

# **Personal Training University's Fitness Professional's Handbook for Personal Training**



## **Table of Contents:**

# Section I – Scientific Concepts and Foundations

[Chapter 1 – Skeletal, Muscular, and Nervous Systems](#)

[Chapter 2 – Kinesiology and Biomechanics](#)

[Chapter 3 – Cardiopulmonary Systems](#)

[Chapter 4 – ATP & Energy Systems](#)

[Chapter 5 – Strength Training and Aerobic Adaptations](#)

[Chapter 6 – Macronutrients](#)

[Chapter 7 – Micronutrients](#)

[Chapter 8 – Nutrition for Performance and Goal Specific Needs](#)

# Section II – Practical Application

[Chapter 9 – Fitness Consultations and Assessments](#)

[Chapter 10 – Fitness Tests and Evaluations](#)

[Chapter 11 – Resistance Training Program Design](#)

[Chapter 12 – Endurance Training Program Design](#)

[Chapter 13 – Speed, Agility, and Plyometric Training](#)

[Chapter 14 – Personal Training & Exercise Technique](#)

[Chapter 15 – Younger, Older, and Pregnant Clients](#)

[Chapter 16 – Special Nutritional and Metabolic Needs](#)

[Chapter 17 – Cardiovascular and Respiratory Conditions](#)

[Chapter 18 – Joint and Orthopedic Concerns](#)

[Chapter 19 – Personal Training Marketing and Sales](#)

# Introduction

PTU's Fitness Professional's Handbook for Personal Training is the most comprehensive guide to becoming an elite personal trainer. You will learn all of the scientific principles required to help individuals achieve their health and physical fitness goals. You will also learn the best step-by-step methods for conducting initial fitness assessments with prospective clients, marketing yourself as a trainer, and building a large clientele base. PTU's Fitness Professional's Handbook for Personal Training is the primary resource for those preparing for the PTU-Certified Personal Trainer, PTU-Certified Master Trainer, and PTU-Certified Nutrition Specialist Certification Exams.

This book was written and developed by industry leaders in anatomy, exercise physiology, biomechanics, sports medicine, nutrition, and fitness sales. Additionally, many PTU Certified professionals have contributed their practical, real-world experiences to help you apply the scientific knowledge to your everyday client interactions.

# Section I – Scientific Concepts and Foundations

## Chapter 1 – Skeletal, Muscular, and Nervous Systems

### The Muscular System

The muscular system enables us to perform physical activity. There are over 600 muscles in the human body. Muscle also makes up the tissue of the heart and the digestive system. There are 3 types of muscle tissue:

- [Smooth muscle](#), which are involuntary muscles, and provide the lining of the digestive system and other internal organs.
- [Skeletal muscle](#), which produce movement through exerting forces on the skeletal system.
- [Cardiac muscle](#), which controls the beating of the heart chambers and is involuntary.

### Major muscles of the body:

- [Abdominals](#) - located in the stomach area, function is sitting up and postural alignment.
- [Biceps](#) - located in the front of the upper arm, function is lifting and pulling.
- [Hamstrings](#) - located in the back of the thigh, function is walking. Made up of three muscles: the semitendinosus, semimembranosus and biceps femoris.
- [Latissimus Dorsi](#) - large triangular muscle in the mid-back, function is postural alignment and pulling.
- [Pectoralis](#) - located in the front of the upper chest, function is pushing up and out.
- [Quadriceps](#) - located in the front of the thigh, function is climbing stairs, walking, and standing up. Made up of the rectus femoris, vastus lateralis, vastus medialis, and vastus intermedius.
- [Rhomboids](#) - located between the shoulder blades, function is postural alignment and pulling.

- [Trapezius](#) - large muscle in upper and mid-back, function is to move the head sideways.

### **Skeletal Muscle**

Skeletal muscle accounts for 36-45% of individual's total bodyweight. Tendons connect muscles to bones of the skeletal system. When a muscle contracts, it pulls on the tendon, in turn pulling on the bone and producing the desired movement. Muscles typically work in opposing pairs, so a muscle that is producing the force of the desired movement is referred to as the agonist muscle, and the muscle that is being stretched due to the movement is referred to as the antagonist muscle.

### **There are several different types of muscular actions:**

- **Concentric** actions occur when the force generated by the muscle is enough to overcome the resistance force and the muscle shortens. An upward movement of a leg extension is an example of a concentric action of the quadriceps muscle.
- **Eccentric** actions occur when the force generated by the muscle is not sufficient to overcome the resistance force and the muscle is forced to lengthen. This occurs during lowering phases of repetitions when the weight has been lifted and is being lowered back to the starting point. Supramaximal eccentric lifting that requires multiple spotters has become popular to overload the muscular system.
- **Isometric** actions occur when the force generated by the muscle is equal to that of the resistance force and the muscle does not shorten or lengthen. An abdominal plank is an example of an isometric action.
- **Isokinetic** actions occur mostly in clinical settings when a medical device controls the speed of the muscular contraction. It simply means that the velocity of the muscular contraction is constant throughout the range of motion.

### **Muscle Structure and Organization**

The structure of a muscle is organized into several components. The most basic units of a muscle fiber are [Myofibrils](#) known as Actin and Myosin. Actin and Myosin act together to produce muscle contractions. Many Myofibrils join together to form a muscle fiber. Each muscle fiber is covered in a layer of connective tissue known as Endomysium. Many muscle fibers are bundled together to form fascicles that may contain as many as 150 muscle fibers. The fasciculus is covered with a layer of connective tissue called perimysium.

Multiple fascicles for a muscle, and the entire muscle is covered with yet another outer connective tissue layer known as the fascia (or epimysium).

### **Microscopic Muscle Structure**

On a microscopic level, the myofibrils (actin and myosin) are organized into [sarcomere units](#). A sarcomere unit lets us measure and study the actions and contractions of actin and myosin filaments. A sarcomere unit runs from Z line to Z line. On each side of a Z line is an actin-only region known as the I band. The region containing both actin and myosin is known as the A band. There is also a region where only myosin is present, which is known as the H zone that contains an M line in its center. The sliding filament theory suggests that when a muscle contracts the actin and myosin slide past each other resulting in the muscle shortening. All of the Myosin fibrils pull the actin fibrils toward the M line causing shortening of the muscle.

### **Muscular and Nervous System Interactions**

Muscles contract in response to an electrical signal from a motor neuron. The electrical signal is known as an action potential. A motor neuron and all of the muscle fibers it innervates is known as a motor unit. According to the size principle, smaller motor units will be recruited before larger motor units. Also, the all or none theory states that once a muscle fiber is activated, it is 100% on or 100% off, so there is no partial action of a muscle fiber. For more force to be produced, larger motor units must be activated.

### **Muscle Fiber Types**

Skeletal muscle is generally classified into three fiber types:

- **Type I** fibers are slow-twitch, aerobic fibers that do not fatigue quickly.
- **Type IIa** fibers contain slow- and fast-twitch fibers and can produce more force than a Type I fiber, but they fatigue more quickly as well.
- **Type IIb** fibers are fast-twitch, anaerobic fibers that can produce the greatest amount of force, but they also fatigue the fastest.

### **Nervous System**

The nervous system is divided into two sections: the central nervous system, which is made up of the brain and spinal cord, and the peripheral nervous system, which is made up of the nerves that extend from the brain and spinal cord to the rest of the body. There are two sub-divisions of nerves in the peripheral nervous system: afferent nerves that are sensory neurons that send signals to the CNS from the body, and efferent nerves that are neurons that send signals from the

CNS to the body. The efferent neurons can be sub-divided even further into 2 additional classifications: somatic nervous systems, which control voluntary actions of skeletal muscles, and the autonomic nervous system, which controls involuntary actions of the stomach, heart, intestines, and blood vessels.

### **Nerves:**

- **Nerves** - fibers that transmit impulses. Composed of axons, dendrites, cell bodies, neuronal membranes, and nerve endings.
- **Axons** - long part of nerve cell that conducts impulses
- **Dendrites** - short part of nerve cell that receives impulses and transmits to cell body
- **Cell bodies** - the portion of the cell containing the nucleus
- **Neuronal membranes** - surrounds the nerve cell
- **Nerve endings** - the end of the axon that doesn't end at a synapse
- **Myelin sheath** - covers the axon and allows for faster nerve conduction

### **Skeletal System**

The skeletal system consists of 206 bones that provide the foundation for our muscular system, cardiovascular system, and other organs. We are born with more bones than this, but many are fused together throughout childhood. The skeletal system is divided into an **axial** and **appendicular skeleton**. The axial skeleton consists of the skull, vertebrae, ribs, and sternum. The appendicular skeleton consists of the arms, legs, shoulders, and hips. Shapes of bones in the human body vary greatly. There are short, long, flat, and irregular bones throughout the body. There are two main types of bones: **compact bones**, which are dense, solid bones, and **cancellous bones**, which are porous, sponge-like bone. Bone functions to support human movement through the muscular system, provide a foundation, produce red blood cells, and store calcium and phosphate. Connective tissue includes ligaments, tendons, and fascia. Ligaments connect bone to other bone. Tendons connect muscle to bone. Fascia supports the structure of the muscle, allows muscular force to be efficiently transferred through the tendon, and it provides an insulation, or covering, for organs of the body.

### **Major bones of the body**

- [Femur](#) - the thigh bone, extending from the hip to knee
- [Fibula](#) - located on the outer side of the lower leg
- [Humerus](#) - located in the upper arm

- [Patella](#) - small bone in the front of the knee, the “kneecap”
- [Radius](#) - located on the thumb side of the forearm
- [Tibia](#) - located on the inside of the lower leg
- [Ulna](#) - located on the little finger side of the forearm
- Bones of the vertebral column:
  - Cervical Spine - made up of 7 vertebrae
  - Thoracic Spine - made up of 12 vertebrae
  - Lumbar Vertebrae - made up of 5 vertebrae
- [Appendicular skeleton](#) - includes 126 bones of the upper and lower extremities
- [Axial skeleton](#) - includes the 80 bones of the head and trunk

**Other structures:**

- [Cartilage](#) - connective tissue, found in many places in the body
- [Ligaments](#) - connect bone to bone
- [Tendons](#) - connect muscle to bone



## Chapter 2 – Kinesiology and Biomechanics

Kinesiology is the study of human movement, and biomechanics is the study of how the components of the body work together to produce movement. Other specialized sciences include Kinematics, or the study of motion, and Kinetics, or the study of forces acting on a system. They are very similar fields with little difference.

### Levers

The musculoskeletal system is many lever systems comprised of various bones, joints, tendons, and muscles. A lever is a rigid structure that can rotate around a pivot. A lever will exert force on anything that is in the path of rotation. This is essentially how movement and work occurs.

What makes up a lever system?

- Fulcrum: point that the lever pivots around
- Line of force action: line through which the force passes and is applied
- Moment arm (or lever arm, or force arm, or torque arm): point from the fulcrum to the point of force application from the resistance force or the applied force
- Resistance force: force from gravity, friction, inertia, etc.
- Muscle force: force exerted by a muscle
- Mechanical advantage: force ratio difference in the applied force required to produce movement of an object. Mechanical advantage less than 1.0 (or 100%) requires more force from the muscle. Mechanical advantage more than 1.0 requires less force from the muscle.

There are three [lever classes](#) that are used within the human body to produce force:

- 1<sup>st</sup> class lever: axis is between the effort force and the resistance. The force arm can be less than, greater than, or equal to the resistance arm. Example: elbow extension.
- 2<sup>nd</sup> class lever: resistance is between the effort force and the axis of rotation. The force arm is greater than the resistance arm. Example: plantar flexion.
- 3<sup>rd</sup> class lever: effort force is closer to the axis of the lever than the resistance. The force arm is smaller than the resistance arm. Example: knee flexion, and most other levers in the body.

## Planes of Movement

Human movement occurs in one of three planes of movement:

- **Sagittal plane:** splits the body into right and left halves. Example of movement within the sagittal plane is leg extension/flexion
- **Frontal plane:** splits the body into anterior and posterior (or front and back) halves. Example of movement within the frontal plane is a lateral shoulder raise.
- **Transverse plane:** splits the body into superior and inferior (or upper and lower) halves. Example of movement within the transverse plane is torso rotations.

Many compound movements and more complex movements in sports occur in multiple planes of movement through various phases of the movement.

## Anatomical Terminology

- **Anterior:** towards the front (ventral)
- **Posterior:** towards the back (dorsal)
- **Superior:** above
- **Inferior:** below
- **Medial:** towards the midline of the body
- **Lateral:** away from the midline of the body
- **Proximal:** closer to the body from the reference point
- **Distal:** further from the body from the reference point
- **Unilateral:** one side
- **Bilateral:** two sides
- **Superficial:** near the surface
- **Deep:** further from the surface (beneath)
- **Cephalic:** towards the head
- **Caudal:** towards the bottom
- **Supine:** lying on back
- **Prone:** lying face down

## Movements Defined

- **Flexion:** decreasing joint angle
- **Extension:** increasing joint angle
- **Abduction:** movement away from the midline of the body
- **Adduction:** movement towards the midline of the body
- **Internal Rotation:** rotation towards the midline of the body
- **External Rotation:** rotation away from the midline of the body
- **Protraction:** abduction of the scapula

- **Retraction:** adduction of the scapula
- **Elevation:** raising of the scapula
- **Depression:** lowering of the scapula
- **Dorsiflexion:** raising toes toward knee
- **Plantarflexion:** pushing toes away from knee
- **Inversion:** inward movement of the sole of the foot
- **Eversion:** outward movement of the sole of the foot
- **Lateral Flexion:** spinal flexion in the frontal plane
- **Circumduction:** circular motion of a ball-and-socket joint
- **Supination:** rotation of the wrist where the palm faces to the front, or inversion, adduction, and plantarflexion of the ankle/foot
- **Pronation:** rotation of the wrist where the palm faces to the back, or eversion, abduction, and dorsiflexion of the ankle/foot

### **Strength, Power, and Work**

Strength is the maximal amount of force that can be exerted by a muscle or group of muscles. Power is the rate that force can be applied by a muscle or group of muscles. Work is the product of force exerted over a distance.

**Strength = maximal force**

**Power = force X velocity**

**Work = force X distance**

**Power = force X distance ÷ time = work ÷ time**

## Chapter 3 – Cardiopulmonary Systems

The cardiopulmonary system is composed of the cardiovascular system and the pulmonary, or respiratory, system. The term cardiopulmonary refers to the heart (cardio) and lungs (pulmonary). After completing this chapter you will have a basic understanding of both systems and how they work together.

The cardiovascular system is made up of the heart, arteries, veins, arterioles, and capillaries. The primary role of the cardiovascular system is to transport nutrients and oxygen, and remove waste products within the body.

### Heart Anatomy and Physiology

- **Right atrium** - receives deoxygenated blood from the body
- **Left atrium** - pumps oxygenated blood to the left ventricle
- **Right ventricle** - pumps deoxygenated blood to the lungs
- **Left ventricle** - pumps oxygenated blood to the body

### Heart Rate

Heart rate is the number of times per minute the heart is beating. Heart rate, or pulse, can be checked on against the wall of the Carotid or Radial arteries. Index and middle fingers should be used to check a client's pulse. The thumb is not advised because you may sense your own pulse when using your thumb. To calculate heart rate, you should count the number of beats within 10 seconds and multiply the number of beats by 6. This will give you an estimate of the number of beats / minute.

### Blood Pressure

- [Systolic blood pressure](#) - pressure exerted against the arterial walls when blood is ejected from the ventricles
- [Diastolic blood pressure](#) - the pressure exerted after the contraction of the heart while the chambers of the heart refill with blood

### Cardiac Output

Cardiac output is the volume of blood pumped by the heart. Cardiac output is the product of heart rate X stroke volume. Stroke volume is the volume of blood ejected by the left ventricle with each contraction.

### The pulmonary system

The pulmonary system is basically composed of the lungs, airways, and vessels within the lungs. The primary role of the pulmonary system is to exchange gases within the body. Oxygen entering the lungs is delivered to Red Blood Cells for use by the body. CO<sub>2</sub> in the blood stream is delivered to the lungs to be exhaled into the outside environment. Atmospheric pressure provides a means for inhalation of air, or filling the lungs with air from the outside environment, therefore, this is automatic and we do not have to think about breathing in. Once the air is in the lungs, gases are exchanged, and exhaling air with added waste and CO<sub>2</sub> is performed through a contraction of the diaphragm. This process entire process is controlled and regulated through the autonomic nervous system, so the action is involuntary under normal circumstances.

### **Pulmonary Anatomy**

- **Lungs** – right and left lung chambers that contain bronchi, bronchioles, and alveoli.
- **Bronchi** - two main branches of the trachea that go into the lungs. They then divide into the bronchioles and alveoli.
- **Bronchioles** - airways that extend from the bronchi into the lungs.
- **Alveoli** - where gases are exchanged in the lungs.

## Chapter 4 – ATP & Energy Systems

Everything we do requires energy, from digestion of our food, to running, to breathing. In this chapter you will learn about the different energy systems, how they function, and when they are important.

### ATP Cycle

Adenosine-triphosphate (ATP) transports energy within cells. ADP, AMP, and CrP are molecules that can bond to form ATP. ADP is formed when phosphate bonds are broken in ATP molecules. Adenosine triphosphate is the body's primary energy source for muscle contractions. A cell can die without enough ATP. To create this energy, the body combines adenosine diphosphate (ADP) and an inorganic phosphate. About 80-100 grams of ATP can be stored in muscle cells at a time. When there is plenty of oxygen in the body, ATP is produced aerobically. For example, when the body is at rest. The cells' mitochondria are responsible for aerobic energy production (otherwise known as cellular respiration, aerobic oxidation, or oxidative phosphorylation). The more mitochondria, the greater capacity for aerobic energy production and are more resistant to fatigue. This method for ATP production uses oxygen as an aerobic metabolic pathway known as oxidative phosphorylation (where oxidation and adding a phosphate creates ATP) utilizes both the Krebs cycle and the electron transport chain.

Water (H<sub>2</sub>O) is used to break down ATP quickly in the muscle. Adenosine and three phosphate molecules. When used, they are turned into Adenosine and two phosphates, energy, and one inorganic phosphate. A large amount of energy is required to complete this process. 60% of the energy from food is converted to thermal energy, so only about 40% of the energy is actually turned into ATP. In sum, eating food is not a quick enough source for ATP creation during a workout. It is vital in post-workout recovery, however. Most ATP is used within 2-4 seconds of intense activity (lifts or sprints) and the body must therefore create more through the ATP cycle in order to finish the task. During weight training, the body must synthesize more ATP using a combination of three processes: phosphocreatine (PC) breakdown, glycolysis (glycogen/glucose breakdown in the muscle), and oxidation (ie, the rest between sets which resupplies muscles with the oxygen molecules needed to shuttle out the rogue phosphate). Outside of weight training, a power burst or after 100m sprint, ATP will be used up as well. The rest at the end of a sprint or jump in this case is

sufficient for recovery. 70% of ATP recovers after 45-60s of complete rest; after 2-3 minutes, you get 100% recovery. This is extremely important in strength training particularly where you are working at a very high load for very short reps in order to have the maximal effort exerted during exercise and therefore see the biggest gains in strength. Without the proper recovery time, you won't be able to utilize maximum muscle recruitment. This applies to both weights and sprints.

### **ATP-CrP system**

Phosphocreatine (PCr or Creatine Phosphate) is an anaerobic source of ATP for the body. The more muscle you have, the more PCr you will have. To create ATP, PCr must combine with ADP, which leaves a lone creatine molecule and ATP when it is done. PC stores in the cells at a level about 4-6 times that of ATP and can therefore allow muscles to work at maximal intensity for up to about 8 seconds. The ATP-CrP system is primarily used during high intensity, short bursts of activity lasting less than 8 seconds. After 6-8 seconds of high intensity activity, Glycolysis must take over as the primary energy system.

### **Glycolysis**

Glycolysis is an anaerobic metabolic pathway that occurs in the cytosol of the cell. Energy is extracted from glucose through ten steps. Phosphofructokinase (PFK) is the rate-limiting enzyme of Glycolysis that ultimately determines how much energy can be produced from the energy system.

### **Fast vs Slow Glycolysis**

Fast Glycolysis is a secondary anaerobic source of ATP for the body. This source of energy is used when intense exertion will be between 6-45 seconds and involves breaking down glucose (sugar, more specifically monosaccharides) or glycogen (polysaccharide) in a multi-step process into pyruvate. The pyruvate can then be converted into lactate for immediate energy to use at a higher intensity, or the pyruvate, during Slow Glycolysis, can be transferred to the mitochondria of the cell for lower intensity exercise use until it goes through the Krebs Cycle (eg, in aerobic exercise where oxygen has taken back over as the main source of ATP for the body). This process requires two molecules of ATP to begin and after can result in 4 ATP if using a simple sugar or 5 if a polysaccharide is used. A combination of Fast (Anaerobic) Glycolysis and Slow (Aerobic) Glycolysis are the dominant energy systems used for physical activity lasting 45 seconds and 2 minutes in length. Slow Glycolysis can have some involvement

for up to 10 minutes of exercise. The primary Difference in Slow vs Fast Glycolysis is just involves the end product, Pyruvate. If Pyruvate is used in the Krebs cycle, Glycolysis' main energy contribution is through that of the Krebs cycle, so while Glycolysis still occurs without oxygen, the Krebs cycle is using oxygen and pyruvate to produce the largest amount of energy being used by the body. If Pyruvate is converted into lactate for immediate energy requirements, all of the energy is being produced anaerobically.

## **Lactate**

The Lactate Threshold is reached once the body passes the energy production capabilities of glycolysis and it still needs energy, it must use the residual pyruvate from the first glycolysis cycle. In order to do so, the body has to break the pyruvate down to lactate (as in the anaerobic use of glycolysis). The lactate threshold (LT) is calculated by how much lactate is in the blood. The body produces more lactate (an alkaline) because during energy production, the body excretes an excess of hydrogen ions which cause a decrease in our blood's pH, effectively making it acidic. When we are in an aerobic state, there is enough oxygen in the body to balance our pH levels naturally. Because of this negative pH state, muscle acidosis sets in. This is the burning sensation we feel when we are working hard and therefore not supplying enough oxygen to our muscles. This correlates with the accumulation of lactate in the cells because exercise intensity is forcibly decreased (from the muscle acidosis-induced fatigue) and is known as the Onset of Blood Lactate Accumulation (OBLA). Anaerobic Threshold, which is pretty much the same as the lactate threshold, is measured by a gas exchange test (ventilatory test). These three values (LT, AT, OBLA) are important for athlete conditioning. They are all good measurements for how conditioned an athlete is because the longer he or she can put off acidosis, the better result the athlete will achieve. Also, there is a lower chance of injury when a client is better conditioned and has a higher lactate threshold or point of acidosis. When muscles fail to contract or don't contract quickly enough, an athlete can seriously hurt themselves, even in practice. If there is not enough rest between intense workouts, there can be significant damage to muscle cells. This can take days or weeks to fully repair, which is lost performance and training time.

After 25 minutes of complete rest, 50% of the accumulated lactate and muscle acid will have been processed. It takes 75 minutes for 95% of it to be removed. The body then converts the lactate back to glucose in the liver (gluconeogenesis), excretes it in urine, or metabolizes it as fuel for other organs



## **Krebs cycle**

The Krebs cycle uses chemical reactions to convert macronutrients (carbs, proteins, and fats) into ATP (usable energy). The Krebs cycle takes the hydrogen molecules from these ingested nutrients so that the hydrogen can be used to complete the electron transport chain along with oxygen, an inorganic phosphate, and an ADP to form ATP. The net gain here is 2 ATP molecules. This process also uses two carrier molecules known as NAD and FAD to transport the hydrogen molecules. No oxygen is used in the Krebs cycle; it is, however, used at the end of the electron transport chain. The Krebs cycle is an aerobic metabolic pathway that occurs in the mitochondria (the “power house of the cell”).

**The most basic steps of the Krebs cycle without going into too much detail are below:**

- Series of eight reactions
- First, glucose is broken down during glycolysis
- Pyruvate is stripped of carbon dioxide
- High-energy electrons are transported to create ATP
- The enzymes needed for the chemical reactions are:
  - Alpha-ketoglutarate dehydrogenase
  - Citrate synthase
  - Aconitase
  - Isocitrate dehydrogenase
  - Succinyl coenzyme A synthetase
  - Succinate dehydrogenase
  - Fumarase
  - Malate dehydrogenase

## **Electron Transport Chain**

Electron transport chain is a chain of molecules that are involved in the aerobic production of ATP. This process creates free radicals in the body (molecules with an unpaired electron) which will bond quickly with other molecules and can damage the cells they touch. The number of free radicals created relates directly to the conditioning level of the athlete as well as the current level and duration of activity. ETC is primarily used in cardiovascular exercise.

## **Lipolysis**

Fat can be broken down to create ATP as well. This is a process known as lipolysis. Fat is the most abundant energy source available to the muscle and is

the primary source of energy during the aerobic oxidation phase of energy production. The only limiting factor in creating ATP via lipolysis is the rate at which we can metabolize it. Lipolysis is used for the largest percentage of energy production when at rest or for very low intensity activity.

## **Chapter 5 – Strength Training and Aerobic Adaptations**

The human body is an organism that adapts to the environment and stresses it experiences. Exercise we perform will determine the type of adaptations it our bodies must make to overcome that stress. This includes growing muscle, losing fat, increasing strength, increasing speed, etc.

### **Progressive Overload Principle**

Progressive overload is the gradual increase of stress placed upon the body during exercise. Overload may be accomplished by manipulating sets, reps, weight, rest times, rep-tempo, and/or exercises. The body adapts to the stresses it incurs on a daily basis. If the stresses remain the same, no further adaptation is required, thus no further results. If the stress increases from any of the variables, the body will be forced to make further adaptations to account for the added demand on the body.

### **Principle of Specificity**

The specificity principle concludes that training for sports should include movements that mimic the sports' movements. It states that exercising a body part, component of the body, or particular skill improves primarily that body part or skill. If you would like to improve performance in a particular movement pattern or skill, you should perform exercises that are most closely related to that movement pattern and movement patterns related to that skill.

### **Recovery**

The body generally needs 72 hours - 96 hours to recover from a strength training workout in untrained individuals. This time frame can be decreased to as little as 48 hours for trained individuals with several years of experience.

### **Reversibility**

The principle of reversibility states that effects of training are lost soon after training is terminated. They may be regained once training begins. Like the principle of progressive overload states, the body adapts to the stresses it incurs on a daily basis. The body will adapt to any environment required. If it needs to be strong, it will. If it needs to survive long periods without food, it will. If it needs to grow, it will. If it needs to run long distances, it will. If it does not need to perform these activities, the body will quickly adapt back to a level of fitness

that is able to overcome and handle any level of energy production, strength, and endurance that is required of it.

### **DOMS**

Delayed Onset Muscle Soreness is the sensation 12-96 hours following new exercise activity. The DOMS sensation occurs due to added swelling in the muscle and pressure being placed on nerve endings.

### **Aerobic Adaptations**

Aerobic exercise includes swimming, running, hiking, etc. Each type of exercise has its own benefits and risks. For example, swimming is not weight bearing and may be better for individuals with joint injuries and older adults.

### **Physiological Adaptations from Aerobic Exercise**

- Blood pressure – decreases.
- Plasma volume – increases with cardiovascular training. This is the first adaptation that occurs in sedentary individuals.
- Red blood cell count - increases with cardiovascular training. Red blood cells transport oxygen through the body.
- Body composition – fat loss
  
- Neuromuscular function – increases with all types of training, but specifically balance and coordination work. Better nerve response and reaction time.
  
- VO2 Max increases as the pulmonary system strengthens which increases maximal output and oxygen delivery.
  
- Type-I muscle fiber development and increased concentrations of aerobic enzymes at the muscular level.

## Chapter 6 – Macronutrients

Most Americans receive nutritional information from TV, Internet, Radio, and Magazines. A large percentage of the information is not accurate and not backed up with any science. It is well within the scope of practice of a knowledgeable personal trainer to dispel nutrition myths and provide general advice relating to nutritional principles.

Food is made up of water, fiber, carbohydrates, fats, and protein, and in some cases alcohol. Carbohydrates, fats, and proteins are the 3 primary energy sources from food. Alcohol provides energy as well; however, it is toxic to the body.

### **Macronutrients:**

Macronutrients are substances that are needed for growth, metabolism, and for many other functions of the body. Macronutrients are nutrients which provide calories or energy. The prefix, “Macro” or “Makro”, is from the Greeks and means big or large. This is because macronutrients provide large amounts of energy. Fats, carbohydrates, proteins, and alcohol are the body’s four sources of energy.

### **Calories and Metabolism:**

A calorie is a unit of energy. In scientific terms, metabolism is a complex matrix of energy consumption and expenditure. For example, a banana may have 100 calories, while a 1 mile walk may use up about 100 calories. The classic equation of “Energy In – Energy Out = Weight Gain (or Loss)” is used to prescribe calorie intake and physical activity for many clients and patients desiring weight loss. The assumption is that if an individual consumes less calories than they burn through physical activity and resting metabolism, they will lose weight. This is true, however, there are many variables that figure into the “energy out” portion of the equation. Also, the equation fails to specify components of the body.

Weight gain or loss can come in the form of loss or gain of muscle, water, fat, bone, etc. This is of vital importance. Also, the equation fails to address the interdependency of macronutrients and hormones.

A simple scenario of the limitations of the equation is this:

Person 1 expends 2000 calories per day and eats 3000 calories from carbohydrates.

Person 2 expends 2000 calories per day and eats 3000 calories from proteins.

Person 2 will lose weight while Person 1 will obviously become a type-II diabetic, develop metabolic syndrome, and gain weight.

Metabolism is a very complex process and needs much more research.

Generally, recommendations should include less calories, fewer simple carbohydrates, more healthy fats, and more lean protein sources.

The energy balance equation still provides practical application and provides a reference point for nutrition recommendations. You should just be aware of the limitations, and be prepared to make adjustments based on the results and change in body composition of your clients.

### **Recommended Dietary Allowance (RDA):**

The Recommended Dietary Allowances (RDAs) are quantities of nutrients in the diet that are required to maintain good health in people. RDAs are established by the Food and Nutrition Board of the National Academy of Sciences. A separate RDA value exists for each nutrient. The RDA values suggest to the amount of nutrient expected to maintain good health in people. The actual amounts of each nutrient required to maintain good health in specific individuals differ from person to person.

## **Carbohydrate**

### **Carbohydrate:**

Carbohydrate is the most abundant organic compounds in nature. It is the major source of energy for living organism in earth. The term “carbohydrate” literally means the “hydrates of carbon”. They are primarily composed of carbon, hydrogen and oxygen. Generally the hydrogen and oxygen in carbohydrate are present in the proportion of water ( $H_2O$ ). Most substance of this class have the empirical formula  $(C. H_2O)_n$ .

### **RDA for carbohydrates:**

For children ages 1 and up and adults: 130 grams per day

For pregnant and nursing women: 175 grams and 210 grams per day

**Source of carbohydrates:**

Egg whites, Potatoes, Whole grains, Citrus fruits, Berries, Watermelon, Apple, Sweet potato, Nuts and legumes, Cereals, Dry fruits, Pizza, Bananas, Bread, Pasta, Green Vegetables, Dairy products,

**Function of Carbohydrates:**

Carbohydrates participate in a wide range of function.

1. They are most abundant dietary source of energy (4 cal/g) for all organisms.
2. Carbohydrates are precursors for many organic compounds such as fats and amino acids.
3. Carbohydrates (as glycoproteins and glycolipids) participate in the structure of cell membrane and cellular functions such as cell growth, adhesion and fertilization.
4. They are structural components of many organisms. These include the fiber (cellulose) of plants, exoskeleton of some insects and the cell wall of micro organisms.
5. Carbohydrates also serve as the storage form of energy (glycogen) to meet the immediate energy demands of the body.

**Proteins****Proteins:**

Proteins are the most abundant organic molecules of the living system. They occur in every part of the cell and constitute about 50% of the cellular dry weight. Proteins form the fundamental basis of structure and function of life.

**Source of Proteins:**

Meat, Beans/ Legumes, Nuts, Dairy Products, Sea Food, Guavas, Avocados, Asparagus, Cauliflower, Dates, Broccoli, Spinach, Brussels sprouts, Sweet corn, Egg white, Apricots, Tangerine, Coconut, bananas, Blueberries, Tofu, Mangosteen, Soy milk, Figs, Apples.

**RDA for Protein:**

<b>Protein</b>
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Age min	Age max	Unit	g	
			Min	Max
5	6	months	10.00	30.00
7	12	months	10.00	42.00
1	3	years	14.00	49.40
4	6	years	18.00	55.00
7	9	years	24.00	68.50
10	12	years	34.00	70.50
13	14	years	46.00	74.00
15	18	years	60.00	90.00
19	24	years	59.00	96.00
25	50	years	59.00	100.00
51	64	years	58.00	95.00
65	80	years	54.00	90.00
During Pregnancy period			58.00	85.00
During breast feeding period			63.00	93.00

### Functions of proteins:

Proteins perform various important functions

1. Many of the proteins in skin, bone, muscle, and hair perform structural roles.
2. Many plasma proteins transport small molecules such as iron and oxygen.
3. Immunoglobulins and clotting factors participate in defense functions.
4. Hormones, hormone receptors, and transcription factors play critical regulatory roles in the cell.
5. Enzymes function as biological catalysts.
6. Protein contains approximately 4 calories/gram.

### Fats

#### Fats:

Fat may be regarded as organic substances relatively insoluble in water, soluble in organic solvents (alcohol, ether etc) actually or potentially related to fatty acids and utilized by the living cells.

#### RDA for Fat:

Fat
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Age min	Age max	Unit	g	
			Min	Max
1	3	years	20.00	30.00
4	6	years	25.00	35.00
7	9	years	30.00	40.00
10	12	years	40.00	50.00
13	14	years	45.00	50.00
15	18	years	50.00	60.00
19	24	years	55.00	65.00
25	50	years	55.00	65.00
51	64	years	50.00	60.00
65	80	years	40.00	50.00
During Pregnancy period			60.00	75.00
During breast feeding period			65.00	80.00

### Source of healthy fats:

Olives, olive oil and canola oil, Avocados, salmon, sardines, herring, mackerel, Nuts, Walnuts, almonds, Flax seed and flax seed oils, Grass fed beef and bison, coconut oil.

### Functions of Fats:

Fats perform several important functions

1. Fats gives us more energy, contains approximately 9 calories/gram.
2. They are the concentrated fuel reserve of the body (triacylglycerols).
3. Fats are the constituents of membrane structure and regulate the membrane permeability (phospholipids and cholesterol).
4. They serve as a source of fat soluble vitamins (A, D, E, and K).
5. Fats are important as cellular metabolic regulators (steroid hormones and prostaglandins).
6. Fats protect the internal organs, serve as insulating materials and give shape and smooth appearance to the body.
7. Serve as the thermal insulator in the subcutaneous tissues and around certain organs.
8. Lipoproteins (combinations of fat and protein) are the constituents of cell membrane and mitochondria within the cytoplasm and serving also as the means of transporting lipids in the blood.
9. Prostaglandins and steroid hormones which contain fat play major roles in the control of the body's homeostasis.

### Alcohol

**Alcohol:** Alcohol is a clear liquid that has a strong smell, that is used in some medicines and other products, and that is the substance in liquors (such as beer, wine, or whiskey) that can make a person drunk.

**Source of Alcohol:**

Fermented drinks, such as beer and wine, contain from 2% alcohol to 20% alcohol. Distilled drinks, or liquor, contain from 40% to 50% or more alcohol. The usual alcohol content for each is:

Beer 2–6% alcohol

Cider 4–8% alcohol

Wine 8–20% alcohol

Tequila 40% alcohol

Rum 40% or more alcohol

Brandy 40% or more alcohol

Gin 40–47% alcohol

Whiskey 40–50% alcohol

Vodka 40–50% alcohol

Liqueurs 15–60% alcohol

**Advantages and Disadvantages of Alcohol:**

**Disadvantages:**

1. Alcohol can cause depression.
2. May lead to dehydration
3. Makes some people violent and abusive towards others
4. Reduces sense of danger and may lead to reckless behavior
5. Can lead to dependency if abused
6. May cause liver damage and disease if abused

**Advantages: (1 serving / day for women. 2 servings / day for men)**

1. Reduces blood pressure
2. Heart health
3. Relieves stress and many report a feeling of euphoria

## Chapter 7 – Micronutrients

Vitamins and Minerals do not provide energy for the body to use; however, they are essential elements for human life, especially for active individuals.

**Micronutrients:** Micronutrients are essential in minute amounts for the proper growth and metabolism of a living organism. They include microminerals and Vitamins. Microminerals or trace elements include at least iron, cobalt, chromium, copper, iodine, manganese, selenium, zinc, and molybdenum. Micronutrients are essential for good health, and micronutrient deficiencies can cause serious health problems. Micronutrients are different from macronutrients because they are necessary only in very small amounts.

### Vitamin

**Vitamin:** Vitamins may be regarded as the organic compounds required in the diet in small amounts to perform specific biological functions for normal maintenance of optimum growth and health of the organism.

Here I have added the most important Vitamin and their rich sources for good health, I think this information will help you for your good health.

### Vitamin A

**Vitamin A:** The fat soluble vitamin A, as such is present only in foods of animal origin. However, its pro-vitamins carotenes are found in plants.

#### **RDA of Vitamin A:**

Vitamin A			
Age min	Age max	Unit	mg
5	6	months	0.6
7	12	months	0.6
1	3	years	0.6
4	6	years	0.7
7	9	years	0.8
10	12	years	0.9
13	14	years	1.1
15	18	years	1.1
19	24	years	1

25	50	years	1
51	64	years	1
65	80	years	1
During Pregnancy Period			1.5
During Breast Feeding Period			2.00

### Function and Source:

Vitamin A	
Function	Source
<ol style="list-style-type: none"> <li>1. Vitamin A, also known as beta carotene, is essential for regulation of immune system by helping to fight off infections.</li> <li>2. Vitamin A plays a vital role in your eye health by promoting a healthy lining of the eye.</li> <li>3. It can also contribute to healthy bones and teeth.</li> <li>4. It helps us in iron absorption.</li> </ol>	<ol style="list-style-type: none"> <li>1. Whole eggs</li> <li>2. Liver</li> <li>3. Milk</li> <li>4. Sweet potatoes</li> <li>5. Fish liver oil</li> <li>6. Fortified cereals</li> <li>7. Carrots</li> <li>8. Apricots</li> <li>9. Pumpkins</li> <li>10. And other dark fruits and vegetables</li> </ol>

### Thiamin (Vitamin B1)

**Thiamin (Vitamin B1):** Thiamine is water soluble. It has a specific coenzyme, thiamine pyrophosphate (TPP) which is mostly associated with carbohydrate metabolism.

### RDA of Thiamin (Vitamin B1):

Thiamin (Vitamin B1)	
Age	mg
Birth to 6 months	0.2
7–12 months	0.3
1–3 years	0.5
4–8 years	0.6
9–13 years	0.9
14–18 years	1.2
19–50 years	1.2
51+ years	1.2

Pregnancy	1.4
Lactation	1.4

### Function and Source:

Vitamin B1 (Thiamine)	
Function	Source
<ol style="list-style-type: none"> <li>1. The primary purpose for vitamin B1 helps to carbohydrates metabolism.</li> <li>2. Utilizing the nutrient for energy.</li> <li>3. This nutrient is to promote a healthy nervous system where it will help maintain proper nerve transmission throughout the cells.</li> <li>4. It also essential for growth.</li> </ol>	<ol style="list-style-type: none"> <li>1. Sunflower seeds</li> <li>2. Yellow fin tuna</li> <li>3. Black beans</li> <li>4. Lentils</li> <li>5. Pine Nuts</li> <li>6. Fish</li> <li>7. Cooked Corn</li> <li>8. Brussels Sprouts</li> <li>9. Breakfast Cereals</li> <li>10. Veggie Products</li> </ol>

### Riboflavin (Vitamin B2)

**Riboflavin (Vitamin B2):** Riboflavin through coenzymes takes part in variety of cellular oxidation-reduction reactions.

### **RDA of Riboflavin (Vitamin B2):**

Vitamin B2			
Age min	Age max	Unit	mg
5	6	months	5
7	12	months	5
1	3	years	6
4	6	years	7
7	9	years	7
10	12	years	11
13	14	years	13
15	18	years	15
19	24	years	15
25	50	years	15
51	64	years	13
65	80	years	12
During Pregnancy Period			15

During Breast Feeding Period	19.00
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### Function and Source:

Vitamin B2 (Riboflavin)	
Function	Source
<ol style="list-style-type: none"> <li>1. Riboflavin helps the body break down and process the three macronutrients (protein, carbs, and fats)</li> <li>2. Promoting a healthy skin complexion.</li> <li>3. The free riboflavin in retina stimulate of the optic nerve.</li> </ol>	<ol style="list-style-type: none"> <li>1. Calf's liver</li> <li>2. Milk and milk product</li> <li>3. Organ meat</li> <li>4. Green leafy vegetables</li> <li>5. Fish</li> <li>6. Cereals</li> <li>7. Almonds</li> <li>8. Cheese (Roquefort, Brie, Limburger)</li> <li>9. Wheat Bran</li> <li>10. Sun-dried Tomatoes</li> </ol>

### Pantothenic Acid (Vitamin B5)

**Pantothenic Acid (Vitamin B5):** Pantothenic acid formerly known as chick anti-dermatitis factor (or filtrate factor) is widely distributed in nature. It is metabolic role as coenzyme A is also widespread.

### **RDA of Pantothenic Acid (Vitamin B5):**

Pantothenic Acid (Vitamin B5)			
Age min	Age max	Unit	mg
5	6	months	3.00
7	12	months	3.00
1	3	years	4.00
4	6	years	4.00
7	9	years	5.00
10	12	years	5.00

13	14	years	6.00
15	18	years	6.00
19	24	years	6.00
25	50	years	6.00
51	64	years	5.00
65	80	years	5.00
During Pregnancy Period			7.00
During Breast Feeding Period			8.00

### Function and Source:

Vitamin B5	
Function	Source
<ol style="list-style-type: none"> <li>1. It is present in all living cells and is very important to metabolism where it functions as part of the molecule called coenzyme A or CoA.</li> <li>2. It is required for synthesis of amino acid, fatty acids and steroid hormone.</li> <li>3. It is required for synthesis of prophyrin, the pigment portion of hemoglobin.</li> <li>4. It also essential for growth.</li> </ol>	<ol style="list-style-type: none"> <li>1. Organ meats</li> <li>2. Brewer's yeast</li> <li>3. Egg yolks</li> <li>4. Fish</li> <li>5. Chicken</li> <li>6. Whole grain cereals</li> <li>7. Cheese</li> <li>8. Peanuts</li> <li>9. Dried beans</li> <li>10. Sweet potatoes</li> <li>11. Green peas</li> <li>12. Cauliflower</li> </ol>

### Pyridoxine (Vitamin B6)

**Pyridoxine (Vitamin B6):** Vitamin B6 is used to collectively represent the three compounds namely pyridoxine, pyridoxal and pyridoxamine (the vitamers of B6).

### **RDA of Pyridoxine (Vitamin B6):**

Vitamin B6
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Age min	Age max	Unit	mg
5	6	months	0.3
7	12	months	0.3
1	3	years	0.4
4	6	years	0.5
7	9	years	0.7
10	12	years	1.00
13	14	years	1.4
15	18	years	1.6
19	24	years	1.5
25	50	years	1.5
51	64	years	1.5
65	80	years	1.4
During Pregnancy Period			1.9
During Breast Feeding Period			2.00

### Function and Source:

Vitamin B6	
Function	Source
<ol style="list-style-type: none"> <li>1. Vitamin B6 or pyridoxine helps in metabolism and in facilitating brain function.</li> <li>2. It can help you boost your memory.</li> <li>3. If you are deficient in this vitamin, you can have anemia, poor brain function and even depression.</li> </ol>	<ol style="list-style-type: none"> <li>1. Bananas</li> <li>2. Cereals</li> <li>3. Oatmeal</li> <li>4. Avocados</li> <li>5. Beans</li> <li>6. meat or poultry</li> <li>7. seeds</li> </ol>

### Folic Acid (Vitamin B9)

**Folic Acid (Vitamin B9):** Folic acid or folacin is abundantly found in green leafy vegetables. It is important for one carbon metabolism and is required for the synthesis of certain amino acids, purines and the pyrimidine –thymine.

### RDA of Folic Acid (Vitamin B9):

Folic Acid (Vitamin B9)			
Age min	Age max	Unit	µg
5	6	months	80.00



7	12	months	80.00
1	3	years	150.00
4	6	years	200.00
7	9	years	300.00
10	12	years	300.00
13	14	years	400.00
15	18	years	400.00
19	24	years	400.00
25	50	years	400.00
51	64	years	400.00
65	80	years	400.00
During Pregnancy Period			600.00
During Breast Feeding Period			500.00

### Function and Source:

Vitamin B9	
Function	Source
<ol style="list-style-type: none"> <li>1. Vitamin B9, or folic acid, is very important particularly during pregnancy.</li> <li>2. This vitamin is also important for the production of blood cells, thereby preventing anemia.</li> <li>3. If you do not take sufficient amounts of folic acid during pregnancy, your child could suffer from a poorly developed nervous system and mental retardation.</li> </ol>	<ol style="list-style-type: none"> <li>1. Beans</li> <li>2. Lentils (Cooked)</li> <li>3. Spinach (Raw)</li> <li>4. Asparagus (Cooked)</li> <li>5. Lettuce</li> <li>6. Avocado</li> <li>7. Broccoli</li> <li>8. Tropical Fruits (Mango)</li> <li>9. Oranges</li> <li>10. Bread (Wheat Bread)</li> <li>11. eggs and liver</li> </ol>

### Cobalamine (Vitamin B12)

**Cobalamine (Vitamin B12):** Vitamin B12 is known as anti-pernicious anemia vitamin. It is a unique vitamin synthesized by only microorganisms and not by animals and plants .It was the last vitamin to be discovered.

### RDA of Cobalamine (Vitamin B12):

Vitamin B12			
Age min	Age max	Unit	µg

5	6	months	0.4
7	12	months	0.4
1	3	years	0.70
4	6	years	1
7	9	years	1.4
10	12	years	1.50
13	14	years	2.00
15	18	years	2.00
19	24	years	3.00
25	50	years	3.00
51	64	years	2.00
65	80	years	2.00
During Pregnancy Period			2.2
During Breast Feeding Period			2.60

### Function and Source:

Vitamin B12	
Function	Source
<ol style="list-style-type: none"> <li>1. Vitamin B12, also called cyanocobalamin, it plays an important role in the formation of new cells and in the production of proteins.</li> <li>2. It also help us as well as for good metabolism.</li> <li>3. It is necessary for synthesis nucleic acids.</li> </ol>	<ol style="list-style-type: none"> <li>1. Shellfish</li> <li>2. Liver</li> <li>3. Crustaceans</li> <li>4. Fortified Soy Products</li> <li>5. Fortified Cereals</li> <li>6. Red Meat</li> <li>7. Low Fat Dairy (Skim Milk)</li> <li>8. Cheese</li> <li>9. Yogurt</li> <li>10. Eggs</li> </ol>

### Vitamin C

**Vitamin C (Ascorbic acid):** Vitamin C is a water soluble versatile vitamin. It plays an important role in human health and disease. Vitamin C has become the most controversial vitamin in recent years.

### RDA of Vitamin C:

Vitamin C			
Age min	Age max	Unit	mg

5	6	months	40.00
7	12	months	50.00
1	3	years	15.00
4	6	years	25.00
7	9	years	30.00
10	12	years	45.00
13	14	years	55.00
15	18	years	75.00
19	24	years	90.00
25	50	years	100.00
51	64	years	90.00
65	80	years	90.00
During Pregnancy Period			115.00
During Breast Feeding Period			120.00

### Function and Source:

Vitamin C	
Function	Source
<ol style="list-style-type: none"> <li>1. Vitamin C also Known as an immunity booster which act as an antioxidant.</li> <li>2. Vitamin C helping you healing faster, promoting tissue growth, and reducing your risk for certain kinds of cancer, heart disease, and tissue damage.</li> <li>3. It is required for formation of tooth dentin.</li> </ol>	<ol style="list-style-type: none"> <li>1. Red and Green Hot Chili Peppers</li> <li>2. Guavas</li> <li>3. Bell Peppers</li> <li>4. Dark Leafy Greens</li> <li>5. Broccoli, Cauliflower</li> <li>6. Brussels Sprouts</li> <li>7. Kiwi Fruits</li> <li>8. Papayas</li> <li>9. Oranges and Clementines</li> <li>10. Strawberries</li> </ol>

### Vitamin D

**Vitamin D:** Vitamin D is a fat soluble vitamin. It resembles sterols in structure and functions like a hormone.

### RDA of Vitamin D:

Vitamin D			
Age min	Age max	Unit	µg
5	6	months	10.00

7	12	months	10.00
1	3	years	15.00
4	6	years	15.00
7	9	years	15.00
10	12	years	15.00
13	14	years	15.00
15	18	years	15.00
19	24	years	15.00
25	50	years	15.00
51	64	years	15.00
65	80	years	20.00
During Pregnancy Period			15.00
During Breast Feeding Period			15.00

### **Function and Source:**

<b>Vitamin D</b>	
<b>Function</b>	<b>Source</b>
<ol style="list-style-type: none"> <li>1. Vitamin D increases the absorption of Ca, P from gastrointestinal tract.</li> <li>2. It leads to proper growth of bone and skeletal.</li> <li>3. Vitamin D actually functions as a hormone and regulates bone homeostasis, together with calcium</li> <li>4. A deficiency of this vitamin can cause you to have osteoporosis.</li> </ol>	<ol style="list-style-type: none"> <li>1. Cod Liver Oil</li> <li>2. Fish</li> <li>3. Fortified Cereals</li> <li>4. Oysters</li> <li>5. Caviar (Black and Red)</li> <li>6. Fortified Soy Products (Tofu and Soy Milk)</li> <li>7. Salami, Ham, and Sausages</li> <li>8. Fortified Dairy Products</li> <li>9. Eggs</li> <li>10. Mushrooms</li> </ol>

### **Vitamin E**

**Vitamin E:** vitamin E (tocopherol) is a naturally occurring antioxidant. It is essential for normal reproduction in many animals, hence known as anti-sterility vitamin. Vitamin E described as a vitamin in search of a disease.

### **RDA of Vitamin E:**

<b>Vitamin E</b>			
<b>Age min</b>	<b>Age max</b>	<b>Unit</b>	<b>mg</b>
5	6	months	4.00
7	12	months	5.00

1	3	years	6.00
4	6	years	7.00
7	9	years	7.00
10	12	years	11.00
13	14	years	11.00
15	18	years	15.00
19	24	years	15.00
25	50	years	14.00
51	64	years	13.00
65	80	years	12.00
During Pregnancy Period			15.00
During Breast Feeding Period			19.00

### Function and Source:

Vitamin E	
Function	Source
<ol style="list-style-type: none"> <li>1. Vitamin E or tocopherol acts as an antioxidant and scavengers.</li> <li>2. It is closely related with reproductive function and prevents sterility.</li> <li>3. Aside from its functions in the production of red blood cells and in the maintenance of the integrity of cellular membranes.</li> <li>4. Vitamin E can help slow down aging.</li> </ol>	<ol style="list-style-type: none"> <li>1. Nuts and nut products</li> <li>2. Wheat germ</li> <li>3. Cod liver oil</li> <li>4. Corn oil</li> <li>5. Safflower oil</li> <li>6. Margarine</li> <li>7. Tofu</li> <li>8. Spinach</li> <li>9. Fish</li> <li>10. Avocados</li> <li>11. Broccoli</li> <li>12. Squash &amp; pumpkin</li> </ol>

### Vitamin K

**Vitamin K:** Vitamin K is only the fat soluble vitamin with a specific coenzyme function. It is required for the production of blood clotting factors, essential for coagulation (in German –coagulation; hence the name K is for this vitamin.)

### RDA of Vitamin K:

Vitamin K			
Age min	Age max	Unit	µg
5	6	months	10.00
7	12	months	10.00

1	3	years	15.00
4	6	years	20.00
7	9	years	30.00
10	12	years	45.00
13	14	years	60.00
15	18	years	80.00
19	24	years	80.00
25	50	years	85.00
51	64	years	80.00
65	80	years	75.00
During Pregnancy Period			70.00
During Breast Feeding Period			85.00

### Function and Source:

Vitamin K	
Function	Source
<ol style="list-style-type: none"> <li>1. Vitamin K is essential for strong bones.</li> <li>2. It is required for the production of blood clotting factor.</li> <li>3. It also reduces your risk of heart disease.</li> <li>4. It is essential for coagulation.</li> <li>5. It is essential for absorption of fat.</li> </ol>	<ol style="list-style-type: none"> <li>1. Dark Leafy Greens</li> <li>2. Herbs (Dried and Fresh)</li> <li>3. Spring Onions (Scallions)</li> <li>4. Brussels Sprouts</li> <li>5. Broccoli</li> <li>6. Chili Powder, Curry, Paprika, and Cayenne</li> <li>7. Asparagus</li> <li>8. Cabbage</li> <li>9. Pickled Cucumber</li> <li>10. Prunes</li> </ol>

## Minerals

Minerals are essential micronutrients that are required in small amounts for the body to function properly. Different minerals play a primary role at different stages of life. For example, menstruating women often need extra iron until they hit menopause and then they can cross iron off their list, as it contributes to oxidative damage in the body. Another example is that one person typically develops bone density during the first 35 years of life, creating a specific mineral reserve that forms the foundation for bone health during the postmenopausal years, when bone density tends to decline.

## Magnesium

**Magnesium:** The adult body contains about 20g magnesium, 70% of which is found in bones in combination with calcium and phosphorus. The remaining 30% occurs in the soft tissues and body fluid.

Magnesium				
Age min	Age max	Unit	mg	
			Min	Max
5	6	months	60.00	100.00
7	12	months	60.00	130.00
1	3	years	80.00	200.00
4	6	years	120.00	220.00
7	9	years	170.00	300.00
10	12	years	230.00	400.00
13	14	years	310.00	500.00
15	18	years	400.00	550.00
19	24	years	400.00	550.00
25	50	years	350.00	570.00
51	64	years	350.00	500.00
65	80	years	350.00	500.00
During Pregnancy Period			310.00	500.00
During Breast Feeding Period			390.00	550.00

### Function and Source:

Magnesium	
Function	Source
<ol style="list-style-type: none"><li>1. Magnesium helps to keep your heart rhythm steady and supports a healthy immune system.</li><li>2. Magnesium is as important as calcium in developing and maintaining bone health.</li><li>3. Magnesium is also involved in energy metabolism and protein synthesis.</li><li>4. Magnesium is required for the synthesis of the antioxidant glutathione, which is crucial for immune system.</li><li>5. Muscle and nerve function</li></ol>	<ol style="list-style-type: none"><li>1. Dark Leafy Greens</li><li>2. Nuts and Seeds</li><li>3. Fish</li><li>4. Beans and Lentils</li><li>5. Whole Grains (Brown Rice)</li><li>6. Avocados</li><li>7. Low-Fat Dairy</li><li>8. Bananas</li><li>9. Dried Fruit</li><li>10. Dark Chocolate</li></ol>

## Calcium

**Calcium:** Calcium is the most abundant among the minerals in the body. The total content of calcium in an adult man is about 1 to 1.5 kg. As much as 99% of it is present in the bones and teeth.

### **RDA of Calcium:**

Calcium				
Age min	Age max	Unit	mg	
			Min	Max
5	6	months	400.00	500.00
7	12	months	300.00	450.00
1	3	years	400.00	500.00
4	6	years	600.00	800.00
7	9	years	700.00	800.00
10	12	years	1,100.00	1,300.00
13	14	years	1,200.00	1,300.00
15	18	years	1,200.00	1,300.00
19	24	years	800.00	1,000.00
25	50	years	800.00	1,000.00
51	64	years	1,000.00	1,200.00
65	80	years	1,000.00	1,000.00
During Pregnancy Period			1,000.00	1,200.00
During Breast Feeding Period			1,000.00	1,250.00

### **Function and Source:**

Calcium	
Function	Source
<ol style="list-style-type: none"><li>1. Calcium is the most abundant mineral in the body and is required for healthy muscle function, nerve transmission, intracellular signaling, and hormonal secretion.</li><li>2. Almost all the calcium in the body is stored in the bones and teeth, where it is vital for their support and structure.</li><li>3. It is especially important for women to get adequate amounts of calcium in order to reduce the risk of developing osteoporosis.</li></ol>	<ol style="list-style-type: none"><li>1. Dark Leafy Greens (Watercress)</li><li>2. Low Fat Cheese (Mozzarella Nonfat)</li><li>3. Fortified Soy Products (Tofu)</li><li>4. Okra (Cooked)</li><li>5. Broccoli</li><li>6. Low Fat Milk &amp; Yogurt (Nonfat Milk)</li><li>7. Chinese Cabbage</li><li>8. Green Snap Beans</li></ol>



4. In addition to its benefits for the bones, calcium is also effective in lowering blood pressure, treating migraines and reducing symptoms of premenstrual syndrome.	9. Almonds 10. Fish Canned
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### Sodium

**Sodium:** Sodium is the chief cation of the extracellular fluid. About 50% of body sodium is present in the bones, 40% in the extracellular fluid and the remaining (10%) in the soft tissues.

#### **RDA of Sodium:**

<b>Sodium</b>				
Age min	Age max	Unit	mg	
			Min	Max
5	6	months	180.00	220.00
7	12	months	180.00	250.00
1	3	years	300.00	600.00
4	6	years	410.00	700.00
7	9	years	460.00	1,200.00
10	12	years	510.00	1,400.00
13	14	years	550.00	1,450.00
15	18	years	550.00	1,600.00
19	24	years	550.00	1,800.00
25	50	years	550.00	2,000.00
51	64	years	550.00	1,800.00
65	80	years	550.00	1,500.00

#### **Function and Source:**

<b>Sodium</b>	
<b>Function</b>	<b>Source</b>
<ol style="list-style-type: none"> <li>1. In association with chloride and bicarbonate, sodium regulates the body's acid-base balance.</li> <li>2. Sodium is required for the maintenance of osmotic pressure and fluid balance.</li> <li>3. It is necessary for the normal muscle irritability and cell permeability.</li> </ol>	<ol style="list-style-type: none"> <li>1. Table salt, baking soda, and baking powder</li> <li>2. Bouillon cubes, Powdered Broths, Soups, and Gravies</li> <li>3. Soy Sauce, Other Sauces, and Salad Dressings</li> <li>4. Yeast Extract Spread</li> <li>5. Salami, Bacon, and Cured Meats</li> <li>6. Sun Dried Tomatoes</li> </ol>

4. It is necessary for initiating and maintaining heart beat.	7. Cheese 8. Snack Foods 9. Pickled Foods 10. Saltwater Crab
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### Potassium

**Potassium:** Potassium is the principle intracellular cation. It is equally important in the extracellular fluid for specific function.

#### **RDA of Potassium:**

Potassium				
Age min	Age max	Unit	mg	
			Min	Max
5	6	months	650.00	1,500.00
7	12	months	650.00	2,000.00
1	3	years	1,000.00	3,000.00
4	6	years	1,400.00	4,000.00
7	9	years	1,600.00	4,200.00
10	12	years	1,700.00	4,250.00
13	14	years	1,900.00	4,600.00
15	18	years	2,000.00	4,700.00
19	24	years	2,000.00	4,700.00
25	50	years	2,000.00	4,700.00
51	64	years	2,000.00	4,500.00
65	80	years	2,000.00	4,000.00

#### **Function and Source:**

Potassium	
Function	Source
<ol style="list-style-type: none"> <li>Potassium maintains intracellular osmotic pressure.</li> <li>It is required for the regulation of acid-base balance and water balance in the cell.</li> <li>It is also required for the transmission of nerve impulse.</li> <li>Extracellular K<sup>+</sup> influences cardiac muscle activity.</li> </ol>	<ol style="list-style-type: none"> <li>White Beans</li> <li>Dark Leafy Greens</li> <li>Baked Potatoes</li> <li>Dried Apricots</li> <li>Baked Acorn Squash</li> <li>Yogurt</li> <li>Fish</li> <li>Avocados</li> <li>Mushrooms</li> </ol>

	10. Bananas
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### **Phosphorus**

**Phosphorus:** An adult body contains about 1 kg phosphate and it is found in every cell of the body. Most of it occurs in combination with Ca in the bones and teeth.

#### **RDA of Phosphorus:**

<b>Phosphorus</b>				
<b>Age min</b>	<b>Age max</b>	<b>Unit</b>	<b>mg</b>	
			<b>Min</b>	<b>Max</b>
5	6	months	300.00	375.00
7	12	months	275.00	350.00
1	3	years	400.00	500.00
4	6	years	500.00	550.00
7	9	years	800.00	900.00
10	12	years	1,250.00	1,300.00
13	14	years	1,250.00	1,400.00
15	18	years	1,250.00	1,400.00
19	24	years	700.00	800.00
25	50	years	700.00	800.00
51	64	years	700.00	800.00
65	80	years	700.00	800.00
During Pregnancy Period			800.00	1,000.00
During Breast Feeding Period			900.00	1,050.00

#### **Function and Source:**

<b>Phosphorus</b>	
<b>Function</b>	<b>Source</b>
<ol style="list-style-type: none"> <li>1. Constituent of bone and teeth.</li> <li>2. Formation of phospholipid, phosphoproteins and nucleic acids.</li> <li>3. It is essential component of several nucleotide coenzymes.</li> <li>4. Several protein and enzymes are activated by phosphorylation.</li> </ol>	<ol style="list-style-type: none"> <li>1. Seeds (Pumpkin &amp; Squash)</li> <li>2. Cheese</li> <li>3. Fish</li> <li>4. Shellfish</li> <li>5. Nuts</li> <li>6. Pork</li> <li>7. Beef &amp; Veal</li> <li>8. Low Fat Dairy</li> </ol>

	9. Soya Foods 10. Beans & Lentils
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### Iron

**Iron:** The total content of iron in an adult body is 3-5g. About 70% of this occurs in the erythrocytes of blood as a constituent of hemoglobin. At least 5% of body iron is present in myoglobin of muscle.

#### **RDA of Iron:**

Iron				
Age min	Age max	Unit	mg	
			Min	Max
5	6	months	8.00	10.00
7	12	months	8.00	11.00
1	3	years	6.00	7.00
4	6	years	8.00	12.00
7	9	years	10.00	12.00
10	12	years	8.00	8.00
13	14	years	12.00	14.00
15	18	years	12.00	14.00
19	24	years	10.00	12.00
25	50	years	10.00	12.00
51	64	years	10.00	12.00
65	80	years	8.00	10.00
During Pregnancy Period			27.00	30.00
During Breast Feeding Period			15.00	22.00

#### **Function and Source:**

Iron	
Function	Source
<ol style="list-style-type: none"> <li>1. Part of the protein hemoglobin</li> <li>2. Carries oxygen in the body</li> <li>3. Found in the protein myoglobin</li> <li>4. Makes oxygen available for muscle contractions</li> </ol>	<ol style="list-style-type: none"> <li>1. Black strap molasses</li> <li>2. dried apricots</li> <li>3. raisins</li> <li>4. Red meats</li> <li>5. fish and poultry</li> <li>6. Lentils</li> <li>7. beans</li> </ol>

	8. Liver 9. Whole grains 10. Dark chocolate and cocoa powder
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## Zinc

**Zinc:** The total content of zinc in an adult body is about 2g. Prostate gland is very rich in zinc (100 mg/g). Zinc is mainly an intracellular element.

### **RDA of Zinc:**

<b>Zinc</b>				
<b>Age min</b>	<b>Age max</b>	<b>Unit</b>	<b>mg</b>	
			Min	Max
5	6	months	2.00	3.00
7	12	months	2.00	3.00
1	3	years	3.00	3.50
4	6	years	5.00	4.00
7	9	years	7.00	8.00
10	12	years	8.00	9.00
13	14	years	9.00	10.00
15	18	years	9.00	10.00
19	24	years	10.00	11.00
25	50	years	10.00	11.00
51	64	years	8.00	9.00
65	80	years	8.00	9.00
During Pregnancy Period			10.00	11.00
During Breast Feeding Period			11.00	12.00

### **Function and Source:**

<b>Zinc</b>	
<b>Function</b>	<b>Source</b>
5. Strengthens immune system 6. Supports absorption of calcium 7. Increases white blood cell count 8. Helps regulate hormones 9. Zinc is necessary for the function of many enzymes in the body, effectively assists in	1. Seafood 2. Beef and Lamb 3. Wheat Germ 4. Spinach 5. Pumpkin and Squash Seeds 6. Cocoa and Chocolate 7. Pork & Chicken

regulating hormones and has even been shown to increase fertility. 10. Zinc can help improve numerous conditions such as acne and poor skin health, among others.	8. Beans 9. Mushrooms 10. Nuts
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### **Iodine**

**Iodine:** The total body contains about 20 mg iodine, most of it (80%) being present in the thyroid gland. Muscle, salivary glands and ovaries also contain some amount of iodine.

#### **RDA of Iodine:**

<b>Iodine</b>				
<b>Age min</b>	<b>Age max</b>	<b>Unit</b>	<b>µg</b>	
			<b>Min</b>	<b>Max</b>
5	6	months	80.00	120.00
7	12	months	80.00	130.00
1	3	years	90.00	100.00
4	6	years	90.00	100.00
7	9	years	90.00	120.00
10	12	years	120.00	180.00
13	14	years	120.00	200.00
15	18	years	150.00	200.00
19	24	years	150.00	200.00
25	50	years	150.00	200.00
51	64	years	180.00	200.00
65	80	years	180.00	200.00
During Pregnancy Period			220.00	250.00
During Breast Feeding Period			280.00	300.00

#### **Function and Source:**

<b>Iodine</b>	
<b>Function</b>	<b>Source</b>
1. It is especially important for women who are pregnant to monitor both their iodine levels as well as levels in their babies in order to prevent certain developmental problems.	1. Seafood 2. Dried Seaweed 3. Cod

2. Iodine strongly influences nutrient metabolism, detoxification, nerve and muscle function, nail, hair, skin and tooth condition, and has a profound impact on physical and mental development. 3. It prevents and treats various thyroid issues, such as enlargement of the thyroid gland. 4. There is also evidence of a link between low thyroid function and fibrocystic breast disease (FBD).	4. Iodized Salt (Fortified) 5. Baked Potato 6. Milk 7. Shrimp 8. Turkey breast 9. Navy beans 10. Egg
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### **Selenium**

**Selenium:** Selenium is important for optimum health, as it is reported to mimic the action of insulin. Studies have shown that selenium effectively stimulates glucose uptake and regulates metabolic processes.

#### **RDA of Selenium:**

<b>Age</b>	<b>Male</b>
Birth to 6 months	15 mcg
7–12 months	20 mcg
1–3 years	20 mcg
4–8 years	30 mcg
9–13 years	40 mcg
14–18 years	55 mcg
19–50 years	55 mcg
51+ years	55 mcg
Pregnancy	60 mcg
Lactation	70 mcg

#### **Function and Source:**

<b>Selenium</b>	
<b>Function</b>	<b>Source</b>

<ol style="list-style-type: none"> <li>1. Selenium stimulates glucose uptake and regulates metabolic processes including fatty acid synthesis.</li> <li>2. Selenium acts as an antioxidant against free radicals.</li> <li>3. Selenium is also important for optimum health, as it is reported to mimic the action of insulin.</li> <li>4. Selenium also plays a role in reducing the oxidative stress associated with diabetes.</li> </ol>	<ol style="list-style-type: none"> <li>1. Brazil Nuts</li> <li>2. Seafood</li> <li>3. Tuna Fish</li> <li>4. Whole-Wheat Bread</li> <li>5. Seeds (Sunflower)</li> <li>6. Pork</li> <li>7. Beef &amp; Lamb</li> <li>8. Chicken and Turkey</li> <li>9. Mushrooms</li> <li>10. Whole Grains</li> <li>11. Cheese</li> <li>12. Egg</li> </ol>
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## **Water**

### **Water:**

Water is the solvent of life. Undoubtedly, water is more important than any other single compound to life. It is involved in several body function. The body process tremendous capacity to regular it is water content. In a healthy individual, this is achieved by balancing the daily water intake and water output.

### **How much water do you need?**

The Institute of Medicine determined that an adequate intake: For men is roughly 3 liters (about 13 cups) of total beverages a day. For women is 2.2 liters (about 9 cups) of total beverages a day.

### **Function of water:**

1. Water is your body's principal chemical component and makes up about 60 percent of your body weight.
2. Water provides the aqueous medium to the organism which is essential for the various biochemical reactions to occur.
3. Water directly participates as a reactant in several metabolic reactions.
4. It serves as a vehicle for transport of solutes.
5. Water is closely associated with the regulation of body temperature.
6. Lack of water can lead to dehydration, a condition that occurs when you don't have enough water in your body to carry out normal functions



## Chapter 8 – Nutrition for Performance and Goal Specific Needs

Many clients you will work with will have goals of improved performance, not just body composition change. The nutritional approach when working with athletes can be quite different compared to approaches used with those in the general population.

### Basic Concepts of BMR

#### Basal Metabolic Rate (BMR)

The BMR is an estimate of how many calories you burn daily without exertion. These are the calories expended as the body keeps itself alive. Calculate your BMR using the formula that follows.

#### Calculate Basal Metabolic Rate

The equation for calculating BMR for Men is:

$$\text{BMR} = 66 + (13.8 \times \text{weight in kg.}) + (5 \times \text{height in cm}) - (6.8 \times \text{age in years}).$$

The equation for calculating BMR for Women is:

$$\text{BMR} = 655 + (9.6 \times \text{weight in kg.}) + (1.8 \times \text{height in cm}) - (4.7 \times \text{age in years}).$$

This equation takes into account your height, weight, age, and sex. BMR increases with height and weight but decreases with age. As always, the value for BMR in this equation is given in "kcal (calories) per day."

### **Calculate Total Calorie Needs**

To get a better sense of how many calories your body uses in any given day, you need to factor in your activity level. To determine your total daily calorie needs, multiply your BMR by the appropriate activity factor, as follows:

**For sedentary active people** (little or no exercise):  $\text{BMR} \times 1.2$

**For lightly active people** (easy exercise/sports 1-3 days/week):  $\text{BMR} \times 1.375$

**For moderately active people** (moderate exercise/sports 3-5 days/week):  $\text{BMR} \times 1.55$

**For very active people** (hard exercise/sports 6-7 days a week):  $\text{BMR} \times 1.725$

**For extremely active people** (very hard exercise/sports and physical job):  $\text{BMR} \times 1.9$

### **For example:**

Let's assume you are lightly active.

Multiply your BMR from above (1394.9) by 1.375 = 1917.9875.

This is the total number of calories you would need to maintain your current weight.

### **Calculate Calories to Lose Weight**

If you want to lose 0.5 kg per week, you might **decrease** your required calories by 500 per day. So, if your daily caloric need is 2,000 to maintain your weight,

subtract 500 from that, and you'll have consumed 1,500 calories each day still lose 0.5 kg in one week.

### **Calculate Calories to Gain Weight**

If you want to gain 0.5 kg per week, you'll need to add 500 calories to your diet each day, consuming a total of 2,500 calories a day.

## **Weight gain**

### **What is weight gain?**

Weight gain is an increase in body weight. This can be either an increase in muscle mass, fat deposits, or excess fluids such as water. Weight gain has a latency period. The effect that eating has on weight gain can vary greatly depending on the following factors: Such as...

1. Energy (calorie) density of foods
2. Exercise regimen
3. Amount of water intake
4. Amount of salt contained in the food
5. Time of day eaten
6. Age of individual
7. Individual's country of origin
8. Individual's overall stress level
9. Amount of water retention in ankles/feet

Typical latency periods vary from three days to two weeks after ingestion.

Gaining weight can cause the following effects, dependent on the variable listed above, but are generally limited to:

1. Increase in body fat percentage

2. Increase in muscle mass
3. Increase in body hydration levels
4. Increase in breast size

### **Dietary Modification for Weight Gain:**

The cause of loss in weight must first be removed and high calorie diet may be give.

**Energy:** About 500 calories a day will help you to gain about 0.5 kg weight per week. Moderately active individuals may be given 2700 to 3200 calories diet for effective weight gain.

### **For Example of 3200 calorie per day diet:**

#### **Carbohydrates:**

$55\% (.55) \times 3200 = 1760$  calories from carbohydrate  
 $1760 \text{ carb calories} / 4 \text{ calories per gram} = 440$  grams of carbs

#### **Protein:**

$30\% (.30) \times 3200 = 960$  calories from protein  
 $960 \text{ protein calories} / 4 \text{ calories per gram} = 240$  grams of protein

#### **Fat:**

$15\% (.15) \times 3200 = 480$  calories from fat  
 $480 \text{ fat calories} / 9 \text{ calories per gram} = 53.3$  grams of fat

**Vitamin and Minerals:** A well-planned, high calorie diet will provide liberal amount of vitamins and minerals. In such cases supplements may not be required.

**Exercise:** Exercise can stimulate their appetite to improve the intake of calories. It also helps in improving muscle tone especially of the digestive system, resulting in better absorption and assimilation of food, which helps tremendously in weight gain. Exercise helps to increase lean weight and prevents fat accumulation. It also increases strength and endurance.

## List of food for weight gain

List of food for weight gain	
<b>Proteins</b>	<ol style="list-style-type: none"><li>1. Fish as in salmon, cod, or tuna</li><li>2. Red meats as in lean ground beef and lean steaks</li><li>3. Turkey and chicken</li><li>4. Dairy products like milk, cottage cheese and low-fat yogurts</li><li>5. Legumes</li><li>6. Ham</li><li>7. Eggs</li><li>8. Pork</li><li>9. Tofu</li><li>10. Lamb</li><li>11. Protein supplements in the form of whey protein and soy protein supplements.</li></ol>
<b>Carbohydrates</b>	<ol style="list-style-type: none"><li>1. Oatmeal</li><li>2. Fruits</li><li>3. nuts</li><li>4. apples</li><li>5. Whole grain cereal and bread</li><li>6. Pasta</li><li>7. Brown rice</li><li>8. Vegetables like corn, broccoli and green beans</li><li>9. Snacking on pretzels</li><li>10. Legumes like lima beans, kidney beans, soybeans and chick peas.</li></ol>
<b>Fats</b>	<ol style="list-style-type: none"><li>1. Olive oil</li><li>2. Almonds</li><li>3. Peanuts and peanut butter</li><li>4. Sunflower and safflower oils</li><li>5. Avocados and walnuts</li></ol>

## Weight Gaining Tips

1. Count how many calories you eat in a normal day.
2. Starting the day after you counted calories, eat 500 calories more than you normally do.
3. Your meals should be balanced with the right amounts of protein, carbohydrates and fat.

4. Divide your optimal calorie intake for weight gain into the proper macronutrient ratios of 55% carbs, 30% protein and 15% fat
5. Meal time should be as attractive and pleasure.
6. Small but frequent meals should be taken. Mid-morning and mid-afternoon snack in addition with regular meals.
7. Choose a generous portion of meat, poultry, fish, seafood, legumes or tofu, and serve with a side of green and colorful vegetables, and something starchy like potatoes, sweet corn, rice or pasta.
8. Serve yourself larger portions of starchy vegetables like potatoes and sweet corn.
9. Add calories with a nutritious beverage such as milk, 100-percent fruit juices, or vegetable juice.
10. Choose natural, unrefined foods. Don't use trying to gain weight as an excuse to pig out.
11. No food should be forced for eating.

## Weight loss

### **What is weight loss?**

Weight loss, in the context of medicine, health or physical fitness, is reduction of the total body mass, due to a mean loss of fluid, body fat or adipose tissue or lean mass, namely bone mineral deposits, muscle, tendon and other connective tissue. It can occur unintentionally due to an underlying disease or can arise from a conscious effort to improve an actual or perceived overweight or obese state.

### **Calculate Calories to Lose Weight**

If you want to lose 0.5 kg per week, you might **decrease** your required calories by 500 per day. So, if your daily caloric need is 2,000 to maintain your weight, subtract 500 from that, and you'll have consumed 1,500 calories each day still lose 0.5 kg in one week.

## Dietary Modification for Weight loss:

**Energy:** Decrease about 500 calories a day will help you to lose about 0.5 kg weight per week. For example, if an individual is fed a 1,500 calories diet for effective weight loss.

### For Example of 1500 calorie per day diet:

#### Carbohydrates:

55% (.55) X 1500 = 825 calories from carbohydrate  
825 carb calories/4 calories per gram = 206 grams of carbs

#### Protein:

30% (.30) X 1500 = 450 calories from protein  
450 protein calories/4 calories per gram = 112 grams of protein

#### Fat:

15% (.15) X 3200 = 225 calories from fat  
225 fat calories/9 calories per gram = 25 grams of fat

### List of food for weight Loss

List of food for weight Loss				
Proteins		Carbohydrates	Fats	Low-fat dairy products
1. Beef		1. Vegetables (all kinds)	1. Omega-3s	1. Low fat yogurt
2. Chicken		2. Fruit	2. CLA fats	2. Greek yogurt
3. Light ham		3. Oats and oatmeal	3. Omega-6s	3. Low fat cottage cheese
4. Lamb		4. Brown Rice	4. MCT fats	4. Low fat cheese
5. Bacon		5. Seeds		5. Low-fat/non-fat sour cream
6. Game meats		6. Nuts		6. Low-fat or Skim milk
7. Deli meats		7. Quinoa		7. Fat free cream cheese
8. Turkey		8. Chia		
9. Veal		9. Yams		
10. Pork tenderloin		10. Lentils		
11. Egg white		11. Whole Grain Breads		
12. Fish		12. Whole Grain Pitas		
13. Crab		13. Whole Grain Cereals		
14. Lobster		14. Potatoes		
15. Shark				
16. Oyster				
17. Prawn				
18. Seafood extender				
19. Tofu				

20. Lentils	15. Whole grain		
21. Chickpeas	pastas		
22. Dried beans (kidney beans, black beans etc)	16. Beans		
23. Vegetarian sausages			

### **Weight loss Tips**

1. Study the weight loss equation
2. Observe your daily calorie intake
3. Eat at predefined hours
4. Understand the importance of water
5. Learn how to lose weight the comfortable way
6. Fill up your diet plan with fruit, veggies, and fiber
7. Keep a food and nutrition journal
8. No need to measure your weight on a daily basis
9. Do not follow more than one diet or weight loss program at the same time
10. Take charge of your food environment
11. Make healthy lifestyle change

### **Nutritional Needs for Endurance Events**

#### **Energy Needs**

The energy needs of endurance athletes are high. Every athlete's calorie needs are different; they depend on gender, age, body composition, training regimen and daily activities. Depending on the intensity and duration of the daily



exercises of the athlete, the total daily calorie requirements may range from 3000 to 5000 Kcal as compared with the calorie requirements for very hard work of 3600-3900 Kcal per day. Calories should come from a variety of sources.

## Carbohydrate

Carbohydrates are a primary fuel for exercise and sports, especially those of moderate to high intensities. About 30 percent of the carbohydrates in the diet should be in the form of sucrose and glucose, as these are readily assimilable to provide energy. Sucrose and glucose should be given in quantities of 50-80 g at a time in the form of drinks once in 2 hours before and after the athletes practice. Carbohydrates provide the perfect fuel for most endurance activities; they are easily digested and quickly used by your body. A diet that includes enough carbohydrates can prevent early fatigue and injury.

Choose foods with lots of carbohydrates, such as rice, pasta, potatoes, yogurt, fruit smoothies, cereals, fruits, crackers, breads, rolls, muffins, energy bars or sports drinks.

Your carbohydrate needs will depend on the type of training you are doing. Recommended amounts and sources of carbohydrates:

Type of Training	Daily Carbohydrate needs per kilogram	Daily Carbohydrate needs per pound
	(per kg body weight)	(per lb body weight)
Light to moderate training	5 to 7 grams per kilogram	2.3 to 3.2 grams per pound
Heavy training load and high intensity	7 to 10 grams per kilogram	3.2 to 4.5 grams per pound
Extreme training and high intensity races (longer than four to five hours)	> 10 to 12 grams per kilogram	>4.5 to 5.5 grams per pound

## Fat

Fat is a concentrated source of energy and hence about 20 to 25 percent of the calorie intake should be derived from fats. The daily fat intake should be between 80-150g consisting about 20-25 percent of daily calorie requirements. Fat helps your body to use some vitamins as well as plant chemicals known as “phytochemicals.” Phytochemicals are antioxidants which help your immune system.

Healthy sources of fat: Include fatty fish, nuts, nuts oils, vegetables oils, spreads made from a vegetable oil base, avocados and olives. Limit your intake of saturated fat, which comes from dairy foods such as whole milk, butter and high-fat cheese and animal products, such as lard and highly-marbled cuts of meat.

## Protein

Protein is very important; you need protein for muscle growth and to repair muscle damage after exercise and promotes immune function. Protein is also used as a minor fuel for endurance exercise and sport. While the protein needs of athletes are highly debated, most researchers agree endurance athletes need more protein than non-athletes. Your body also uses protein to make hormones and enzymes, which help regulate metabolism.

Good sources of protein: Fish, Chicken, Turkey, Beef, Low-fat milk, Cheese, Yogurt, Eggs, Nuts, Soy

Protein needs depend on the type of training. Recommended amounts and sources of protein:

Type of Training	Daily Protein needs per kilogram	Daily Protein needs per pound
	(per kg body weight)	(per lb body weight)
Light to moderate training	1.2 to 1.7 grams per kilogram	0.55 to 0.8 grams per pound
Heavy training load and high intensity	1.4 to 2.0 grams per kilogram	0.7 to 0.9 grams per pound

**Vitamins and Minerals:**

A well-planned, high calorie diet will provide liberal amount of vitamins and minerals. There such types of vitamin and mineral are kindly needed for athletes such as, Calcium, Iron, Thiamine, Riboflavin, Niacin, Ascorbic acid, Folic acid, Vitamin B12, Vitamin D, and Vitamin E. Vitamins and minerals do not give you more energy, but they help to unlock the energy stored in food so your body can use it as fuel. Take a multivitamin/mineral supplement to ensure you are getting adequate amounts.

**Nutritional Needs for Strength, Power, and Speed Events**

Strength, Power, and Speed athletes are naturally focused on maximizing their strength-to-weight ratio so as to generate the greatest power at the lowest weight. To do this requires an eating strategy that enables a maintenance or increase of the muscle mass, coupled with the lowest possible body-fat percentage.

**Energy Needs**

The energy needs of Strength, Power, and Speed athletes are high. Every athlete's calorie needs are different; they depend on gender, age, body composition, training regimen and daily activities. Depending on the intensity and duration of the daily exercises of the athlete, the total daily calorie requirements may range from 3000 to 5000 Kcal. Calories should come from a variety of sources. The foods are consumed around the practice sessions in a way that helps sustain energy balance throughout the day ( $\pm$  500 calories).

**Carbohydrate**

Carbohydrates are a primary fuel for exercise and sports, especially those of moderate to high intensities. About 30 percent of the carbohydrates in the diet should be in the form of sucrose and glucose, as these are readily assimilable to provide energy. Sucrose and glucose should be given in quantities of 50-80 g at a time in the form of drinks once in 2 hours before and after the athletes practice.

Carbohydrates provide the perfect fuel for most endurance activities; they are easily digested and quickly used by your body. A diet that includes enough carbohydrates can prevent early fatigue and injury.

Choose foods with lots of carbohydrates, such as rice, pasta, potatoes, yogurt, fruit smoothies, cereals, fruits, crackers, breads, rolls, muffins, energy bars or sports drinks.

**RDA:**

- If you compete in very-high-intensity, brief events, eat 2.7 to 3.6 grams of carbohydrate per pound of body weight per day (6 to 8 g/kg/day).
- If you compete in high-intensity, short-duration events, eat 2.3 to 3.2 grams of carbohydrate per pound of body weight per day (5 to 7 g/kg/day).

**Fat**

Fat is a concentrated source of energy and hence about 20 to 25 percent of the calorie intake should be derived from fats. The daily fat intake should be between 80-150g consisting about 20-25 percent of daily calorie requirements. Fat helps your body to use some vitamins as well as plant chemicals known as “phytochemicals.” Phytochemicals are antioxidants which help your immune system.

Healthy sources of fat include fatty fish, nuts, nut oils, vegetable oils, spreads made from a vegetable oil base, avocados and olives. Limit your intake of saturated fat, which comes from dairy foods such as whole milk, butter and high-fat cheese and animal products, such as lard and highly-marbled cuts of meat.

**RDA:** You need at least 0.45 grams of fat per pound of body weight per day (1 g/kg/day). Choose heart-healthy fats, such as canola oil, olive oil, and nuts.

**Protein**

Protein is very important; you need protein for muscle growth and to repair muscle damage after exercise and promotes immune function. Protein is also used as a minor fuel for endurance exercise and sport. While the protein needs of athletes are highly debated, most researchers agree endurance athletes need more protein than non-athletes. Your body also uses protein to make hormones and enzymes, which help regulate metabolism.

Good sources of protein include fish, chicken, turkey, beef, low-fat milk, cheese, yogurt, eggs, nuts, and soy foods (tofu, soy nuts, soy burgers)

RDA: Track and field athletes need 0.55 to 0.8 grams of protein per pound of bodyweight per day (1.2–1.7 g/kg/day).

### **Vitamins and Minerals:**

A well-planned, high calorie diet will provide liberal amount of vitamins and minerals. There such types of vitamin and mineral are kindly needed for athletes such as, Calcium, Iron, Thiamine, Riboflavin, Niacin, Ascorbic acid, Folic acid, Vitamin B12, Vitamin D, and Vitamin E. Vitamins and minerals do not give you more energy, but they help to unlock the energy stored in food so your body can use it as fuel. Take a multivitamin/mineral supplement to ensure you are getting adequate amounts.

# Section II – Practical Applications

## Chapter 9 – Fitness Consultations and Assessments

Before working with a client, personal trainers must first interview prospective clients and evaluate their needs, wants, risks, and baseline measurements while taking notes on all of the information they are receiving. Steps of an initial client evaluation include:

- Setting an appointment with the new or prospective client
- Meeting a client and building rapport with the client
- Interviewing the client to assess health risks and discover their goals
- Having the client sign a liability release waiver that releases you from any legal claims that are potential when training clients
- Performing a physical assessment of various physical tests to establish a baseline point of reference for progress and to determine their strengths and weaknesses
- Reviewing your fee structure that a client will be required to pay to hire you as a personal trainer
- Help them decide on the appropriate program based on their goals, fitness level, and budget

### Interview Process

The interview process should be conducted using a standardized PAR-Q form. There are many different PAR-Q forms available today through different personal training companies like the PTU. You may also develop your own; however, be aware that a liability release waiver should be included in your PAR-Q and it is wise to have an attorney write the liability release portion of the

PAR-Q. PTU PAR-Q is available at [ptuniversity.org](http://ptuniversity.org) in the trainer resources section on my account page.

The first questions in your interview process after you've established a level of rapport should be directed towards the goals of the clients. Why do they want to work with a personal trainer? What do they want to change about their physical appearance? Do they have performance goals for a sporting event? What health related goals do they have?

You should generally take weight and body fat% measurements for all clients before performing any physical tests. After checking these numbers, explain any health risks associated their values and help the client set realistic short- and long-term goals.

Personal trainers should also ask about good and bad habits the client wants to change. Frequency and amount of fast food, restaurants, take-out, alcohol, tobacco, sweets, sugary drinks, and energy drink consumption are a few examples of what should be discussed.

Strength, endurance, flexibility, balance, and coordination tests should be performed during the initial assessment as well. These will be covered in chapter 10.

## Chapter 10 – Fitness Tests and Evaluations

Measurements and physical tests should be conducted during an initial assessment with a prospective client and conducted with all clients on a weekly and/or monthly basis to determine progress.

### Measurements may include:

- Weight
- Height
- BMI
- Blood pressure
- Resting Heart Rate
- Bodyfat%
- Fat weight
- Lean weight
- Waist circumference
- Hip circumference
- Upper arm circumference
- Thigh circumference
- Chest circumference
- Shoulder width
- Calf circumference

### Physical tests may include:

- Sit-and-reach test
- Step tests
- Push-up tests
- Squat tests
- Overhead pressing tests
- 40-yd, 400m, 800m, 1-mile, 3-mile, etc times
- Vertical Jump
- 1-RM bench, squat, deadlift tests

### Components of Fitness and Fitness tests



- Strength - maximum amount of force that can be produced by a muscle / group of muscles. Tested by:
  - A 1-RM (Repetition Maximum) Test - the maximum amount of weight that can be lifted one time.
  - Dynamometer - measures hand grip strength. A test of static strength.
- Power - time that it takes to produce a certain amount of force.
  - Can be tested by vertical jump test.
- Muscular Endurance - ability of a muscle to perform a continuous task without fatiguing.
  - Can be tested by lifting a certain weight (ex: bench press) for as many reps as possible.
- Cardiovascular Endurance - ability of the heart and lungs to fuel the body with oxygen.
  - $VO_2$  max is the best test of aerobic capacity.
- Flexibility - ability of a joint to move through the full range of motion.
  - Can be tested with the sit and reach test.
- Body composition - amount of body fat compared to amount of lean tissue. Tested by:
  - Hydrostatic weighing - also called underwater weighing. Considered “gold standard” for body composition.
  - Skin fold method - measured with calipers. Common measurement sites are:
    - ➔ Subscapular
    - ➔ Triceps
    - ➔ Chest / Pectoral
    - ➔ Midaxillary
    - ➔ Suprailiac
    - ➔ Abdominal
    - ➔ Thigh
  - Note: Body Mass Index does not measure body composition - it only compares weight to height.

## Chapter 11 – Resistance Training Program Design

Programs are broken into daily, weekly, monthly, quarterly, and annual progressions. Weeks are represented by Microcycles. Months and quarters are represented by Mesocycles. Each year (or training season) represents a Macrocycle. Each cycle should include specific goals. Resistance training program design can vary greatly depending on the client. Designing a resistance training program involves manipulating different progression variables throughout the time frame of the program. A program can be as short as 1-week or as long as 1-year or more. Designing programs is largely based on client- or sport-specific goals. Applying the specificity principle is important to ensure that the outcome of the program will be in accordance with the client's desires. For example, if a client wants to improve vertical jumping capabilities, he or she needs to work the muscles of the thighs and hips. Plyometric activities should be included to improve explosive jumping force capabilities.

### Components of a Resistance Training Program

- Exercise (mode)
- Frequency (days / week)
- Intensity (weight or load)
- Order (which exercise is performed 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, etc)
- Sets (sets / exercise)
- Reps (reps / set)
- Volume (reps x sets x weight)
- Rest (time between sets)
- Tempo (concentric & eccentric time/rep)
- Progression Methods

#### Exercise (mode)

A variety of compound, multi-joint movements and isolation, single-joint should be used for most clients. Compound movements generally have more

application to sports and daily activities. Single-joint movements are used to develop a specific muscle or group of muscles for therapy or rehab purposes, appear weaker than other muscles relative to overall strength, or are important for aesthetic reasons.

### **Types of exercise**

- Isometric – basically involves the body maintaining muscle contraction for an extended period of time. For example: wall sit, plank, etc.
- Plyometric – involves sudden power movements, such as squat or box jumps, jumping jacks, etc. Used to increase power, speed, agility, coordination, and balance. Positive effects include fat loss, increased sports performance, better cardiovascular health.
- Isotonic – tension remains constant, but the contraction is not held. Eg, bicep curl, squat, etc. Best used for increasing muscle mass (hypertrophy), strength, coordination, and balance. Positive effects include increased strength, decreased fat, and increased muscle mass.
- Cardiovascular – sustained increase of heart rate. Designed to increase pulmonary and cardiovascular health. Positive effects include decreased heart rate, increased VO2 max, as well as fat loss.
  - Training cardio at too high of an intensity (read: too fast) can cause protein loss.
- Stretching – there are three kinds of stretching: static, ballistic, and dynamic. Both involve lengthening muscle tissue. Positive effects include: better body balance, decreased risk of injury, increased range of motion and therefore workout efficacy, decreased pain and discomfort, and it can be relaxing (mind/body wellness).
  - Static stretching – holding a muscle in its eccentric position for minimally 30s to encourage the fibers to lengthen. For example, raised hamstring stretches, tricep stretch behind the head, etc. Excellent as part of post-workout recovery cycle.
  - Ballistic stretching – lengthening muscle fibers by bouncing during the stretch. For example, stretch the calf on a riser and bouncing during the hold. Good pre-workout stretch as it helps to lengthen the fibers without causing too much stress on the tendons. More advanced than static.
  - Dynamic stretching – encouraging muscle fibers to go to lengthen through movement. For example, hip or pendulum swings, scorpions, etc. Best used as a pre-workout to increase ROM for the

current workout, as well as to limber up joints and decrease chance of cramps, etc.

### **Frequency (days / week)**

Frequency can range from 1 day/week up to 7 days/week, and may even include more than one work each day for advanced athletes and bodybuilding programs. Improvements can be made with a 1-2 day/week program, however, trainers should strongly encourage their clients to workout 3+ days/week even if they are not working out with the trainer one-on-one.

### **Intensity (weight or load)**

Intensity is determined by the goal. Strength gain is optimal at 85%+ 1-RM. Hypertrophy is optimal at 65%-85% 1-RM. Muscular Endurance is optimal at higher rep ranges using 45-65% 1-RM.

1-RM % Chart with rep-ranges and goals

REPS	%	BENEFIT	
1	100	Strength	Muscular/ Functional Hypertrophy
2	95		
3	93		
4	90		
5	87		
6	85	Strength/ Endurance	Energy Hypertrophy (increase in VO2 max, cardiac output)
7	83		
8	80		
9	77		
10	75		
11	70		
12	67	Endurance	
15	50		
20	60		
30	50		
50	40		
100	30		

**Order (which exercise is performed 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, etc)**

Compound exercises, power exercises, and exercises that are most important for achieving the primary goal of the program should be performed first. Isolation exercises and assistance exercises should be performed later in the workouts. When a client begins a workout, they have plenty of energy and are not fatigued; therefore, they can perform exercises during the beginning of the workout with more intensity and focus. This leads to better results for the movement patterns that are used in the beginning of the workout. Explosive power movements require more neuromuscular control and should be performed early in a workout. Performing power movements while the nervous and muscular systems are fatigued is not productive and can be very dangerous.

### **Sets (sets / exercise)**

A set is a group of repetitions performed without rest. Beginners may see hypertrophy, strength, and endurance improvements with as little as one set. Intermediate and advanced clients will require two or more sets to continue making progress. Sets are one of the first variables that can be increased throughout the program progression.

### **Reps (reps / set)**

Rep ranges ultimately are restricted by the load being used. Optimal Strength gain rep ranges are 1-6 reps/set. Optimal Hypertrophy rep ranges are 6-12 reps/set. Optimal Muscular Endurance rep ranges are 12-25 reps/set. For single-effort power lift performance, 1-2 reps/set should be used during training. For multi-effort power lift performance, 3-5 reps/set should be used during training.

### **Volume (reps x sets x weight)**

Volume is a great measure of overall progress of a program. For overall strength, hypertrophy, and endurance to continue improving, volume must continue to increase. Certain weeks of a program may include a de-loading phase where volume is decreased to allow muscle recovery from previous weeks.

### **Rest (time between sets)**

Shortening rest times will increase the difficulty level of any workout. Decreasing rest is a great way to work cardio during a resistance training session. Short rest times maintain an elevated heart rate throughout the workout. However, certain results may be diminished by decreasing rest times. For example, power lifters must perform one repetition for maximal strength

tests during competition. Power lifters may rest for 5-10 minutes between sets to allow maximal force production during the subsequent set. Decreasing rest times would simply decrease the amount of weight the power lifter is capable of lifting thus hindering progress towards his or her goal of increasing strength.

### **Tempo (concentric & eccentric time/rep)**

Concentric actions should be fast to recruit the largest Type-IIb motor units. All motor units are not required to fire during any sub-maximal effort, however, if you try to lift the weight as fast as possible, the body recruits the larger motor units to allow the weight to be moved faster than the smaller motor units are capable of moving it. For hypertrophy, eccentric action should be slow (2+ seconds). For strength, eccentric action should be moderate (1-2 seconds). For endurance, eccentric action should be moderate (1-2 seconds).

### **Progression Methods**

Progression is simply increasing or decreasing the previous variables we've covered. Progression is simple, but complicated. What should be increased first? How long do I wait before increasing a program variable?

A very conservative method is the 2-for-2 rule which states that when a client can perform 2 additional reps over the assigned amount for each set for 2 consecutive workouts, the personal trainer should increase the weight for the next workout.

Most personal trainers prefer a more aggressive approach that will produce faster progress, and does not increase risk for the large majority of clients. This method involves increasing the sets, reps, or weight each week if a client is able to complete all sets and reps for a given exercise. If a client fails to complete all sets and reps without the assistance of the trainer, the same sets, reps, and weight will be used for the following week (or workout).

### **Resistance Training Program Design Summary and Final Thoughts**

Workouts should be based off of clients' 1RM (one rep max) when designing weight training programs. This is a far more effective way of training clients and will also help ensure you never injure your client and therefore business. When compiling a workout, follow the FITT principle and always keep your client's ability as well as goals in mind. SMART goals, always, to help encourage client compliance and success. Few workouts are purely one or the other type of training style, however it is important to vary your training to encourage muscle

confusion and progress in your client's' goals. The following are a few guidelines for types of training. Periodization is a highly effective way of training. This involves 'cycling' through the various phases/styles of workouts so that the body is constantly being challenged. Bodybuilders and other special client populations will require tailored programming. Strength gain is optimized by using short rep range, high intensity (% weight load of 1-RM). Need a longer rest cycle between sets in order to get full muscle involvement for each set. Rest times can be between 10 seconds – 5 minutes. Sprinting is in this category (HIIT training, short track sprints of 30 to 400m at full speed, etc).

- Hypertrophy – medium rep range, depending on type of hypertrophy desired. More mass requires more volume of training. Multiple sets are highly effective. Mid-range intensity. Rest periods are about 1.5-2.5 minutes long.
- Endurance – high number of repetitions, lower weight load. Hypertrophy occurs in the cardiopulmonary system. Results in increased stamina and decreased heart rate. Rest periods are as needed and short.
- Rehabilitation – only if you are qualified. Clients will injure themselves during the course of life and training. Oftentimes, the trainer needs to overcome knee, shoulder, back, neck, ankle, and hand injuries. It is important to learn how to compensate exercises to accommodate these new risks and problems, and even rehabilitate the problem.
  - Different problems require different approaches, but generally rehab work does not involve high intensity weights. Rather, it is more focused on sustained motion and flexion, high number of reps, and flexibility.
  - Refer out! If in doubt, make friends with a certified physiotherapist, massage therapist, chiropractor, etc. Ultimately it is your reputation and you do not want to make an injury worse or appear incompetent. As your knowledge base grows, you will get referrals from your professional networking and impress your clients.

# Chapter 12 – Endurance Training Program Design

## Endurance Training Components

- Muscular endurance is a muscle's ability to repeatedly exert force over a period of time.
- Most endurance training is undertaken to increase VO<sub>2</sub>max and length of muscular performance. For example, endurance training is used in sports such as hockey and soccer, as well as for long-distance runners and swimmers.
- It is important to cycle out of this phase as well. Transitioning between strength and endurance as well as endurance to plyometric is vital to maintain peak performance. In sum, a client cannot only do cardio or only use a certain rep-range indefinitely. Oftentimes overuse injuries are made this way and the client plateaus – no positive physical changes or gains are seen and there can be a loss in performance values.

## Mode

- Endurance training uses a lot of the same types of exercises as a strength or hypertrophy program would. The main difference is in the number of reps and speed of contraction.
- A good endurance program melds both cardiovascular and resistance training principles to achieve maximal effect. The longer the muscles are working, the more effect the training will have on this particular type of exercise.
  - You will inevitably have cross-over in your program design. However, to stick to the program, you should avoid power movements like long-jump or strength movements like high-weighted bench press.

## Intensity



Mid-range intensity of about 30-85% of 1RM. The higher you get in the range, the closer you get to a strength training program. You will choose the level of intensity appropriate to your client's goals and needs.

- Rep ranges should be between 7-100 reps. This is a large range and the higher end of the range should be for the larger muscle groups (think squats or jumping jacks). The lower range of reps are useful for things like pushups for a beginner who won't be able to do a lot at once.
- For cardio, the % of intensity will refer to their heart rate or perceived exertion. You must teach the client how to monitor their heart rate during exercise.
- Beginner clients
  - For the basic beginner client, intensity should remain low and constant, about 30-55% 1RM.
- Intermediate clients
  - Will work at about 55-70% of 1RM. They are more familiar with the workout range and will be able to sustain a higher intensity for longer.
- Advanced clients
  - Will work at between 70-85% of 1RM. Their tolerance for intensity during endurance exercises will be very high and you will be able to challenge them with the most advanced exercises.

## **Duration**

The length of an endurance workout is dependent on what your client is training for. Generically, an hour is a good average. It allows for complete exhaustion at the proper intensities. However, sometimes shorter durations of intense cardiovascular activity has shown to increase VO2max quickly and effectively because the pulmonary system increases in muscle mass; therefore, this is a strength training component which can also help in cardiovascular efficacy.

- Beginner exercisers should workout only until fatigue is reached, which often happens at 30 minutes.
- Intermediate exercisers are capable of a solid 45 minutes of work. Their conditioning will be good enough to allow training challenges such as more complicated movement patterns.
- Advanced exercisers find an hour to be fairly easy. At this level, introducing more complex workout variations such as HIIT training cycles as well as weight training and resistance challenges to current endurance activities.

- This type of client might choose to do their sustained cardio on their own and use you, as their trainer, solely for their weight component.
- These clients often include recreational athletes, so keep in mind that they are probably used to working hard on a regular basis. E.g., an individual who plays soccer 2-3x per week already.

## **Frequency**

During an endurance program, proper rest is required for complete ATP recovery and lactic acid removal. In order to have the highest recruitment possible for the longest possible time, try to give the client 24-48 hours between intensive endurance training. Once clients are accustomed to working out, they will be able to do some form of endurance training every day; however, this training will not be for gains, but for pleasure, maintenance, or fat loss. To see performance gains, there must be rest and recovery.

- The frequency which your clients workout at is dependent on their goals. A client who wishes fat loss should train more regularly but at a lower intensity of cardio than a client who wishes to run a half marathon.
- A client who is looking to increase their performance time in the gym should focus more on steady weights to increase the muscle's potential for lifting. Again, giving enough rest is important. If a client can tolerate it, then with split training he or she would be able to workout every day.

## **Progression**

When mapping out a client's goals, a major component of a trainer's job is ensuring that the client can achieve those goals in a timely fashion. Giving a client markers to go by is integral for their motivation and compliance. For example, asking a client to go from learning to run in week one and then prescribing that they run 5k 3x/week in week 3 is unrealistic.

- Each client will be unique; however, it is realistic to expect that most beginner clients can run 5k in about 6 weeks. Therefore, the trainer must be able to break down each week of training in segments of both time and distance until the client is running a continuous 5k. There are many different styles to approaching this situation, but a basic example would be:
  - Week 1 – 3minutes walking, 1 minutes light jog, for the duration of 5 km. 3x/week. Repeat until 5k is reached.
  - Week 2 – 2minutes of walking, 1.5 minutes light jog, 3x/week.
  - Week 3 – 1.5 minutes of walking, 2 minutes of light jog, 3x/week.

- Week 4 – 30s-1 minute of walking, between periods of jogging, 3x/week.
- Week 5 – 15-30s of rest between jogging cycles. 3x/week.
- Week 6 – each session will be a forced jog of 5kms until success. Hopefully client will achieve success on the first run, but if not, run til exhaustion and then only allow rest for 15 seconds before continuing.
- Note: some clients may require a lengthier program, this is for you to figure out via fitness assessments prior to taking them on and designing a program.
- Gym progressions are in a similar vein to cardiovascular progressions. Getting a client to squat 100 times or 100 pushups requires practice and patience. It will also take longer than a running program for most clients.
  - For example: training for squats is a multi-layered problem. Ensure you have done a proper assessment so you have learned of any potential problems such as tight hips or weak glutes.
  - With functional movements, we progress from unweighted to weighted and often use the assistance of machines or other isotonic movement patterns to cross-train our muscles to assist in the full movement pattern (training hamstrings, glutes, and quads for a full body squat, for example).
  - Weighted compound movements, the progression rate is dependent on how many times you can move a weight load. If the goal is to squat 85lbs 50 times, it is good to break it down in weight and reps. For example, in a one version of a 6 week progression (not focusing on the whole program):
    - Week 1 – 40 lbs squat, 20x, 3 sets.
    - Week 2 – 50 lbs squat, 15x, 4 sets.
    - Week 3 – 60lbs squat, 15x, 3 sets with a 40 lbs set til fatigue.
    - Week 4 – 75 lbs squat 20x, 4 sets (good time to test how many squats can be done at 75 lbs before fatigue sets in; allows time for adjustment).
    - Week 5 – 80 lbs squat, 20x, 3 sets, with a 60lbs set til fatigue.
    - Week 6 – 85 lbs squat til fatigue. By end of week, should be able to complete 50 reps.

### **Types of Endurance Training: LSD, Tempo, Interval, Cross-Training**

#### **LSD – Long Slow Distance Training**

- Long slow distance training is a form of continuous training where you keep a constant pace of low-moderate intensity over an extended distance or duration. This approach is used in running and cycling. This will improve cardiovascular function, increased oxidative capacity of skeletal muscle tissue, improves mitochondria energy output, increases body heat regulation efficiency, and burns fat as fuel.
  - This is most effective in beginner and intermediate exercisers as a way of adaptation to exercises and progression towards more advanced modalities of training.
  - Doesn't work with weight training.

## Tempo

- Tempo training involves timing your eccentric, isometric, and concentric lift times. For example, you may choose a 2-1-4 tempo which means you are releasing the load over 2 seconds, holding it for 1, and lifting over 4 seconds. The time spent doing a lift is referred to as "Time under Tension."
- Varying your tempo training will provide continuing challenges to your muscles over the weeks without having to augment your current exercises. For example, changing the lift speed with which you approach a deadlift will change how difficult it is. Beginning with a shorter time under tension will be better for a beginner exerciser.
  - Since muscle fibres are 30% stronger on the eccentric load, it is often helpful to make your eccentric phase longer as a primary challenge before putting too much stress on an undertrained joint by prolonging the concentric or isometric (hold) phase.

## Interval

- As with tempo training, this has to do with timing. In this case, interval training for both cardio and weights is highly useful for quick increases in both load and efficiency. With Interval training, you will decide if you're going to do short bursts between longer cardio training sessions or quick, free weight movements of a similar training style as the main weighted exercise.
- An example of interval training is HIIT training – high intensity interval training. This is where a client will work at a high intensity for 30s-1min and then cycle down to a lower intensity for 3-5mins. This is a quick way of increasing VO2max and endurance.

## **Cross-Training**

- Excellent approach to increasing muscular capacity. Cross-training involves using different modalities to train the same muscle groups so that the muscle remains balanced, flexible, and strong.
- An example of cross-training is using squats, deadlifts, and sprints to train the glutes. Or doing sprints and stairs to increase jogging distance.
- Cross-training is used very successfully in sports as well. Hockey players will play golf in the summer to ease off the stress of the joints and muscles (thereby decreasing the chance of injury) while still utilizing some similar muscle tissue and keeping the player active.
- Combining quick movements and held movements is a highly effective way of doing cross-training.

## **Chapter 13 – Speed, Agility, and Plyometric Training**

### **Speed, Agility, Balance, Coordination and Plyometrics Defined**

Plyometrics is a three-part process: the first is a rapid lengthening of the muscle (eccentric). The second involves a short rest period (amortization). The third is when the individual finally engages in an explosive movement (concentric). For example: vertical jump. Client squats (eccentric in quads), brief pause at bottom (amortization), and then explosively jumps straight up (concentric). The goal of plyometrics is, essentially, to decrease the amount of time of the amortization phase.

This approach to training is often used as a primary mode for athletes and as an advanced phase for regular clients. The stability, awareness, and adaptivity requirements of this phase are not suitable for beginner clients.

Speed is defined as rate at which a body is capable of movement. For the purpose of this training, speed is intended to be fast, usually as fast as possible while maintaining control.

Agility is the ability to move quickly, repeatedly, with control. For example, quick-pivoting turns.

Balance is the body's ability to maintain stability. In context with this phase of training, it is when a person can stop quickly without falling over or tripping; maintain balance and coordination in various off-centre positions, such as standing on one foot or leaning/reaching; also it is the ability to hold on to or carry objects while in motion as well as in a stable stance.

Coordination is moving all disparate parts of the body together with smoothness and control. This is usually done for a purpose such as catching a ball or skating while handling a puck. However, coordination is important for things like yoga and pilates as well.

Plyometrics are exercises which involve maximum force in as short amount of time as possible. The goal of these exercises is to increase both speed and power. By nature, these exercises are explosive in nature, including moves like box jumps, sprints, and hurdles.

### **Stretch Reflex**

Stretch reflex is the reflexive contraction of a muscle when the attached tendon is pulled. When a muscle gets to its full length and therefore has stretching within itself, there is a monosynaptic reflex which regulates the skeletal muscle length. The body maintains its upright posture this way. This is involved in every aspect of movement. As a muscle lengthens, the muscle spindle gets stretched, therefore increasing nerve activity. When alpha motor neurons are engaged, the muscle fibers contract and resist the stretch. The opposing muscles then relax as a second set of neurons fire to maintain structural integrity. For example, when hamstrings are in flexion (during walking), the quads are relatively relaxed; until you reach the maximal length of hamstring flexion, where the quadriceps will take over and the hamstrings relax. It is important for maintaining constant muscle length. Short recovery time; may seem instantaneous until exhausted, where our 'reflexes' become tired and slow and we don't react as quickly. When exhausted, can increase chance of injury as muscles don't fire as quickly and stabilizers may not engage when needed. For example, this could lead to an athlete missing a crucial pivot while maintaining ball and foot control during a soccer game.

### **When should Plyometrics be used?**

Plyometrics are required by athletes of all levels. From the recreational to competitive player, plyometrics will improve athletic performance and increase ability.

For recreational players, this will not only help their basic comprehension of their sport but will also decrease their chance for injury by increasing their muscle control.

For competitive athletes, this is a regular part of their training. It is necessary for these athletes to gain any edge possible via training their explosive and power movements. Shaving off a tenth of a second in a 200m dash is the difference between a win and a loss.

Plyometrics can also be added in gradually to allow a client to adjust to the stress on the body that comes with a fully explosive program. They pair nicely with a strength training program and elements can be added into an endurance program as well.

### **Safety considerations for plyometrics**

If a client has any chronic injuries or limitations, it is vital to be aware of this prior to training. Before commencing a plyometric-based program, be sure to do a full assessment on your client's' range of motion, muscle balance, and a base-line fitness test. Your base-line test should include a basic agility test, speed, coordination, power/jump tests, etc. It will be what you base your programming off of, so it pays to be thorough.

Any bone or joint problems need to be seriously considered before engaging in plyometrics.

Chronic injuries are not new, they are ongoing, and if they haven't been treatable before you commence this stage of training, you need to work with and around them. For example, a client with a slipped disc in their back is going to be treated differently than a client who tore their ACL when they were 16. Both clients can still do plyos.

Acute injuries – hopefully the client hasn't injured themselves before their training commences or during it, but if so, make sure to work around this injury by downgrading the intensity. For example, a sprained ankle might require a few days of rest before getting back into training. At that point, it is best to

commence with stability and balance training since ankle flexion and stability will be very low and there is a high risk of reinjury.

Ability – some people are not as neuromuscularly connected as others. These clients are difficult to train on plyos because their movement patterns will be clunky and slow to develop. Know your client. If you are starting with a client who is a bit clumsy in their movements, do not start him or her with aggressive foot patterns such as tight pylon racing or grapevine ladders. Start, instead, with a simple straight line grape vine or widely spaced pylons.

Another consideration is VO2max. If their cardiovascular system isn't primed enough for this exercise program, you will need to either incorporate more breaks or switch up some of the exercise orders.

Equipment – everything you use as a trainer in a plyometric program needs to be 100% in good working order. Nothing can be broken or weakened in structure because a client can and will hurt themselves.

Space – you can do plyos with almost no space at all, if you plan correctly. However, if you're looking to do certain drills, you may need to look into a local gymnasium or an outdoor forum like a track or field. Sometimes it is nice to switch the venue to teach the client different exercise options, as well.

### **Plyometric Program Variables and Progression: Intensity, Frequency, Volume**

Planning a plyometric program requires careful consideration of your client's abilities and limitations. Most clients will need to start from the ground up, moving from stability movements all the way to dynamic challenges.

Movement patterns mimic sport. Transform movements of the sport into exercise patterns. Break down the actions into their basic movement patterns. Some will be better for weight lifting and others will be perfectly suited for a progressive plyometric program.

Intensity – plyometric training is done at a high intensity: 75-90% of effort.

During training, it is important not to sacrifice integrity for effort. If your client plays sports, their maximal output should be during the sport or competition.



Training must be done at a high enough level to challenge the body and its reactions. During the workout, the client should be tasked with maximal exertion several times. For example: highest box jump, fastest time, most number of repetitions, etc.

Frequency – clients can do this workout on the same premise as a regular strength building regime. 3-4 days per week is ideal for seeing maximum gains.

This programming can also be supplemental to a strength or endurance program where you do 1 or 2 times per week of plyo in order to improve maximal load or exertion for the other days of regular training.

Volume – the number of repetitions done within the training session. So, for box jumps, it's not how high, but how many. The volume you choose for your client will be based on what you specifically want to accomplish. For example, a client might do 20x 1ft box jumps during a 6-cycle circuit OR 10x 3ft box jumps during the same cycle. The more reps the client does, the more effective the movement pattern becomes; however, there is a plateauing effect after too much of the same, so make sure to challenge your client by varying their training.

### **Speed and Agility Training**

A fairly complex mode of training, speed and agility can be done in a large variety of ways. First, these two concepts can be trained by themselves or in conjunction with each other. Secondly, there are many crossovers between the two and cross-training them can improve results in both faculties, but overtraining them can cause overuse injuries.

#### **Speed**

To train speed, you can utilize sprints, jumps, and resistance equipment will increase the body's ability to explode powerfully and maintain high rates of momentum.

#### **Acceleration**

Slightly different than maintaining a high rate of momentum during a couple-hundred meter sprint, acceleration needs to be trained for that initial burst. Faster acceleration is key in agility and short-distance sprints.

#### **Agility**

To train this side of plyometrics, using ladders, pylons, jumping motions, etc are useful. The faster a client can move their feet with proper coordination, the better the results he or she will have in their sport. Agility is highly important in avoiding injury, as well. The more agile a person is, the better able they are to avoid obstacles and missteps in other modes of training and sport.

### **Balance and Coordination Activities**

Balance and coordination training is important for not just athletes and the average client, but also in rehabilitation. It is very difficult to have any true success with higher-level training if your client doesn't have good balance and coordination. If a client is easily thrown off balance, jump work and quick turns can cause injury; if a client isn't in control of their own two feet, then running quick ladders will be impossible

#### **Balance**

To train balance, in a beginner client it is important to start with standing exercises before progressing to one-legged stances, incorporating balls, bosus, or balance discs. Intermediate to advanced clients can incorporate all of those elements and add in coordination challenges or challenge the client with moving an object through space. For example, one legged squats while doing figure 8s with a ball challenges both balance and coordination, but will increase your balance more by engaging your proprioceptors subconsciously.

#### **Coordination**

Coordination can be developed in a variety of ways, from something as simple as a ball toss for hand-eye coordination to ladder challenges for foot-eye coordination. Beginner clients should focus on a stable base before they start their coordination activity. For example, they can perform a ball-toss before racquet sports. Intermediate and advanced clients are able to do sports-based activities that have been modified for the gym. While variety is key to continually challenge a client, if you have an athlete for a client, you will have to specialize in the skills directly related to their sport. A tennis player will need to focus on foot drills and power lunges alongside rotational speed through the trunk and shoulders. This is a complicated movement pattern that requires a high-level of coordination, but it will improve their game-play.

## Chapter 14 – Personal Training & Exercise Technique

### Know Your Clients

- FITT principles need to be modified for each group of client. Frequency, Intensity, Time and Type.
- Beginner – client who has never been to the gym before, generally deconditioned and with limited coordination and tendon strength.
  - Fragile eggs are under this category: people who are scared of gyms and other organized forms of exercise.
- Intermediate – some previous workout experience either via occasional usage of a gym or some regular participation in a sport or activity (soccer, running, tennis, etc). This client is familiar with increasing their heart rate and other physiological responses to exercise.
- Advanced – clients who are both familiar with and comfortable in a gym. They have likely been working out consistently for a long time and will be

more knowledgeable of the exercises expected of them in the gym. Good coordination and understanding of basic movement patterns.

## Heart Rate

- $((\text{Max HR} - \text{Resting HR}) \times \%X / 100) + \text{Resting HR}$ . Max HR is  $220 - \text{age}$ .
  - Eg. 20 year old client who should be training at 85% intensity and has a RHR of 78
  - $((200 - 78) \times 85\%) + 78 = 181.7$ . This client should reach a Training Heart Rate of 181.7 for 85% exertion.
- The best way to check HR is using a heart rate monitor with a chest strap. Other methods include using a stethoscope or index and middle fingers on the carotid artery (neck). The wrist is another location to check heart rate, however, it is not as easy to test compared to other methods.
- Heart rate training zones are particularly useful for beginner clients who do not understand what an 'intense' workout should feel like and for those fragile eggs who are concerned they are going to injure themselves if they workout too hard. For advanced exercisers, Target Heart Rate zones are crucial tools for beating personal bests and achieving peak performance.
  - A different, though less accurate, way of measuring exertion is through the Rate of Perceived Exertion scale. The RPE Scale goes from 6-20 (each number corresponds, roughly, with 10 beats) where 6 is not working out, 13 is somewhat hard and 20 is what the client considers maximal exertion.

## Chapter 15 – Younger, Older, and Pregnant Clients

### Senior Adults

Special considerations need to be made for elderly clients. They are more fragile, due to bone density and muscle mass decreases, and they don't recover from exercise quickly. They have decreased coordination, balance, and a lack of hormone production.

- Swimming, bodyweight exercises and then using resistance bands, balance work, pilates are important for a safe workout environment, ease of joint stress, and to slow the effects of aging.
- Eg, proprioceptor training exercises such as standing on one foot or moving a small ball against a wall in circles with a hand. Progressing to eyes closed or with a balance challenge such as a pilates disc incorporated.
- Caution: elderly clients will lose their balance and a fall could be disastrous. It is crucial that you are constantly aware of what your client is doing and how they're feeling, especially if there is a pre-existing medical condition.

### Children

When training children, keep in mind that their bodies are not yet fully formed, therefore, special considerations are required. There are many hormones and skeletal changes, and their skin and muscles are just trying to keep up. With that in mind, when designing a program for them, extreme heavy lifting should

be avoided. However, bodyweight training exercises and functional training have excellent results.

- ➡ With the obesity rates at an all-time high among children, focusing a child's training on movement, coordination and balance exercises will yield tremendous results. Training needs to be fun for long term success.
- ➡ There is a concern over tendon and ligament damage at high-intensity training. This mostly occurs in sports (Osgood-schlatter, for example, or patellofemoral pain syndrome) or in extremely heavy lifting. A good trainer and a safe cross-training program can help alleviate these concerns by balancing the body as it develops and encouraging proper rest and flexibility training to offset any overtraining for sports.

## Chapter 16 – Special Nutritional and Metabolic Needs

As a personal trainer, you'll likely work with clients with special nutritional and metabolic needs. Being educated on these conditions will help you assist your clients in reaching their goals. The following are conditions that you'll likely come across and need to address.

### **Overweight / Obesity**

Body composition and weight control are of concern to many people undertaking fitness programs. The prevalence of people who are overweight or obese has increased dramatically in recent years, and you have a unique chance to help clients lose weight or maintain a healthy weight.

An adult with a BMI (body mass index) of 25 to 29.9 is considered overweight, while an adult with a body mass index of 30 or more is considered obese. Remember, though, that BMI only compares height to weight and isn't always a good judge of health status. A very muscular athlete may have a higher BMI due to increased muscle mass, which weighs more than fat. Although they weigh more, they should not be considered unhealthy.

A client who is overweight or obese may ask for help losing weight. The best way to help a client lose weight is through a moderate daily restriction in the amount of calories they consume, along with additional daily physical activity. This will

help them change their energy balance, so they will burn slightly more calories than they lose each day.

This approach helps them maintain muscle while losing fat. Maintaining muscle is important, as muscle burns more calories than fat, so maintaining or increasing muscle ensures that the client's metabolism won't slow down. This approach, with only a moderate restriction in calories, also works by making sure the client still takes in enough calories to maintain their physical activity.

Keeping a food log can help your client lose weight. Encourage them to write down everything they eat for three days. This is a good amount of time to get a snapshot of eating patterns, but doesn't become too tedious. Recording on at least one weekday and one weekend day is a good idea, as eating patterns may vary. The food log helps clients become more aware of what they consume each day, rather than just guessing at how much they're eating. This is a good first step to lowering caloric intake and losing weight.

Besides helping clients to lose weight, there are additional considerations to think about when designing training programs for obese or overweight clients. You'll want to design training plans that help overweight or obese clients burn as many calories as possible during each session. Include whole body aerobic exercise, like walking, dancing, swimming, or cycling. The intensity of these activities may need to be kept low at first, as the client may have poor fitness.

Some clients may have problems with back, knee, or ankle pain during physical activities due to the load placed on their joints by excess weight. If this is an issue, you may need to substitute non-weight bearing activities, like swimming or cycling. Also, keep in mind that overweight or obese clients may feel uncomfortable wearing swimsuits or shorts, so they may be reluctant to do these activities. Initially, choose activities that they are comfortable with.

It can be very difficult for overweight or obese clients to actually start a physical activity program. Once they're started being active, make sure to give them lots of positive feedback and encouragement. You want them to enjoy being active and make it a lifelong habit.

### **Anorexia / Bulimia**

While working as a personal trainer, you may come across clients with eating disorders. Eating disorders are very common, affecting about eight million

Americans. Most people with eating disorders are women – only about 10% are men. The two most common eating disorders are anorexia (anorexia nervosa) and bulimia (bulimia nervosa).

Anorexia is characterized by an intense fear of gaining weight and becoming fat. People with anorexia refuse to eat enough food to maintain a normal body weight. Their body weight becomes below normal, but they still see themselves as fat because of a distorted body image. Anorexia is very dangerous – there are many medical consequences, including neuroendocrine and cardiovascular problems, digestive issues, changes in the skin and hair, and even death.

Bulimia is characterized by episodes of bingeing and purging. During a bingeing episode, a bulimic will eat large amounts of calorie-dense foods. They will then purge by vomiting, taking laxatives, compulsively exercising, or fasting. Bulimia is actually much more common than anorexia, and it's not physically obvious if someone is bulimic. They may be underweight, normal weight, or overweight. Bulimia also has serious physical consequences, including problems with the neuroendocrine system, cardiovascular system, and digestive system. Besides anorexia and bulimia, eating disorders can also be classified as "eating disorder not otherwise specified." This classification includes different types of disordered eating behaviors.

Eating disorders are especially common among athletes. The same traits that help people excel in athletics, including perfectionism, competitiveness, drive, and motivation, are also personality traits that can drive people to eating disorders. This is especially a problem in sports where there is a drive for athletes to be thinner, like running and gymnastics.

It's very difficult to help someone with an eating disorder, as they may be in denial that they have a disorder and will most likely refuse help. The best approach you can take as a personal trainer is to be able to identify warning signs of eating disorders. Warning signs of anorexia include a preoccupation with being too fat (despite being at a normal or low body weight), frequent comments about body weight or shape, losing a significant amount of weight, recurring stress fractures, a compulsive need for vigorous exercise beyond training needs, and wearing baggy clothes to disguise thinness.

Warning signs of bulimia that you may notice include a preoccupation with being too fat, large gains and losses in body weight, and mood changes. Other



signs of bulimia all deal with eating behaviors that you may not be able to observe. If you see warning signs and become concerned about a client you're working with, you may be able to refer them to a sports medicine professional or a therapist. Eating disorders are complex physical and mental issues, and they need to be dealt with by professionals. Your role can be to support and encourage your client and be patient with them – resolving an eating disorder will take time.

## **Diabetes**

You may also end up working with clients who are diabetic. These clients will have specific precautions and strategies to follow when they undertake an exercise program.

Type I diabetes is an autoimmune disease in which the body destroys its own beta cells, which produce insulin in the pancreas. The body does not produce insulin, which is necessary for the transport and uptake of glucose. Type I diabetes needs to be managed through injections of exogenous insulin. Type I diabetes is usually diagnosed during childhood.

Type II diabetes is non insulin-dependent. People with type II diabetes do produce insulin, but their bodies cannot use it well. Type II diabetes is also called adult diabetes, as it is rare in children. However, it does occur in children, and the prevalence has increased recently along with the prevalence of childhood obesity, as the two conditions are usually associated.

Exercise has a direct effect on insulin, making it difficult to regulate blood glucose during exercise. Exercise suppresses insulin production and has the same effect on the body as insulin. Diabetics can include exercise as part of their insulin dose and decrease the amount of exogenous insulin given.

When diabetics participate in high intensity exercise, they may need a larger dose of insulin or consumption of carbohydrates during exercise. This is because carbohydrate is relied on at higher rates in high intensity exercise than in low to moderate intensity exercise. Diabetics also may need a larger dose of insulin or consumption of carbohydrates during exercise when participating in long endurance activities because of the potential for hypoglycemia.

But with good blood glucose monitoring, people with diabetes can participate in exercise and reach the same level of success as those without diabetes. As a personal trainer, be aware of clients with diabetes. Help watch for the warning

signs of hypoglycemia, like shakiness, dizziness, and sweating. If clients exhibit these signs, ask if they need to take a break or stop and eat a snack containing glucose.

### **Metabolic Syndrome**

Metabolic syndrome (also called insulin resistance syndrome) is a group of factors that put people at higher risk for cardiovascular disease and type II diabetes. These factors include insulin resistance, hypertension, abnormal blood lipids (high triglycerides, high LDL cholesterol, and low HDL cholesterol), and abdominal obesity. If three of these factors are found through tests, the diagnosis of metabolic syndrome is made.

Since the factors in metabolic syndrome are directly related to physical inactivity, exercise programs can help prevent the syndrome from developing or progressing. Losing weight can greatly help reduce metabolic syndrome factors. When working with a client with metabolic syndrome, start gradually if they are new to exercising. Work up to including lots of moderate to vigorous activity to help combat their risk factors and aid weight loss. Interval training can help as well when the client is ready for it.

## Chapter 17 – Cardiovascular and Respiratory Conditions

You may also work with clients who have or have had cardiovascular or respiratory conditions. Clients with these conditions will need special considerations to be able to exercise safely.

### **Asthma**

Asthma is a respiratory condition characterized by airway obstruction and inflammation caused by a variety of triggers. Triggers include allergens, irritants, infections, and exercise. Asthma causes wheezing, coughing, and shortness of breath.

There are three major types of asthma: exercise-induced, mild, and moderate / severe. The type of asthma and the severity of it determine how much exercise someone with asthma can do, as asthma can limit exercise and also be exacerbated by it. Work with your client to determine realistic goals for their exercise program. The following are recommendations for exercise programs.

Clients with exercise-induced asthma or mild asthma can work towards improving their fitness in the same way that non-asthmatics would. Have the client start out with easier exercise for the first six weeks, and make sure they learn to self-monitor their intensity.

Clients with moderate to severe asthma can work towards improving their exercise tolerance, but may not be able to actually achieve gains in their fitness. Have them start with low to moderate intensity exercise. If their asthma is well controlled, they can incorporate more high-intensity exercise.

For clients with very severe asthma, working towards musculoskeletal conditioning is the safest approach. Use circuit training exercises with low resistance and high repetitions.

Encourage your client to monitor their intensity when exercising. Using the Borg scale can be helpful, as it allows them to determine if difficulty breathing is due to intense exercise or is caused by asthma. Also, clients with asthma will likely have an inhaler they use before exercise and during asthmatic episodes. Make sure they have easy access to their inhaler during exercise.

### **Ischemia**

Insufficient blood flow and oxygen supply in the heart is called ischemia. There are two types of ischemia: silent and symptomatic. Silent ischemia occurs in some patients with coronary artery disease. Since they don't experience pain, their ischemia has to be detected by laboratory tests.

The main symptom of symptomatic ischemia is angina. Angina is chest pain caused by low oxygen supply to the heart. It can feel like heaviness or constriction in the chest, and the pain can also radiate into the jaw, neck, shoulders, or arms. Angina can be considered stable or unstable. Unstable angina occurs unpredictably, and means that there is intermittent blockage of an artery. This may soon become permanent and cause a myocardial infarction (heart attack). Unstable angina needs to be treated immediately.

Exercise is usually beneficial for people with ischemia who have stable angina. Exercise helps with ischemia by increasing the supply of oxygen and reducing the amount of oxygen the heart needs. It also helps by stopping the growth of atherosclerotic plaques in the arteries. The goal of an exercise program for clients with ischemia should be to allow them to complete activities of daily living with less angina.

There are special precautions that need to be taken for those with ischemia. Since they have a limited supply of oxygen to the heart, their cardiac output will be lower and they will fatigue faster. Make sure to include a long warm up and cool down that include stretches and low-intensity exercise. During exercise, clients with ischemia will have an upper heart rate limit that they need to stay under. Have them complete short intervals of exercise with lots of rest between. This is safest for the heart and helps the client avoid additional episodes of ischemia. Exercise can bring on angina, so clients will need to stop exercising if they experience chest pain.

### **Chronic Obstructive Pulmonary Disease**

Chronic obstructive pulmonary disease, or COPD, is an ongoing blockage of airflow and breathing difficulty. Emphysema, chronic bronchitis, and even asthma can be considered types of COPD. COPD damages the lungs and cannot be fully reversed.

COPD causes many different issues in the body: ventilatory, gas exchange, cardiovascular and muscular impairments; limitations due to dyspnea (breathlessness); and psychological disturbances like depression or anxiety. Exercise can help with many of these issues. Ventilatory efficiency, cardiovascular conditioning, and strength can all be improved.

The ability to exercise is usually limited in clients with COPD. Exercise may be limited by ventilatory capacity, making breathing during exercise more rapid than normal. It can also be limited by cardiovascular factors, like deconditioned muscles and reduced blood flow, or by symptoms like dyspnea.

When working with a client with COPD, be aware that they may also be working with respiratory therapists, physical therapists, and occupational therapists, so you may be able to coordinate with these professionals. The client may also need to be on oxygen while exercising. This can help them exercise more effectively.

The exercise program for a client with COPD should include cardiovascular exercise like swimming, walking or biking. Short intervals with moderate rest between are a good way to start out. The length of the intervals can be increased and the rest between can be decreased as the client becomes more conditioned. Including coordination and balance exercises can also be helpful to improve the client's activities of daily living.

## **Hypertension**

Hypertension, or high blood pressure, is a common health problem. It often leads to other types of cardiovascular disease, including coronary artery disease and strokes. Optimal blood pressure is 120/80 and normal blood pressure is 130/85. Blood pressure above 130/85 is considered to be hypertension.

The goal of exercise training for those with hypertension should be to lower blood pressure to below 140/90. The most beneficial exercise for clients with high blood pressure is endurance training, which has been shown to lower blood pressure (both systolic and diastolic) about 10 mmHg. Cardiovascular exercise at

a low intensity for 30 - 60 minutes is recommended. Low intensity exercise can reduce blood pressure just as well as higher intensity exercise, and is safer for clients who are elderly or have other health conditions.

Most strength training does not lower blood pressure. The only type of strength training that has been shown to lower blood pressure is circuit training. If circuit training is done, the resistance training portion should be done with low weights and high repetitions.

### **Atherosclerosis and Heart Attacks**

Atherosclerosis refers to hardening of the arteries through the buildup of fatty plaques on the artery walls. It is considered a form of cardiovascular disease as well as a risk factor for cardiovascular disease. Atherosclerosis can be caused by hypertension, high cholesterol, irritants like nicotine, and diabetes. The inner wall of the artery becomes damaged by these irritants and platelets clump at the injury site to repair the artery. The fatty deposits, which are made of cholesterol and cellular waste products, accumulate at the injury site and harden.

Plaques can then swell or rupture, which can totally block the coronary arteries and cause heart attacks (myocardial infarctions). Heart attacks are fairly common - they affect 1.5 million Americans per year, and a third of those affected will die. The symptoms of heart attacks are severe chest pain, which can also be felt in the neck, back, or arms; increased levels of cardiac enzymes that are released by dying cardiac cells; and changes in the heart that show up in electrocardiograms.

Most people who have had a heart attack will be able to exercise safely. Exercise can help clients relieve chest pain, lose weight, and decrease fat stores and blood pressure. The best types of exercises for post-heart attack clients are moderate intensity aerobic activities, like walking, cycling, and rowing. Moderate resistance training can also be helpful, as it can improve cardiovascular function as well as strength and body composition.

Exercise is also recommended for those with atherosclerosis (who have not had a heart attack). It can greatly help treat atherosclerosis and prevent further buildup of plaques.

### **Stroke**

Strokes are caused by a loss or interruption of blood supply in the brain due to blocked arteries or burst blood vessels. The blood loss and subsequent lack of oxygen causes brain cells to die. 750,000 Americans have a stroke every year, and one third of strokes cause death. Strokes can cause many issues, including impaired motor and sensory function on one or both sides of the body, vision problems, and mental confusion.

After a stroke, a client may or may not be able to exercise, depending on the severity of the stroke and the issues it causes. Exercise may be limited due to weakness, limited range of motion, lack of balance, and mental confusion. The injury to the brain can also cause frustration, so be patient with someone who's had a stroke.

If a person who's had a stroke does have enough motor function to exercise, aerobic training can greatly help improve their conditioning. This can help them become more mobile and not have to use assistive devices to walk. Exercise will also help decrease risk factors of strokes, like hypertension, which can prevent clients having a second stroke.

A combination of aerobic exercise and strength training is recommended. The type of aerobic exercise that is done will depend on losses of strength and function in different parts of the body. Clients will likely be deconditioned and will have to start at a low intensity. Aim to have them work up to 20 minutes of aerobic exercise.

The type of weight training that can be done will also depend on any losses of strength and balance. For example, clients may need to perform exercises seated instead of standing.

## Chapter 18 – Joint and Orthopedic Concerns

### **Joint Problems: Shoulders, Knees, Hips, Elbows**

#### *Shoulders*

Common shoulder problems include impingement syndrome, anterior instability, and rotator cuff. Exercise can help most of these conditions by correcting muscle imbalances and improving poor posture. Make sure to always follow physical therapists' guidelines for rehabilitating these injuries.

Impingement syndrome occurs when tendons or bursa are pinched, or impinged, by bones. This can be caused by repetitive overhead motions, like painting or tennis, or by joint or bone abnormalities. When training a client with impingement syndrome, included strength exercises for the rhomboids and trapezius to help stabilize the rotator cuff and scapula. Avoid exercises that raise the elbow too high and lat pull downs behind the head.

Anterior instability is a type of shoulder dislocation where the shoulder slips forward and the humerus moves forward and down. Dislocation can reoccur if the shoulder joint is not stabilized. Exercise can help by strengthening the rhomboids and trapezius to help stabilize the rotator cuff and scapula. Caution must be used to choose exercises that are safe for the shoulder and won't cause re-injury.

Rotator cuff injuries include strains, tears, tendonitis, and bursitis. These injuries can be caused by poor posture; falling, lifting, or pulling; and repetitive stress. Strains are usually treated with surgery, but other rotator cuff injuries can be treated with exercise and other less invasive measures. The exercises would, again, be done to stabilize the rotator cuff and scapula. After surgery to repair strains, similar exercises can gradually be added in.

#### *Knees*



Knee injuries and conditions you may encounter are ACL injuries, chondromalacia, and patellar tendonitis. The ACL (anterior cruciate ligament) is often injured in sports by changing direction rapidly or landing from a jump. It may need to be reconstructed through surgery. After surgery, rehabilitation exercises can help return to normal function. Be careful with leg extension exercises, and avoid full extension for six months to one year.

Chondromalacia and patellar tendonitis are both types of anterior knee pain. Chondromalacia is the breakdown of the cartilage on the underside of the patella (kneecap). It is caused by the knee not tracking properly and rubbing against the end of the femur. Patellar tendonitis is inflammation of the patellar tendon, which connects the patella to the tibia. It often occurs as an overuse injury in runners. When working with a client with anterior knee pain, use caution with any exercises requiring greater than 90 degree knee flexion. Cycling or swimming are good options while waiting for the injury to become less inflamed.

### *Hips*

You may work with clients who have had hip replacement surgeries. These clients should be able to ease into a weightlifting program, which will help rebuild strength and endurance. Starting with lifting in a seated rather than standing position will be safer. The client can then progress to lifting weights while standing and holding onto a rail for support. The client may always have some limitations that you'll need to work around. They most likely will not be able to move the hip past 90 degrees extension or flexion, or cross the affected side past the midline of the body.

### *Elbows*

Common elbow injuries include bursitis, tendonitis, and pinched nerves. Bursitis is an inflammation of the bursa, while tendonitis is inflammation of the tendon. Pinched nerves are caused when the ulnar nerve is pinched by the elbow joint.

### **Arthritis**

Arthritis is a disease characterized by pain and stiffness in the joints. There are two major types of arthritis, osteoarthritis and rheumatoid arthritis.

Osteoarthritis is a degenerative joint disease that affects mainly the hands, spine, knees, and hips. Rheumatoid arthritis is an inflammatory disease, where the immune system acts against the joints. The wrists, hands, knees, feet, and spine are commonly affected.

Besides the effects on the joints, arthritis can also affect cardiac and pulmonary function, making exercise more difficult. Other difficulties with exercise include gait abnormalities and biomechanical inefficiencies due to joint pain, limited range of motion, and poor fitness.

Exercise can be beneficial for those with arthritis, and most people with arthritis are able to do some type of activity. Exercise can improve aerobic capacity, strength, and endurance, which can then improve function and decrease pain and swelling in the joints.

Low to moderate intensity exercise is recommended, with intensity and duration progressing gradually. The client with arthritis may need to start with physical activity broken up into several shorter sessions each day as they gain fitness. The main precaution to take with arthritic clients is to protect their joints.

Low-impact activities are best, and different modes of exercise may need to be substituted to accommodate joint pain. A thorough warm up is helpful, as is working on flexibility and range of motion.

Clients who have arthritis in the knees or hips should avoid climbing stairs and any exercises that require standing on one leg. They may also need to wear good shock-absorbing shoes and insoles. Vigorous exercise should never be done when joints are acutely inflamed.

### **Cerebral Palsy**

Cerebral palsy is a physical disability characterized by limited balance, posture, and movement abilities. These difficulties are caused by changes in muscle tone due to a brain injury that occurs around birth. Cerebral palsy is a fairly common disability, affecting 1.5 to 5 out of every 1,000 babies born.

Depending on the location and extent of the injury to the brain, cerebral palsy varies greatly in severity. Some people with cerebral palsy have minor limitations, while others need assistive devices or wheelchairs to get around.

Those with cerebral palsy can benefit from an exercise program. Exercise can improve symptoms like abnormal muscle contractions and spasms, as well as strength, endurance, coordination, and range of movement. The ability to complete activities of daily living can also be improved.

A combination of endurance, strength and flexibility training is recommended. Adaptations may need to be made depending on the client's level of function. For example, strapping the clients' hands to an arm ergometers pedals can help them maintain grip and exercise more efficiently. Design exercises so that the client can be independent as much as possible.

### **Multiple Sclerosis**

Multiple sclerosis is a neurological disorder that damages the nerves and causes movement problems. It can vary greatly in severity from minimal effects to severe disability. Symptoms of multiple sclerosis include muscle weakness, impaired balance and coordination, fatigue, and heat sensitivity.

Exercising does not actually stop or slow the progression of multiple sclerosis, but it is still recommended for improving fitness and activities of daily living. The goals of the exercise program should be maintaining or increasing endurance, strength, and flexibility. Cycling, walking, and swimming are good options for aerobic activity. Weight machines, free weights, and isokinetic machines can all be used to improve strength. Do not have the client perform strength training and aerobic training on the same days. Stretching can be done daily.

The symptoms of multiple sclerosis can make exercise difficult, and there are some special considerations that need to be taken. Because of the sensitivity to heat, the room may need to be kept cooler or fans may need to be provided. The client may also have cognitive deficits, so they may have a hard time understanding directions or may need more time to process information.

Multiple sclerosis can progress at different rates. It may take years or only weeks for the disease to progress. Therefore, it can be difficult to see gains in fitness if the disease is worsening at the same time. Symptoms can recur or go into remission, so exercise programs will need to be adjusted depending on the client's symptoms.

## **Chapter 19 – Personal Training Marketing and Sales**

In this chapter you will learn how to build your clientele and start training clients. Sales is one of the most important aspects of being a fitness professional. You can have all of the scientific knowledge in the world about exercise physiology, anatomy, and biomechanics, but if you don't have clients then you never get to use your knowledge. Sales is really about talking to people and asking the right questions.

### **Personal Training Marketing and Sales**

Marketing is the action of promoting yourself and getting information to others that you are available to train. "Sales" is simply influencing others. Believe it or not, everyone is in sales in some shape, form, or fashion. Anytime you influence someone to do something you need them to do, you are selling them on why they should perform the desired request as opposed to not performing it. Below are marketing and sales methods that have been used very successfully by many certified personal trainers across the nation.

### **Complimentary Boot Camp Class**

Offer a free class for individuals to attend. After each class, you should let all attendees know to talk to you if they are interested in more specific one-on-one coaching.

### **Complimentary Consultations and Assessments**

This is simply a session that allows you to find a client's needs and wants while reviewing health and medical history to determine the best methods for training. During this process, you should take clients through a physical assessment workout to test their strengths and weakness while also allowing you to give them a sample of what it will feel like to be working with you as your client. You should always follow up the workout with a few inviting "yes"

questions that will eventually lead you to ask them if they would like to start working with you on a consistent basis.

“Yes” questions are simple, but many trainers fail to ask the right questions, fail to ask them in the appropriate way, or fail to ask them at all. A couple examples of “yes” questions are “did you like the workout?” and “did you learn something today?”

This will lead you to discuss pricing options with the prospective client.

### **Social Media**

Add your profession and contact info and a “call to action” statement to your social media pages. Include where you train, what hours you’re available, and a contact method for pricing options. It’s also recommended to post your certifications on your social media profiles.

### **Flyers inside Your Gym**

If you work in a gym and the owner will allow, try to place a couple flyers up in your gym. Include the benefits of working with a personal trainer. Include a question along the line of “When is the last time you had your Bodyfat% tested?” Always include a statement towards the bottom with your contact information if they are interested in more details or would like to schedule a complimentary fitness evaluation.

### **Website / Blog**

We highly suggest starting a blog website where you can post anything that interests you in the fitness world. Many bloggers only do a single new article each week, but even this will increase your exposure and credibility. Plus, you can add your personal blog web address to your business cards and your social media pages. This can also lead to offers to write fitness articles for larger websites that can be very lucrative for your business. The most important aspect of your blog is content. You must continue producing high quality, relevant content that will peak the interest of those in the fitness community.

### **Word of Mouth**

This is pretty simple: deliver results and an exceptional experience for your clients. People love to help those that go the extra mile and deliver great service. Just think about what you’ve personally recommended based on quality: movies, restaurants, doctors, computers, cars, cell phones, food

products, etc. People talk about pretty much anything they spend money on with their friends and family. This also works in the opposite direction. If the service is bad, they will pass that information along as well.

The point is, keep your clients happy, show them you care about them, deliver measurable results, and always go the extra mile to ensure you're doing a better job than other trainers in your area.