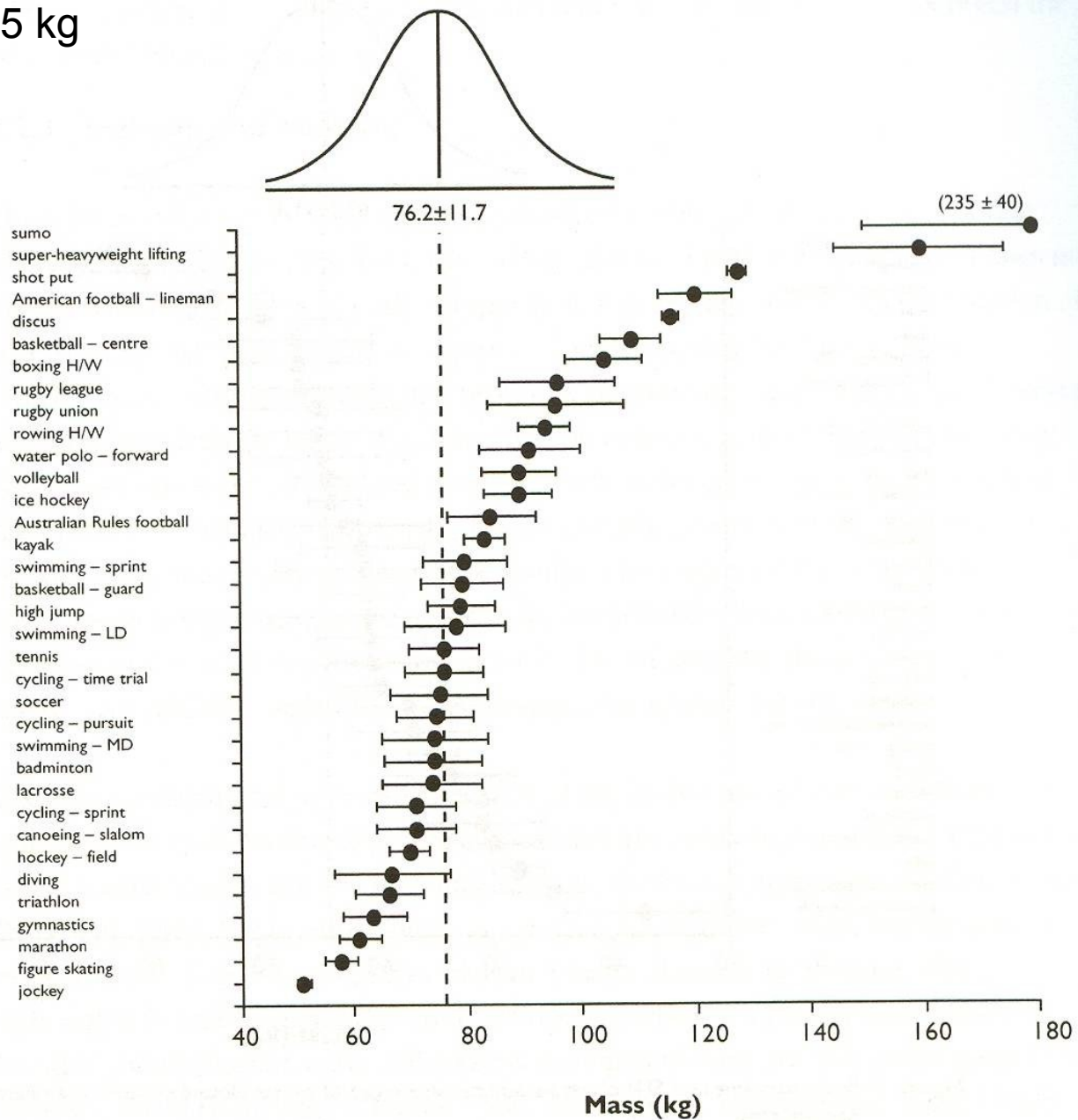


Figure 8 Body mass (mean ± SD) of male athletes in a range of sports plotted relative to a reference group of non-athletes.

WOMEN mean CZ 60 kg

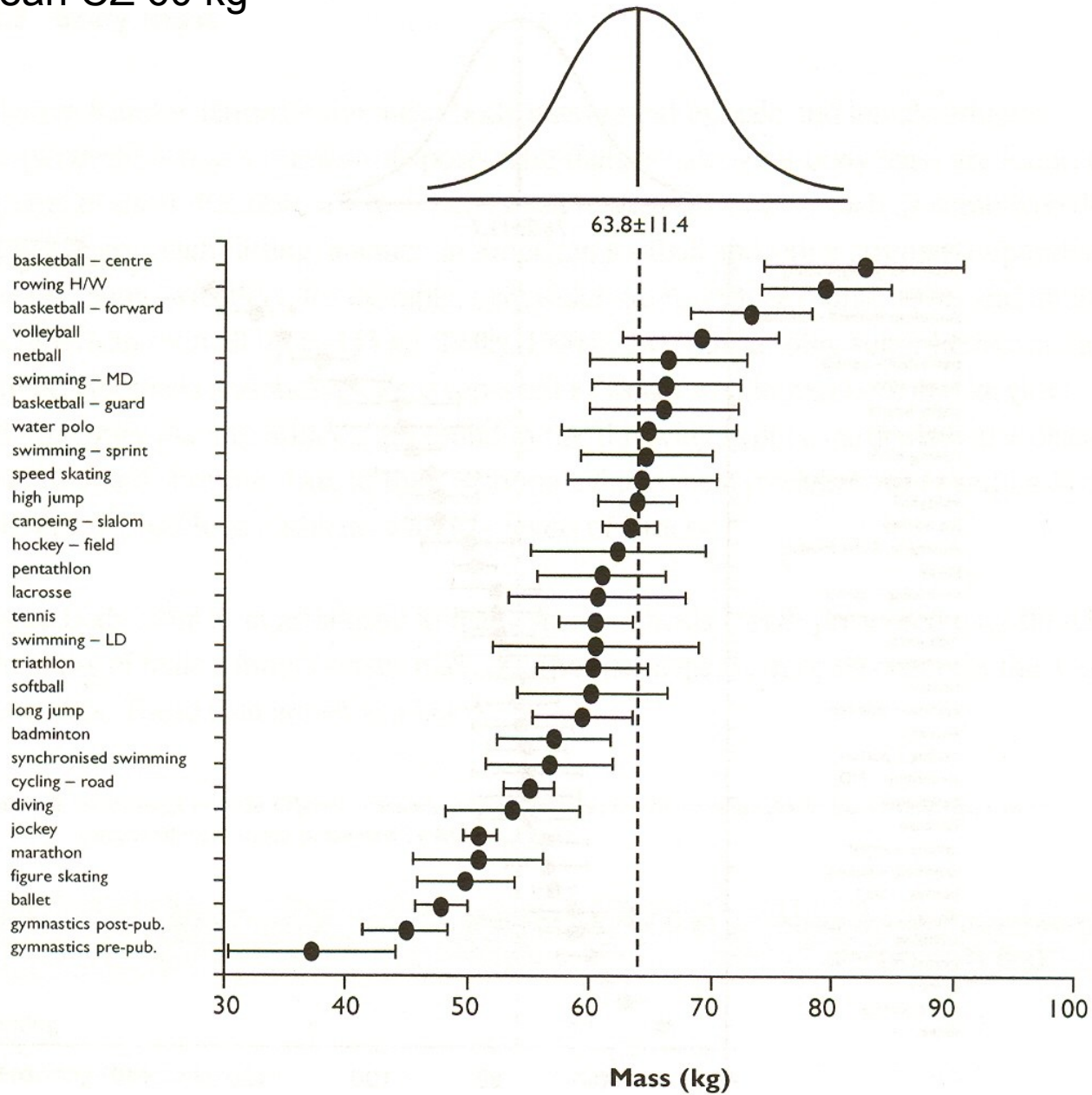


Figure 9 Body mass (mean ± SD) of female athletes in a range of sports plotted relative to a reference group of non-athletes.

Chart A – Determining frame size using wrist size in inches

Frame	Men	Women
small	6 inches or less	5.5 or less
medium	6.25 – 7.25	5.75
large	7.5 or more	6 or more

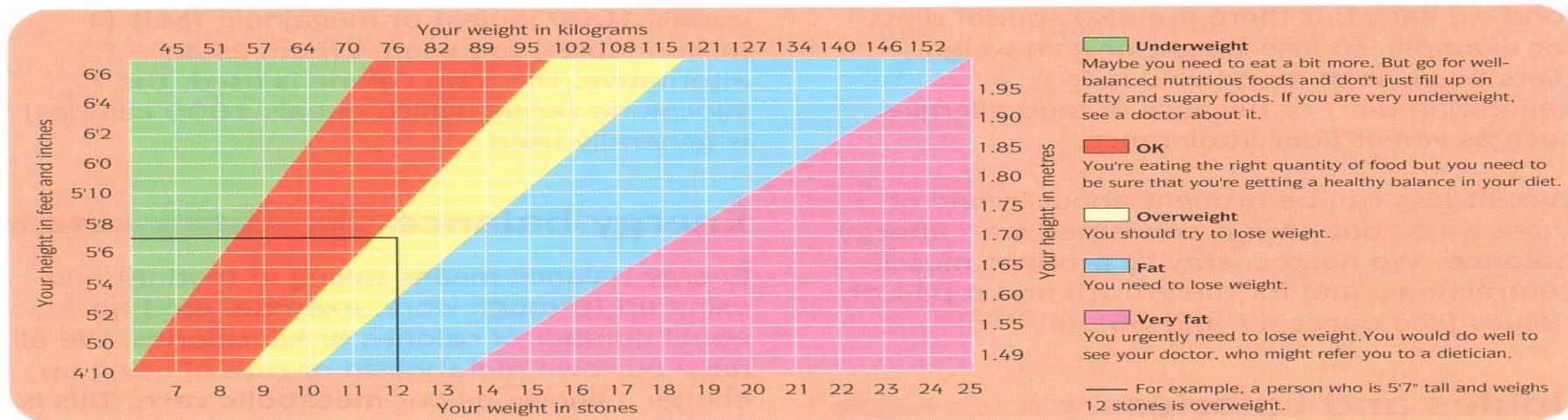
Chart B – Desirable body weight for women (kgs)

Height (metres)	Small frame	Medium frame	Large frame
1.47	46-50	49-55	53-59
1.49	47-51	50-56	54-61
1.52	47-52	51-57	55-62
1.54	48-53	52-58	56-63
1.57	49-55	53-60	58-65
1.60	50-56	54-61	59-67
1.62	51-57	56-62	61-68
1.65	53-59	58-64	62-70
1.67	54-60	59-65	63-72
1.70	55-61	60-67	65-74
1.72	56-62	61-68	66-76
1.75	58-64	63-69	68-77
1.77	59-65	64-71	69-78
1.80	60-67	65-72	70-80
1.82	62-68	67-73	71-81

Chart C – Desirable body weight for men (kgs)

Height (metres)	Small frame	Medium frame	Large frame
1.57	58-60	59-64	62-68
1.60	59-61	60-65	63-69
1.62	59-62	61-66	64-70
1.65	60-63	62-67	65-72
1.67	61-64	63-68	66-74
1.70	62-66	64-70	67-76
1.72	63-67	65-71	69-78
1.75	64-68	67-72	70-80
1.77	65-70	68-74	71-82
1.80	66-71	70-75	73-83
1.82	67-73	71-77	74-85
1.85	70-74	72-79	76-87
1.87	71-76	74-81	78-89
1.90	71-78	76-82	80-92
1.93	73-80	77-85	82-93

Chart D – Height-to-weight chart for men and women



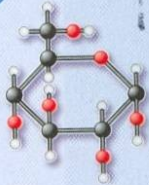
Source: Health Education Authority

Level I Atomic



Element	Amount (kg)	% Body Mass
Oxygen	43.0	61.0
Carbon	16.0	23.0
Hydrogen	7.0	10.0
Nitrogen	1.8	2.6
Calcium	1.0	1.4
Remainder	1.2	2.0

Level II Molecular



Protein

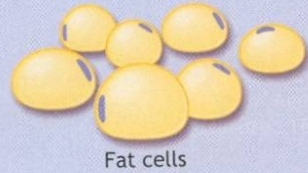
Carbohydrate

Lipid

Mineral compounds

Water

Level III Cellular

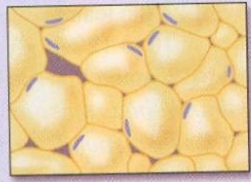
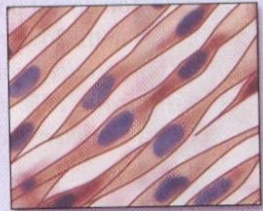


Body cell mass
(does not include storage fat)

ICF
ECF
Body fluids

Organic and inorganic
Extracellular solids

Level IV Tissue



Level V Whole body

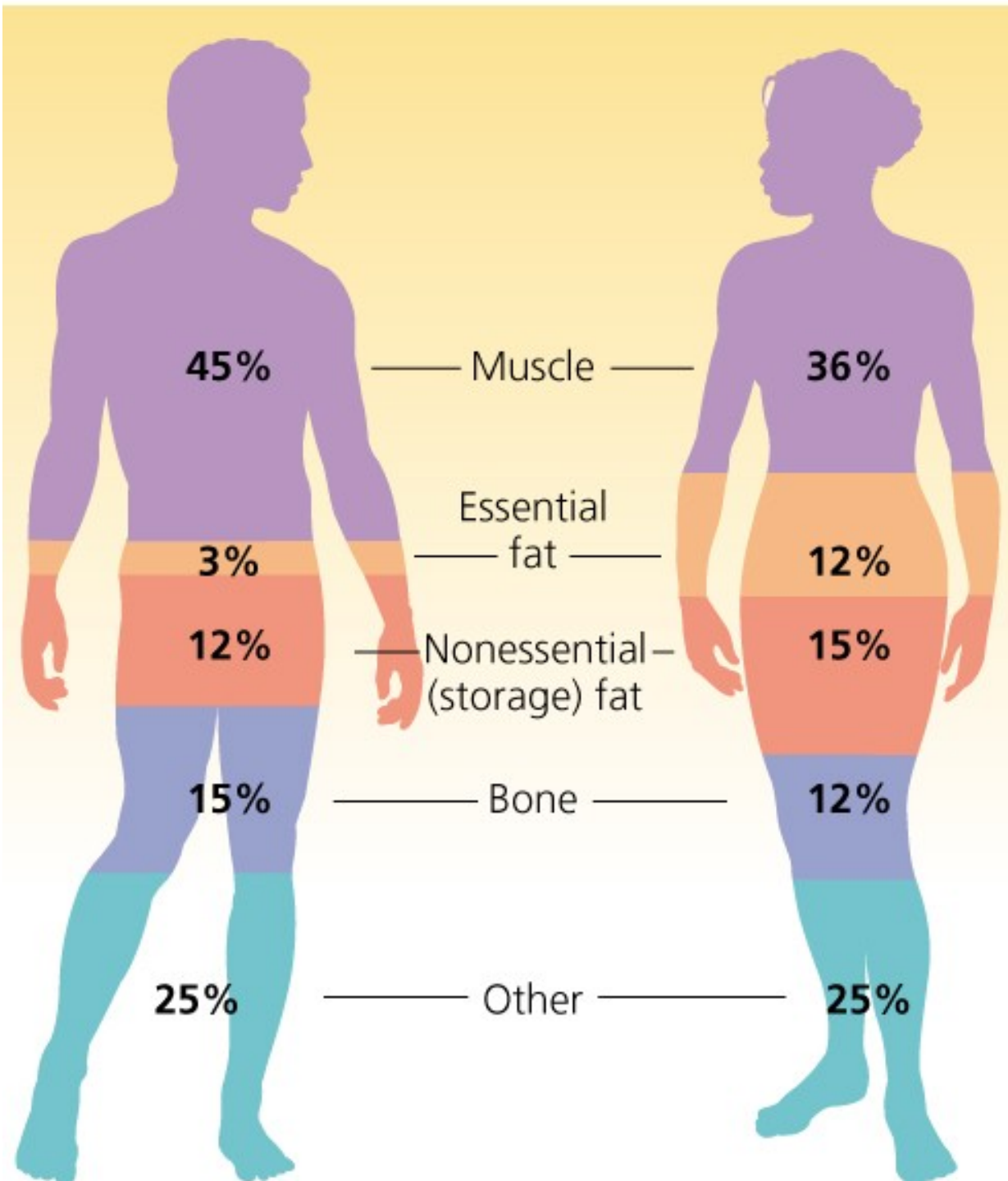


Body Composition

Matiegka Method

4 components:

- Skeletal mass (bones)
- Fat body mass (fat)
- Muscle mass (muscles)
- Other



BREADTHS

- biepicondylar humerus
- bistyloideus
- biepicondylar femur
- bimalleolar



GIRTHS

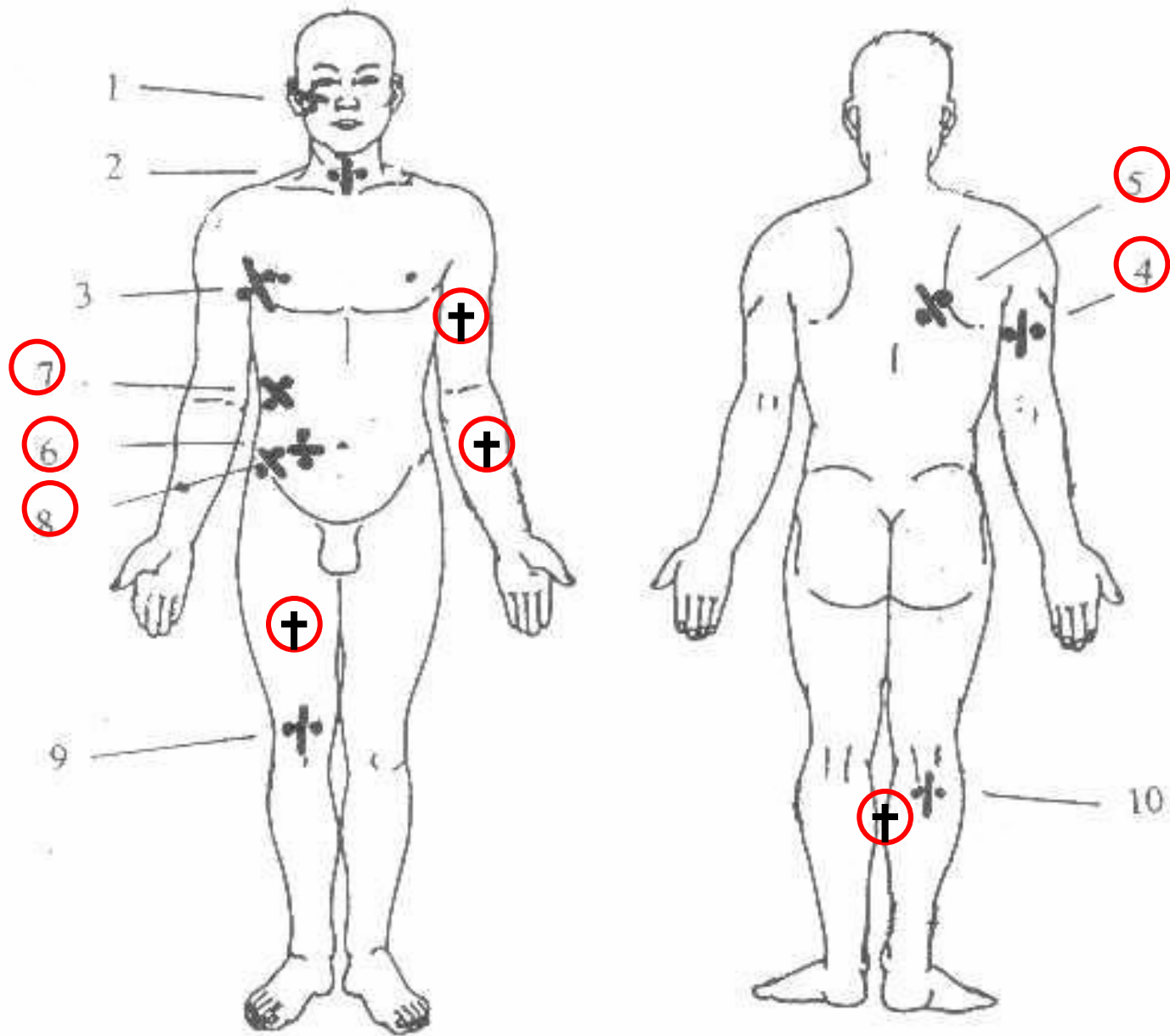
- relax arm
- flexed arm
- forearm girth
- thigh girth
- calf girth



SKINFOLD MEASUREMENTS

- triceps
- subscapular
- chest 2
- abdomen
- supraspinal

- biceps
- forearm
- mid-thigh
- medial calf



Standardní místa snímání tloušťky kožních řas pro stanovení relativní hmotnosti depotní tukové tkáně kaliperem.

MEN

WOMEN

Skeletal mass:

17%

16%

Muscle mass:

46%

41%

Fat body mass:

14%

22%

Other:

23%

21%

35%



8%



45%



15%



BIOELECTRIC IMPEDANCE ANALYSIS (BIA)

DEVICE:

- Omron
- Tanita
- Body stat
- In-Body

BIOELECTRIC IMPEDANCE ANALYSIS (BIA)

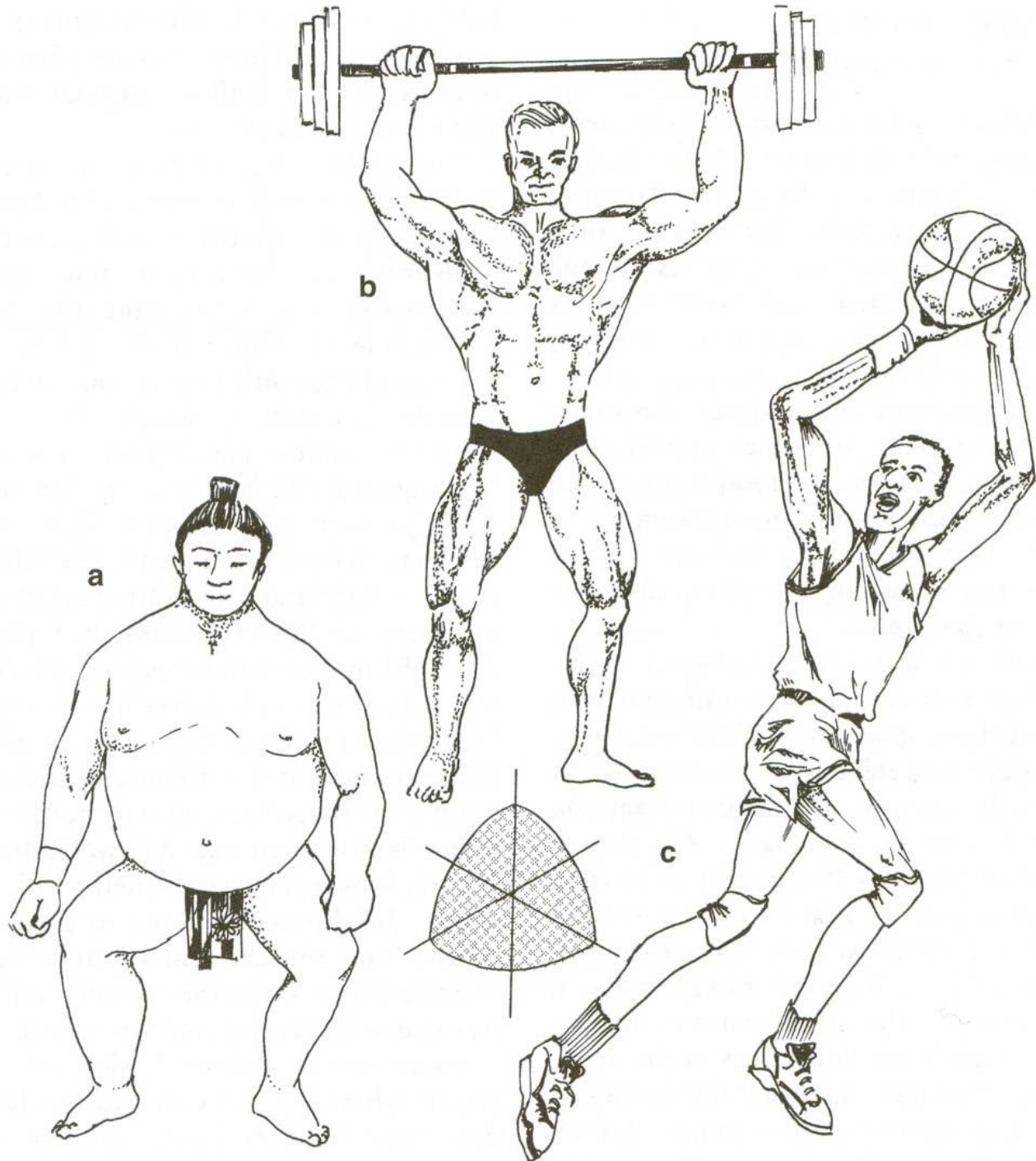
- Body fat scales use the Bioelectrical Impedance Analysis (BIA) technique.
- This method measures body composition by sending a low, safe electrical current through the body.
- The current passes freely through the fluids contained in muscle tissue, but encounters difficulty/resistance when it passes through fat tissue.
- This resistance of the fat tissue to the current is termed 'bioelectrical impedance', and is accurately measured by body fat scales.
- When set against a person's height, gender and weight, the scales can then compute their body fat percentage.

SOMATOTYPING

The Heat-Carter Somatotype
method

SOMATOTYPE

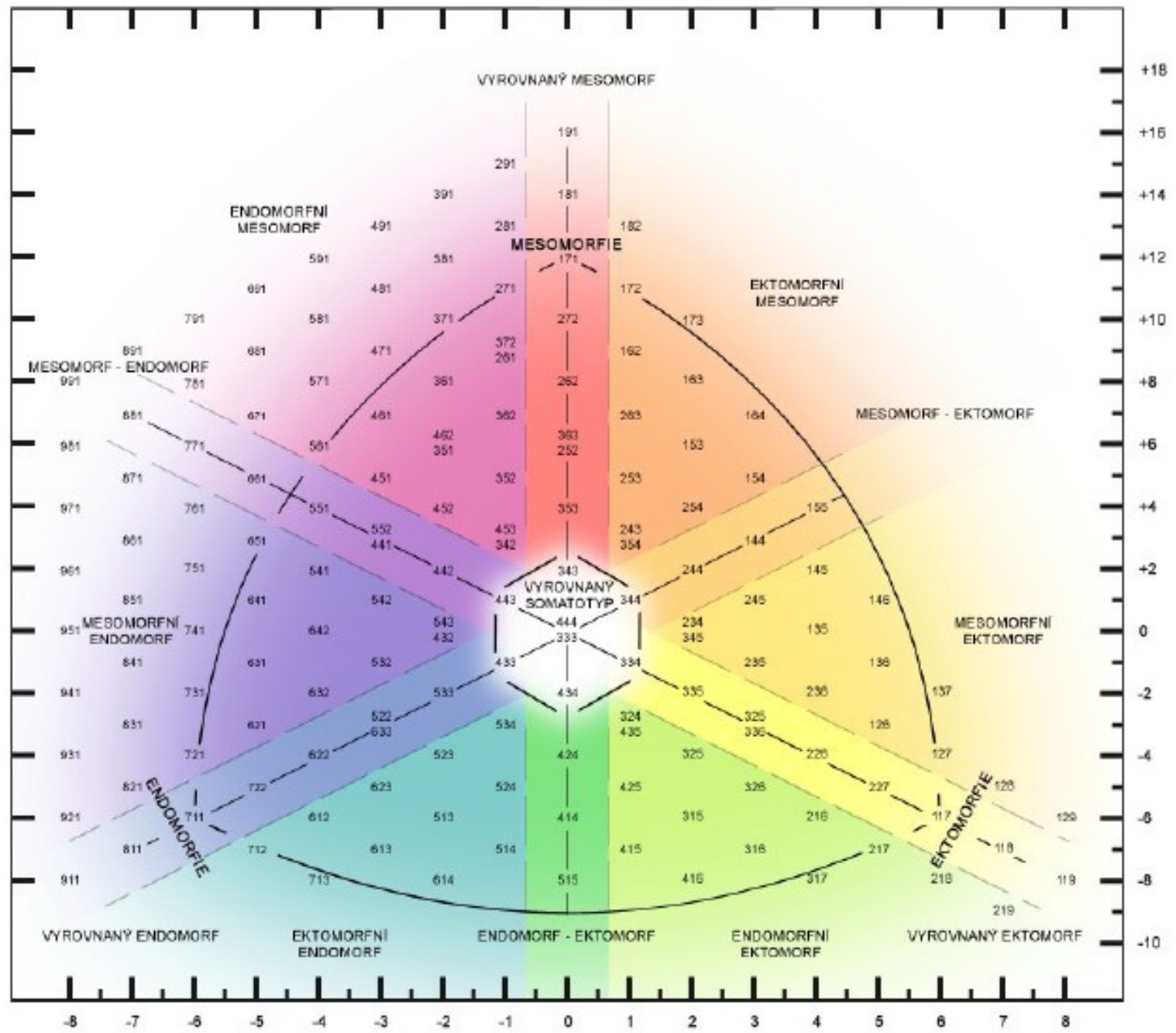
ENDOMORPHY	describes the relative degree of adiposity of body (fat mass)
MESOMORPHY	describes the relative muscle-skeletal development of the body (apparent robustness - muscle, bone)
ECTOMORPHY	describes the relative slenderness of the body (fragility of the limbs)

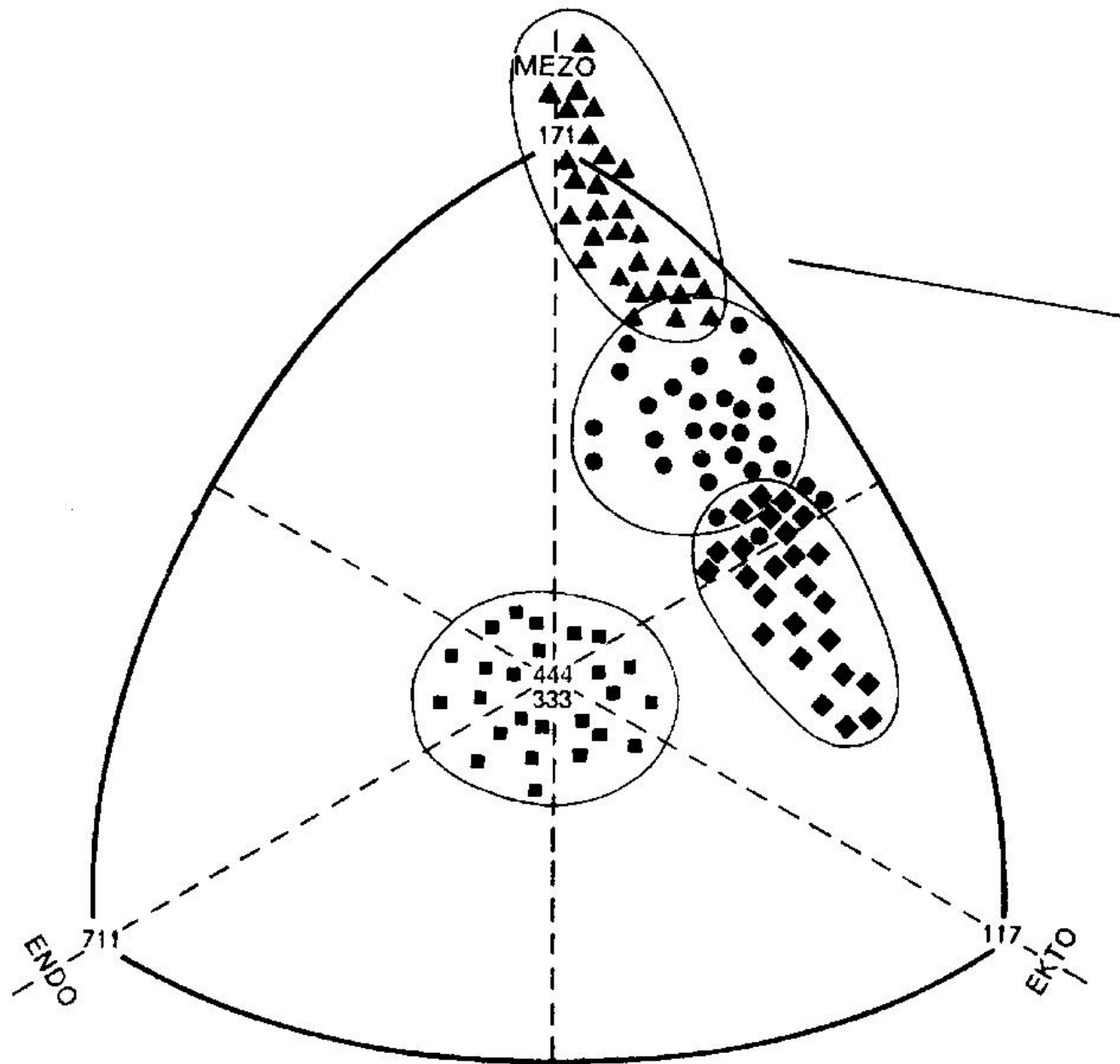


Somatotype categories:

Balance endomorph (balance mesomorph, balance ectomorph)	1 component predominates, 2 and 3 are balanced
Mesomorphic endomorph (ectomorphic endomorph, endomorphic mesomorph, atd.)	1 component predominates, 2. is upper than 3.
endomorph - mesomorph (endomorph - ectomorph, ectomorph - mesomorph)	1 component is below 3, 2. and 3. are balanced
Central type	All components are 3, 4

X = EKTOMORFIE - ENDOMORFIE
 Y = 2 x MESOMORFIE - (ENDOMORFIE + EKTOMORFIE)





■ průměrná populace

▲ vrcholovi čs. gymnasté

● vrcholovi čs. plavci

◆ vrcholovi čs. hráči košíkové

Figure 1 Calculations of the anthropometric somatotype for subject A using the rating form.

Name A. Medhurst Age 20yr 5mo Sex (M) F No A
 Occupation Designer Ethnic Group Black Date 1 Jan 1996
 Project Track sprinter Measured by TSO

Skinfolds mm		Sum 3 Skinfolds (mm)	
Triceps = 6.4	Upper Limit	10.9 14.9 18.9 22.9 26.9 31.2 35.8 40.7 46.2 52.2 58.7 65.7 73.2 81.2 89.7 98.9 108.9 119.7 131.2 143.7 157.2 171.9 187.9 204.0	
Subscapular = 7.1	Mid-point	9.0 13.0 17.0 21.0 25.0 29.0 33.5 38.0 43.5 49.0 55.5 62.0 69.5 77.0 85.5 94.0 104.0 114.0 125.5 137.0 150.5 164.0 180.0 196.0	
Supraspinale = 4.6	Lower Limit	7.0 11.0 15.0 19.0 23.0 27.0 31.3 35.9 40.8 46.3 52.3 58.8 65.8 73.3 81.3 89.8 99.0 109.0 119.8 131.3 143.8 157.3 172.0 188.0	
Sum 3 Skinfolds = 18.1	$\times \left(\frac{170.18}{178.3} \right) = \mathbf{11.3}$ (height corrected skinfolds)		
Calf = 5.2			
		Endomorphy 1 1½ 2 2½ 3 3½ 4 4½ 5 5½ 6 6½ 7 7½ 8 8½ 9 9½ 10 10½ 11 11½ 12	

Height (cm) = 178.3	139.3 143.5 147.3 151.1 154.9 158.8 162.6 166.4 170.2 174.0 177.8 181.6 185.4 189.2 193.0 196.9 200.3 204.5 208.3 212.1 215.9 219.7 223.5 227.3		
Humerus width (cm) = 7.20	5.19 5.34 5.49 5.64 5.78 5.93 6.07 6.22 6.37 6.51 6.65 6.80 6.95 7.09 7.24 7.38 7.53 7.67 7.82 7.97 8.11 8.25 8.40 8.55		
Femur with (cm) = 9.75	7.41 7.62 7.83 8.04 8.24 8.45 8.66 8.87 9.08 9.28 9.49 9.70 9.91 10.12 10.33 10.53 10.74 10.95 11.16 11.36 11.57 11.78 11.99 12.21		
Biceps girth (cm) = 33.7			
-- triceps skinfolds (cm) = 0.6			
33.3	23.7 24.4 25.0 25.7 26.3 27.0 27.7 28.3 29.0 29.7 30.3 31.0 31.6 32.2 33.0 33.6 34.3 35.0 35.6 36.3 37.0 37.6 38.3 39.0		
Calf girth (cm) = 37.6			
-- calf skinfold (cm) = 0.5			
37.1	27.7 28.5 29.3 30.1 30.8 31.6 32.4 33.2 33.9 34.7 35.5 36.3 37.1 37.8 38.6 39.4 40.2 41.0 41.7 42.5 43.3 44.1 44.9 45.6		
		Mesomorphy ½ 1 1½ 2 2½ 3 3½ 4 4½ 5 5½ 6 6½ 7 7½ 8 8½ 9	

Weight (kg) = 67.2	Upper Limit	39.65 40.74 41.43 42.13 42.82 43.48 44.18 44.84 45.53 46.23 46.92 47.58 48.25 48.94 49.63 50.33 50.99 51.68	
Ht ³ /Wt = 43.4	Mid-point	and 40.20 41.09 41.79 42.48 43.14 43.84 44.50 45.19 45.89 46.32 47.24 47.94 48.60 49.29 49.99 50.68 51.34	
	Lower Limit	below 39.66 40.75 41.44 42.14 42.83 43.49 44.19 44.85 45.54 46.24 46.93 47.59 48.26 48.95 49.64 50.34 51.00	
		Ectomorphy ½ 1 1½ 2 2½ 3 3½ 4 4½ 5 5½ 6 6½ 7 7½ 8 8½ 9	

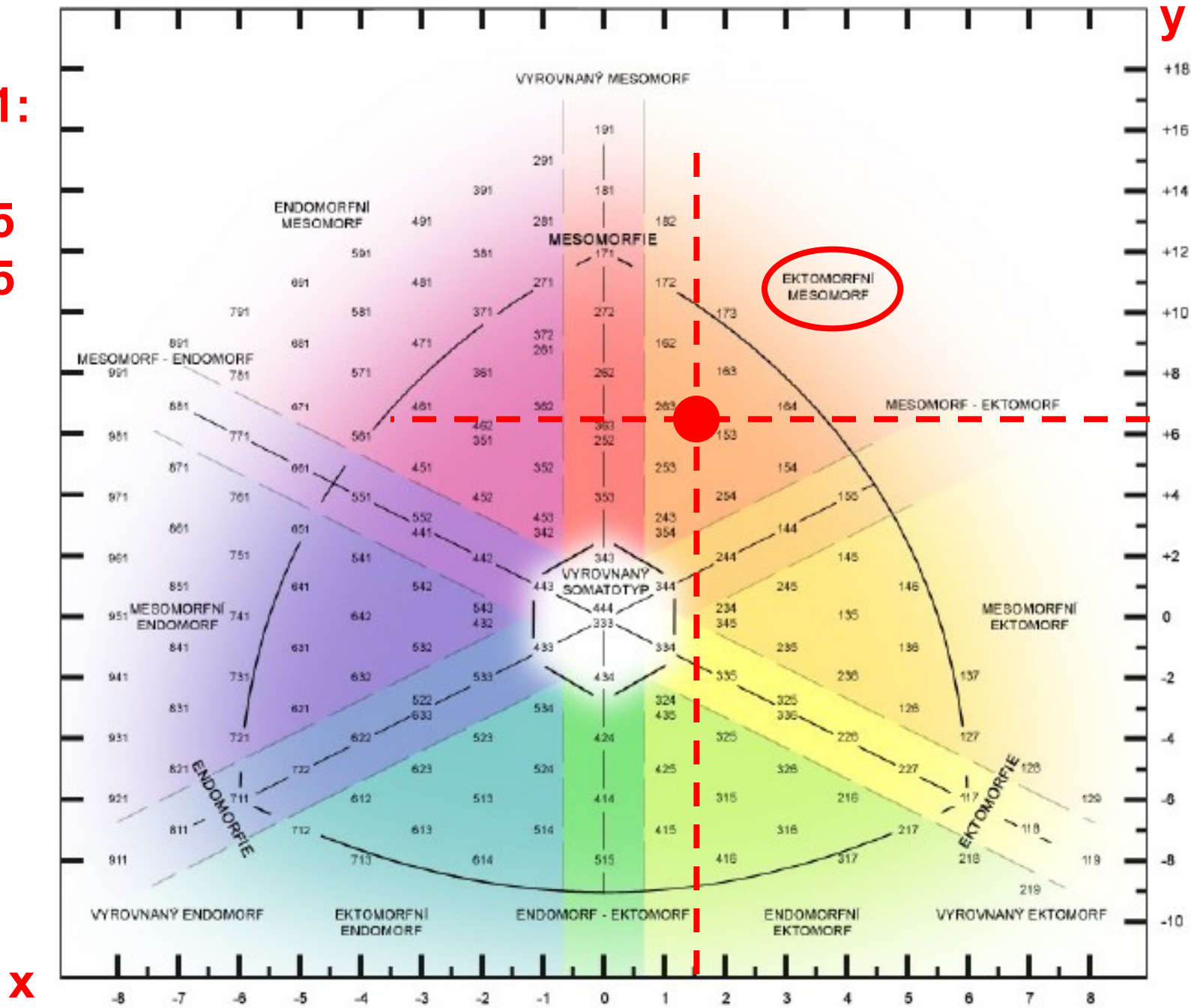
Anthropometric Somatotype	ENDOMORPHY	MESOMORPHY	ECTOMORPHY	BY
	1½	5½	3	TSO
Anthropometric plus Photoscopic Somatotype				RATER:

Biceps girth in cm corrected for fat by subtracting triceps skinfold value expressed in cm. Calf girth in cm corrected for fat by subtracting medial calf skinfold value expressed in cm.

X = EKTOMORFIE - ENDOMORFIE
 Y = 2 x MESOMORFIE - (ENDOMORFIE + EKTOMORFIE)

Příklad 1:

Endo 1,5
Mezo 5,5
Ekto 3



- 1 Basketball (3.7-4.0-2.9)
- 2 Hockey (3.7-4.5-2.2)
- 3 Netball (3.0-3.8-3.3)
- 4 Soccer (4.2-4.6-2.2)
- 5 Softball (3.8-4.3-2.7)

- 6 Squash (3.4-4.0-2.8)
- 7 Volleyball (3.0-3.5-3.5)
- 8 Badminton (4.1-4.4-2.5)
- 9 Lacrosse (4.1-4.5-2.4)
- 10 Cricket (4.9-4.4-2.0)

- Australian Rules (2.1-5.7-2.5)
- Basketball (2.1-4.5-3.5)
- Gymnastics (1.9-6.1-2.5)
- Hockey (2.4-5.4-2.6)
- Hurdles (1.8-4.1-3.9)

- 6 Powerlifting (2.7-7.9-0.6)
- 7 Heavyweight rowing (2.0-5.2-3.0)
- 8 Rugby Union (2.7-6.0-2.0)
- 9 Distance running (1.8-4.4-3.7)
- 10 Squash (2.5-5.2-2.8)

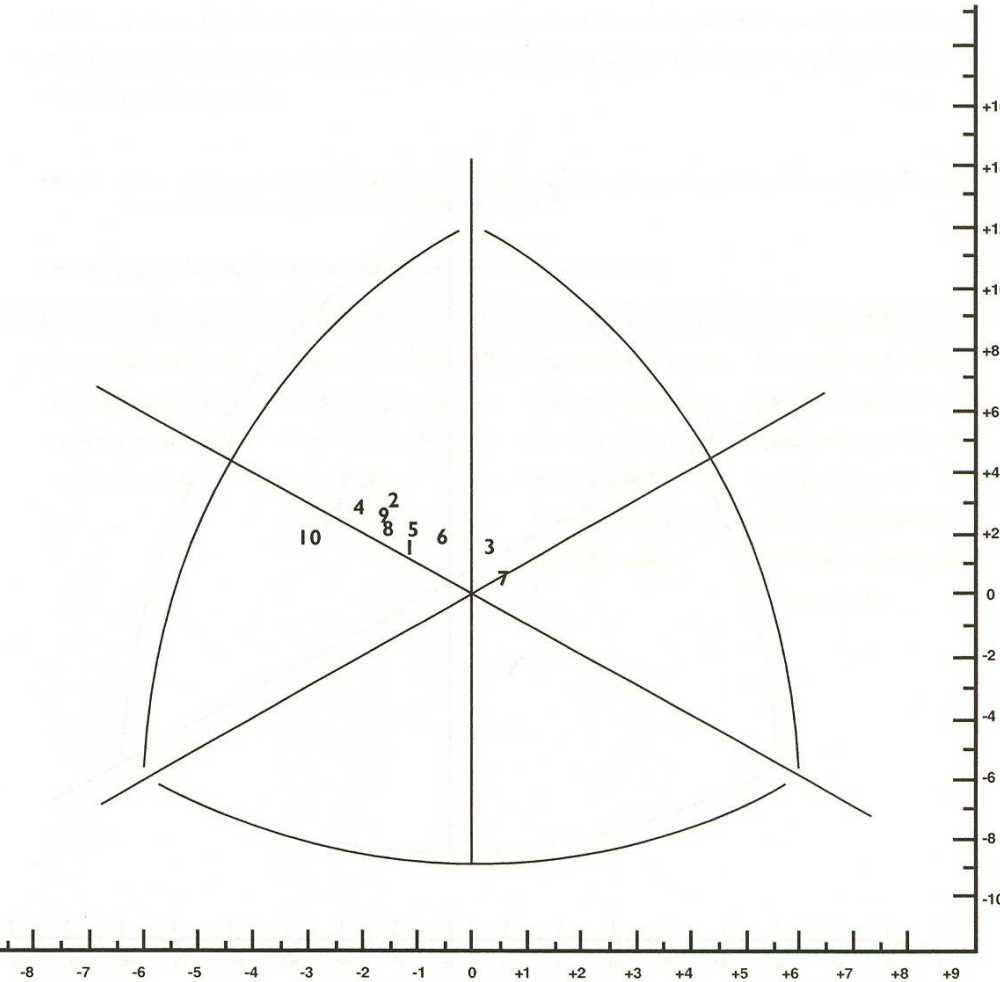


Figure 7 Somatochart showing the somatoplots for Australian female athletes. The mean values are shown after each sport. (Data from Withers, et al., 1987).

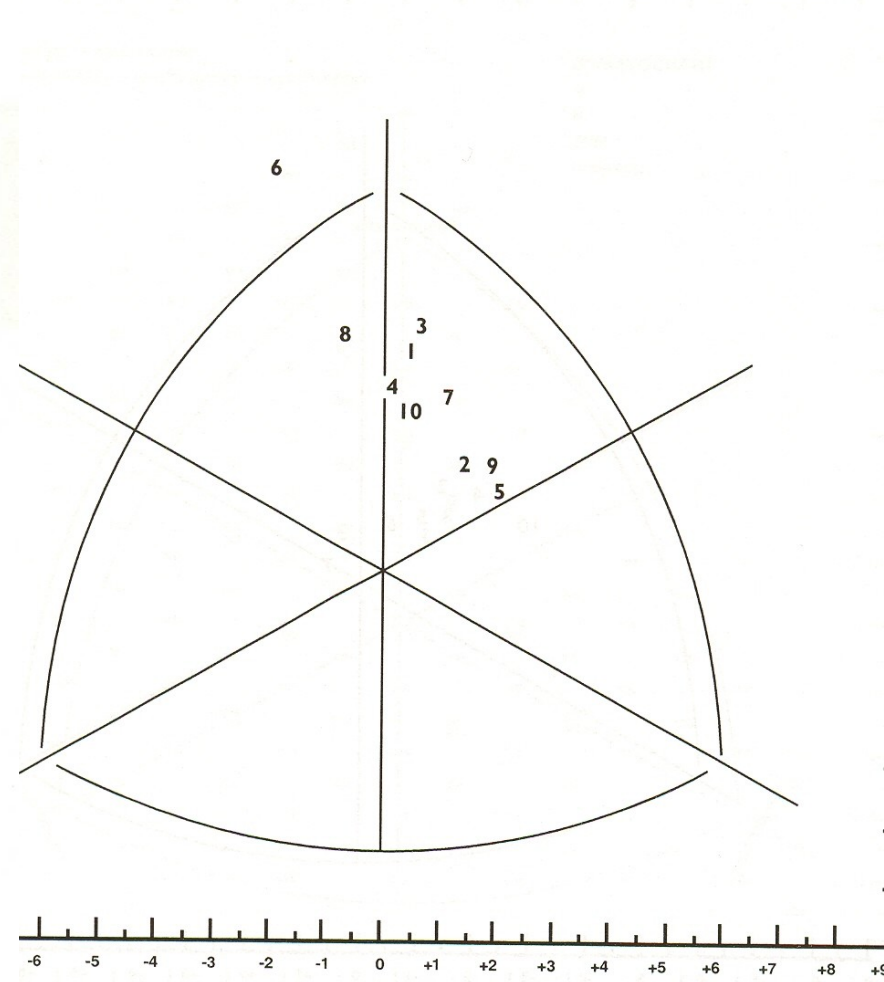


Figure 8 Somatochart showing the somatoplots for Australian male athletes. The mean values are shown after each sport. (Data mainly from Withers, et al., 1986).



INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

Thank you for your attention.

Projekt: Zvyšování jazykových kompetencí pracovníků FSpS MU
a inovace výuky v oblasti kinantropologie, reg. č.: CZ.1.07/2.2.00/15.0199