

## Bio-Impedance Analysis (BIA)

BIA is the clinical assessment of tissue and fluid compartments in the human body. Simply explained, BIA measures the impedance or resistance of an electrical current as it travels through the water that is found in muscle and fat. A normal distribution of tissue and fluid in the body is associated with high immunological function and longevity. BIA is most useful in combination with dieting and exercise as it illustrates the conversion of fat body mass to lean body mass. Other uses of BIA are...

\*Extra-cellular water verses intra-cellular water to determine electrolyte balance and water absorption.

\*Basal Metabolic Rate to determine your ideal caloric intake.

\*Total body capacitance.

## Understanding Your Body Bio-Impedance Analysis results

**Phase Angle:** Phase angle is an indicator of cellular health and integrity. Research on humans has shown that the relationship between phase angle and cellular health is increasing and nearly linear. A low phase angle is consistent with an inability of cells to store energy and an indication of breakdown in the selective permeability of cellular membranes. Cell membranes have a high lipid content therefore this reading gives an indication of your cell lipid status. A high phase angle is consistent with large quantities of intact, healthy cell membranes and body cell mass.

Phase angles for adults range from 3 - 10 degrees, with normal values of 6 to 8 degrees. A phase angle of 5' or lower can indicate a serious energy deficiency. A phase angle higher than 8' is excellent.

**Body Capacitance:** Body capacitance is the absolute amount of energy storage of the body due to intact cellular membranes. A high capacitance indicates that your body stores energy effectively. A low capacitance would suggest that your cells are having trouble storing energy. Normal values are between 500 to 1000 pF.

**Resistance:** Resistance is the ratio of electrical potential to the current in a material. A material with low resistance conducts well whilst a material with high resistance conducts poorly. The primary conductor in the human body is water. In the human body, a low resistance is associated with large amounts of lean body mass. A high resistance is associated with smaller or low amounts of lean body mass.

Resistance helps to calculate the amount of water in the body. Low resistance, indicating high conductivity, is due to large amounts of water in the body. Resistance in the body is proportional to the amount of lean body mass since water is contained solely within lean body mass as opposed to fat body mass.

**Reactance:** Reactance is a measure of the cells' ability to store energy. A body that stores energy easily has high reactance and a body that stores energy poorly has low reactance. Energy is stored in the cell membrane therefore this reading gives an indication of the amount of intact cell membranes in the body. Since intact cellular membranes are contained primarily within body cell mass, the reactance of the body is proportional to the amount of body cell mass. The reactance helps to calculate the proportion of the body that is metabolically active.

**Body Cell Mass (BCM):** BCM contains all the metabolically active tissues (living cells) of the body, including muscle cells, organ cells, blood cells and immune cells. BCM includes the "living" portion of fat cells but not the stored fat lipids and also includes the water inside living cells called intracellular water. The main electrolyte of intracellular water is potassium.

**Extracellular Mass (ECM):** ECM contains the metabolically inactive parts of the body components including bone minerals, and blood plasma. ECM also includes water contained outside living cells called extracellular water. The main electrolyte of extracellular water is sodium.

Body Cell Mass and Extracellular Mass are used to calculate the ECM/BCM ratio (*see below*).

**ECM/BCM Ratio:** This is the ratio of extracellular mass to body cell mass. A low value is desirable and indicates a high ratio of body cell (active) mass to extracellular (inactive) mass. Normal values are typically near 1.0, indicating a 50/50 distribution of body cell mass and extracellular mass.



## Bio-Impedance Analysis (BIA) (cont).

**Fat-Free Mass:** Fat-free mass, also referred to as lean body mass, is the total amount of nonfat (lean) parts of the body. It consists of approximately 73% water, 20% protein, 6% mineral, and 1% ash. Lean body mass contains virtually all the body's water, all the metabolically active tissues and bone, and is the source of all metabolic caloric expenditure. Lean body mass is further divided into body cell mass (BCM) and extracellular mass (ECM).

**Fat Mass:** Fat mass is all the extractable lipids from adipose and other tissue in the body. It is the total amount of stored lipids (fats) in the body and consists of subcutaneous fat and visceral fat. Subcutaneous fat is located directly beneath the skin and serves as an energy reserve and as insulation against outside cold. Visceral fat is located deeper within the body and serves as an energy reserve and as a cushion between organs. Everyone needs a certain amount of fat in their body. The ideal fat % is dependent on age and gender.

The basal metabolic rate is determined by lean body mass since only lean body mass metabolizes. The greater the individual's lean body mass, the greater the rate of caloric expenditure. One of the main benefits of exercise is the maintenance of lean body mass.

Dieting alone may cause a reduction in lean body mass and can actually reduce the body's ability to burn calories. The main principle of weight management is to maintain or increase lean body mass. Since this is not always possible during weight loss, the goal is to minimize reduction of lean body mass. A typical person will experience a loss of 0.45 pounds of lean body mass and 0.55 pounds of fat mass for each pound of weight loss while dieting without exercise.

**Body Mass Index (BMI):** This is a measure of a person's weight relative to their height. Please be aware this classification has limitations, as it does not take frame size into account.

**Total Body Water:** Water is contained in lean body mass. Total body water consists of two compartments - intracellular water (ICW) and extracellular water (ECW). It is the amount of water contained in the body and is a measure for evaluating basic hydration status.

**Intracellular Water (ICW):** This is a measure of the amount of water contained within the cell. Healthy cells maintain their integrity and hold their fluid inside the cell membrane. Water is needed inside the cell to hold in water-soluble nutrients such as vitamins B and C. The optimum amount of water that should be inside the cell differs according to gender and age. As a general rule, 2/3 of your water should be inside the cell. This is the number of calories consumed and metabolized at a normal resting state over a 24 hour period. For a typical person, BMR accounts for more than 90% of their total daily expenditure - more than 90% of calories are burned while the person is at rest.

**Extracellular Water (ECW):** This is a measure of the amount of water outside the cells. This water stores some nutrients and also helps to remove waste from inside the cell. As a general rule, 1/3 of your water should be outside the cell.

A low ICW reading may be due to many things including dehydration, nutritional imbalance, hormonal imbalance or toxicity. Talk with a wellness consultant to determine if a naturopathic, nutritional or traditional Chinese medicine consultation would be suitable for you.

**Total Body Water/Lean Body Mass:** This is the percentage of lean body mass that is water. Normally about 73% of fat-free mass is water.

**TBW/Total Weight:** This is the percentage of total weight that is water. In females, this should be approximately 55% and in males, 60%.

A progressive increase in lean body mass, body cell mass, and phase angle are associated with increasing physical performance. With the use of the BIA to monitor key indicators of health and fitness, InsideOut Wellness & Acupuncture can develop, monitor and manage diet, nutrition and exercise programs that lead to improved overall physical condition.

The use of BIA to evaluate the effectiveness of treatment strategies for various health conditions is widespread. BIA is used in many studies and clinical trials around the world.

For more information visit: <http://nutrition.uvm.edu/bodycomp/bia/bia-toc.html>

