Module 6

Performance Nutrition

- Essential Nutrition Concepts
- Carbohydrates
- Protein
- Fat
- Vitamins and Minerals
- Fluids
  - Dehydration Prevention
- Weight Gain / Weight Loss

Introduction

Producing a strong and well-conditioned athlete involves more than spending long hours in the gym. The nutrition strategies athletes follow before they get to the gym, what they eat and drink after they leave practice, and what they do to assure an optimal flow of fluid and energy into their bodies during exercise is critical to improving strength, conditioning, and athletic performance.

A failure to consider nutrition as an integral component of the strength and conditioning program will increase the risk for injury and poor health, result in poor improvement rates, and cause a breakdown in the athlete's belief that improvement is possible. On the other hand, well-nourished athletes do better in sports, recover more quickly from unavoidable injuries, and derive more performance-improving benefits from long and strenuous training sessions.

Essential Nutrition Concepts

Nutrition Misinformation

While the scientific information on the relationship between good nutrition and athletic performance is clear, the massive amount of misinformation on sports nutrition often makes it difficult for coaches and athletes to know:

- When is the best time to eat before practice and competition?
- What foods will best sustain energy levels?
- What's best to drink before, during, and after competition to maintain optimal hydration?
- How do you balance an optimal energy intake with an ideal body composition?
- How do you make certain nutrient intake meets nutrient needs?

The nutrition information found in the media and in stores makes it hard for athletes to make the right choices. Athletes should ask for evidence about whether nutritional products actually work. The best evidence comes from information published in refereed (peer reviewed) scientific journals.

In seeking nutrition advice, look for people who have a graduate degree in nutrition and/or are Registered Dietitians with the letters "R.D." after their name. Be certain to ask others giving nutrition advice about their formal training in nutrition, and what credentials they have to demonstrate knowledge of sports nutrition.

Essential Nutrition Concepts

Nutrients

Nutrients provide muscles with the energy they need to work, help metabolize that energy, and provide the building materials for muscles, organs, and bones. For athletes to be healthy and successful in sport, they must think about nutrition needs as having as much importance as training needs.

The six classes of nutrients include: 1) carbohydrates, 2) proteins, 3) fats, 4) vitamins, 5) minerals, and 6) water. Each class of nutrient is important, and athletes should not think of any single nutrient as more critical than any other nutrient. Put simply, nutrient balance is critical to good health and performance. The athlete's goal should be to find the appropriate balance between all the nutrients, since too much or too little of any one nutrient will cause health and/or performance problems.

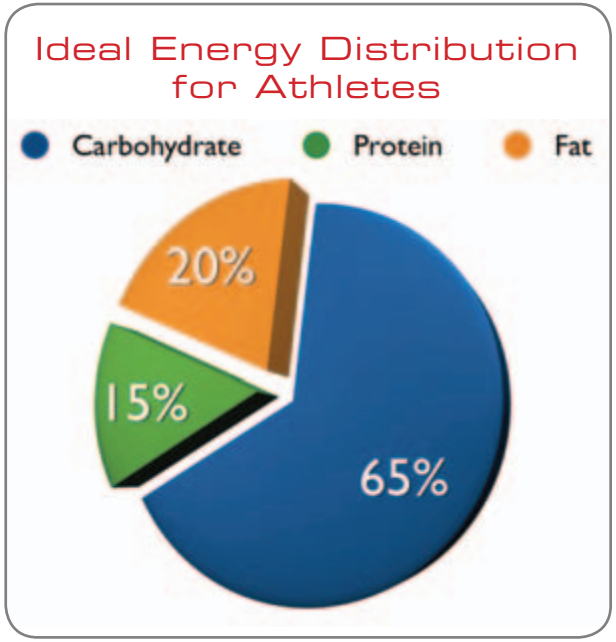
The easiest way to assure optimal nutrient exposure is to consume a wide variety of foods. No single food has all the nutrients a person needs to stay healthy, so eating a wide variety of foods helps people know that all the needed nutrients are available to them. An added benefit of eating a wide variety of foods is avoidance of nutrient toxicities, which result from excess vitamin and mineral intake.

The availability of inexpensive nutrient supplements dramatically increases the possibility of nutrient toxicities. Many athletes are motivated by the belief that, 'if a little bit of nutrient is good then more must be better'. There is no evidence that providing more nutrients than the body can use provides a benefit. On the contrary, excess nutrients cause additional energy expenditure to eliminate the surplus.

Essential Nutrition Concepts

Energy Nutrients

Energy nutrients are those nutrients that provide fuel for cellular work. Carbohydrates, proteins, and fats are considered energy nutrients because they all can be metabolized as energy. Energy nutrients allow us to do muscular work, transfer electrical energy between nerve cells, and maintain body temperature.



Ideal Energy Distribution for Athletes

• 65% from Carbohydrate • 15% from Protein • 20% from Fat

Energy is measured in kilocalories. Calories are the units of energy contained in the food and drink we consume. Calories are either burned to produce energy or, if excess to requirements, stored as fat.

It's easy to get confused about calories and kilocalories since, in a nutrition context, values are actually given for the number of kilocalories in a food, but referred to simply as calories.

In Scientific Terms: 1000 calories= 1 kilocalorie= 1 kcal= the energy, or heat, it takes to raise the temperature of 1 kg of water by 1°C (McArdle, Katch, & Katch, 1999).

In Nutritional Terms: ie. What you'll find on food packaging; calories= kilocalories, and are used interchangeably.

Essential Nutrition Concepts

When a person exercises, the rate at which energy is metabolized rises. Because this process is not 100% efficient, some of the energy is lost as heat. This extra heat causes body temperature to rise, which tells the body to increase its sweat rate as a means of cooling down body temperature. Therefore, the two essential components of sports nutrition are: 1) provision of sufficient extra energy to satisfy the needs of physical activity, and 2) provision of sufficient fluids to maintain body water and replace fluids lost as sweat.

All sports have resistance associated with them. Skaters must overcome the resistance of a skate blade going over the ice, cyclists have the resistance created by air, and weightlifters have the resistance from weights. Sports performance is related to the ability of the athlete to overcome resistance (or drag), and the ability to sustain power output by overcoming this resistance on repeated bouts or long distances (Lamb, 1995). While these two factors are clearly related to performance, they are perceived by many athletes to be in conflict – a fact that causes many athletes problems with meeting energy needs. Athletes often view their ability to overcome the resistance or drag with their ability to carry a lot of muscle and relatively little fat. Since fat mass does little to contribute to sports performance and may contribute to drag, this makes a lot of sense. However, the strategy that athletes often use to reduce fat mass and maximize muscle mass is to diet by lowering total energy intake. This dieting strategy is counterproductive because it restricts the intake of energy that is needed to sustain power output.

Essential Nutrition Concepts

How do athletes maximize their ability to sustain power output, while at the same time, reduce body fat percent to make it easier to overcome resistance or drag? According to a number of studies, the answer may lie in consuming small but frequent meals to stay in better energy balance throughout the day (Fabry, 1964).

Energy balance has typically been thought of in 24-hour units. That is, if the athlete consumes 3,000 kilocalories during the day and burns 3,000 kilocalories during the day, they are in energy balance. However, what the athlete does during the day to achieve a state of energy balance makes a difference. If they spend most of the day in an energy deficit state (metabolizing more kilocalories than are being consumed), but then eat a huge meal at the end of the day to satisfy their energy needs, they might still be in energy balance. It appears that the athlete who does this has different outcomes than the athlete who stays close to an energy-balanced state throughout the day.

Eating small but frequent meals has the following benefits:

- Maintenance of metabolic rate.
- Lower body fat and lower weight on higher caloric intakes.
- Lower blood lipid levels.
- Better glucose tolerance and lower insulin response (making it more difficult to manufacture fats from the foods you eat).
- Lower stress hormone production.
- Better maintenance of muscle mass.
- Improved physical performance.

Most surveys of athletes suggest that they tend to delay eating until the end of the day, and many athletes have severe energy deficits earlier in the day (particularly on days when they train hard and need the energy the most!) Problems with energy deficits include:

- Difficulty maintaining carbohydrate stores (This would impede endurance on high-intensity activities).
- Problems maintaining lean (muscle) mass.
- Lower metabolic rate.
- Difficulty meeting nutrient needs (foods carry both energy and other nutrients)
- Increased risk of injury
  (Undernourished athletes may develop mental and muscular fatigue that, in some sports, would predispose them to injury).
- Missed opportunities to aid muscle recovery.

Maintaining energy balance throughout the day by consuming small but frequent meals during the day is an excellent strategy for reducing these problems.

Essential Nutrition Concepts

Guidelines for Eating and Drinking Before, During, and After Exercise

Before Exercise or Competition

The pre-exercise meal should focus on the provision of carbohydrates and fluids. Ideally, athletes should consume a high-carbohydrate, moderate-protein, low-fat meal three hours before exercising or before competition. Light carbohydrate snacks (crackers, etc.) and carbohydrate containing beverages can be consumed after the meal and before exercise, provided large amounts are not consumed at one time. Drink 17 to 20 ounces of fluid 2 to 3 hours before practice or competition. Drink an additional 7 to 10 ounces of fluid 10 to 20 minutes before practice or competition.

During Exercise or Competition

Drink 28 to 40 ounces of fluid (sports beverages containing a 6 to 7% carbohydrate solution and electrolytes are preferred) per hour. This corresponds to about 7 to 10 ounces every 10 to 15 minutes, but this amount may need to be adjusted based on body size, sweat rate, exercise intensity, and environmental conditions. Two main goals are to avoid dehydration and to avoid the mental and muscular fatigue that can be caused by inadequate carbohydrate replacement.

After Exercise or Competition

Muscles are receptive to replacing stored glycogen following exercise. Because of this, athletes should consume 200 to 400 kilocalories from carbohydrates immediately following activity, and then an additional 200 to 300 kilocalories from carbohydrates within the next several hours.

Drink at least 20 ounces of fluid per pound of body weight that was lost during the practice or competition. This should be consumed within 2 hours of finishing the practice or competition, with the goal of returning body weight to near pre-exercise weight before the next exercise bout.

Carbohydrates

Description

Carbohydrates are often referred to as if there is only one single compound. In fact, carbohydrates come in many different forms that have different nutritional outcomes. Some carbohydrates are digestible while others are not, some are considered complex while others are simple, and some carbohydrates contain soluble fiber while others contain insoluble fiber. The basic carbohydrate for human nutrition is the simple sugar glucose, but the human body makes a complex carbohydrate called glycogen, which is the body's storage form of glucose.

Types of Carbohydrates

Simple Carbohydrates (sugars)

These are sugars that include glucose, fructose (typically found in fruits and vegetables), galactose (one of the sugars in milk), sucrose (table sugar), lactose (milk sugar), and maltose (grain sugar).

Complex Carbohydrates

These are carbohydrates that contain many molecules of connected simple carbohydrates. Complex carbohydrates can be digestible (starch, dextrins, and glycogen), or indigestible (cellulose, hemicellulose, pectin, gums, and mucilages).

Carbohydrates

Good Carbohydrates vs. Bad?

In actuality there is no such thing as a bad carbohydrate, however, the timing of different types of carbohydrates is important. For example, athletes are recommended to consume the majority of their carbohydrates from whole-grain foods and starchy vegetables rather then simple sugars. Whole grain foods and starchy vegetables can provide additional vitamins, minerals, phytonutrients, and fiber that is often absent in simple sugars. These foods also tend to be digested more slowly causing a smaller spite in blood sugar levels and consequent energy levels. The exception to this rule is during exercise and following workouts during these times our bodies are in desperate need of carbohydrates to either provide energy for the rest of the workout or to restore carbohydrate stores depleted from exercise. Simple sugars appear to be the best type of carbohydrates during these times.

Provide Energy

Carbohydrate is the preferred fuel for the body and it's an instantaneous energy source. Carbohydrates provide 4 kilocalories of energy per gram. People should consume at least 40 to 50 grams of carbohydrate per day to avoid health problems. This is a minimum of between 160 to 200 kilocalories per day from carbohydrates. To assure that athletes are able to train and compete at their best, carbohydrates should provide well above this minimum: Athletes should make certain that carbohydrate provides between 55 to 65 percent of total kilocalories. Carbohydrate needs can also be assessed based on body weight. A minimum of 5 – 7g/kg of body weight should be consumed for women, while 6 – 8g/kg of body weight should be consumed for men. These recommendations are based on active high school and collegiate athletes. Less carbohydrates are required for recreational athletes. It's also important for athletes to understand that on high activity days when the volume, intensity, and duration of practice is increased. Carbohydrate needs are greater than on less intense short duration days.

Carbohydrates

Carbohydrate Functions

Store Energy

Carbohydrates have two storage forms: glycogen and fat. The ideal storage form for carbohydrate is glycogen, because it can easily be converted back to glucose and used for energy. However the storage capacity for glycogen in the human body is relatively small, so when the glycogen capacity is filled, excess carbohydrate can be converted to and stored as fat.

Protein Sparing

This is an often overlooked, yet very important function of carbohydrates. Because carbohydrate (glucose) is a preferred fuel, providing enough carbohydrate to meet the majority of energy needs preserves protein from being broken down and used as a source of energy. This allows protein to be used for important functions that only protein can accomplish, such as building muscle tissue.

Carbohydrates

Carbohydrates In the Diet

Should the focus of an athlete's diet be carbohydrate, protein, or fat? There are many studies showing that carbohydrates are the limiting energy substrate for athletes (Burke, 2004). That is, when carbohydrates run out, the athlete typically reaches a point of exhaustion. It is recommended that athletes consume approximately 65% of total kilocalories from carbohydrates. (An athlete consuming a 3,000-calorie diet should consume between 1,650 to 1,950 kilocalories from carbohydrates.) As mentioned previous, carbohydrates can also be expressed in terms of grams per kilogram of bodyweight. Athletes should consume between 5 to 10 grams of carbohydrate per kilogram of body weight. For a 75 kg (165 lb) athlete, that amounts to between 450 grams (1,800 kilocalories) to 750 grams (3,000 kilocalories) per day from carbohydrate alone.

Carbohydrates

Carbohydrate Quick Facts

- Minimum Intake is 50 to 100 grams per day (200 to 400 Kilocalories)
- Average U.S. Intake is 200 to 300 grams per day (800 to 1200 Kilocalories per day)
- Recommended Fiber Intake is 20 to 30 grams per day, or more
- Average U.S. Fiber Intake is 10 to 15 grams per day
- Recommended Intake of Carbohydrate as Percent of total Caloric Intake is 65% of total kilocalories for athletes
- Good Sources of Carbohydrates: Grains, Legumes, Seeds, Pasta, Fruits, Vegetables

Sample of Good High Carbohydrate Snacks

- Apple
- Bagel
- Baked Corn Chips
- Baked Potato
- Banana, Beans
- English Muffin
- Fruit Cup
- Fruit Smoothie
- Gatorade
- Gatorade Energy Bar
- Grapes
- Mashed Potatoes
- Mixed Berries
- Oatmeal
- Orange Juice
- Popcorn
- Rice
- Saltine Crackers
- Spaghetti
- Whole Wheat Toast

Protein

Description

Proteins are large complex compounds that are made of different amino acids, which uniquely contain nitrogen. Body proteins are constantly changing, with new proteins being made and old ones broken down. Growth hormone, androgen, insulin, and thyroid hormone are anabolic hormones that initiate the formation of new proteins. Cortisone, hydrocortisone, and thyroxin are catabolic hormones that initiate the breakdown of proteins.

The requirement for protein is double that of non-athletes, but most athletes far exceed their need for protein. For instance, the non-athlete adult requirement for protein is 0.8 grams per kilogram of body weight, while the adult athlete requirement for protein is between 1.5 and 2.0 grams per kilogram of body weight. An athlete weighing 180 pounds (about 82 kilograms) would require between 123 to 164 grams of protein per day. At 4 kilocalories per gram, this amounts to between 492 and 656 kilocalories from protein per day (Tipton, 2004). Most athletes far exceed this amount of protein just from the foods they consume. Consider that the protein in a hamburger, a chicken fillet sandwich, and one cup of milk provides more than half the total daily protein requirement for a 180-pound athlete.

Protein

Types of Protein

Proteins, being constructed from amino acids, can be classified as either essential or non-essential. The human body can produce non-essential amino acids, but cannot produce essential amino acids. For this reason, essential amino acids must be consumed in the diet. Most animal sources of protein such as eggs, meats, milk, cheese, and fish contain all essential amino acids and thus are strongly encouraged in the diets of athletes. Most plant sources of protein lack one or more essential amino acids and must be combined with other plant foods to form complimentary proteins. Missing essential amino acids in one food are made up for with another.

Protein

Protein Functions

Enzyme and Protein Synthesis
There are hundreds of unique tissues and enzymes that are proteins.

Transportation of Nutrients
Proteins make transportation carriers, enabling nutrients to go to the correct tissues.

Source of Energy
The carbon in protein provides the same amount of energy per unit of weight as carbohydrates (4 kilocalories per gram).

Hormone Production
Hormones control many chemical activities in the body, and are made of unique proteins.

Fluid Balance
Protein helps to control the fluid balance between the blood and surrounding tissues. This helps athletes maintain blood volume and sweat rates during physical activity.

Acid-Base Balance
Proteins can make an acidic environment less acidic and an alkaline environment less alkaline. High intensity activity can increase cellular acidity (through lactate buildup), which protein can help to buffer.

Growth and Tissue Maintenance
Protein is needed to build and maintain tissue. This is one reason why the protein requirement for growing children can be double that of adults. The protein requirement for athletes is approximately double that of non-athletes because of muscle development and maintenance, and a small increase in the protein lost through sweat and urine (Tipton, 2004). The highest protein requirements are in young, growing athletes.

Synthesis of Nonprotein Nitrogen-containing Compounds
The compound phosphocreatine is a high-energy nitrogen-containing compound that can quickly release energy over a short duration for quick-burst activities. Amino acids are used in the formation of creatine.

Protein

Protein In the Diet

Protein is often the focus of many athlete diets, but there is a tendency to consume too much protein. Studies have found that athletes do best with protein intakes that supply approximately 15% of total kilocalories or between 1.5 and 2.0 grams of protein per kilogram of body weight. For a 75 kg (165 lb) athlete, that amounts to no more than 150 grams (600 kilocalories) of protein per day. Athletes often have protein intakes of 3, 4 and more grams of protein per kilogram of body weight per day.

Vegetarian athletes can assure an optimal protein quality by combining cereal grains (rice, wheat, oats, etc.) with legumes (dried beans or peas.) Vegetarian athletes are clearly more at risk for inadequate protein intake because the best source of high quality protein is from animal sources. However, with some good diet-planning vegetarian athletes can consume enough high-quality protein.

Protein isn't the best fuel for physical activity, but it can be used for energy if needed. Athletes need to focus on proteins role in recovery and rebuilding. This is where the timing of protein intake is of paramount concern. Studies have shown that consuming protein before exercise and especially resistance training exercise can have a positive effect on net protein balance. Studies also confirm that the ingestion of protein following exercise can signal protein synthesis and start the rebuilding process of muscles and connective tissues damaged during exercise. A small protein feeding of 7-20g containing all essential amino acids is best at eliciting such a response (Wolfe, 2006).

Protein

Protein Quick Facts

Recommended Intakes

- Infants: 2.2 grams per kg of body weight
- Children: 1.0 to 1.6 grams per kg of body weight
- Adults: 0.8 grams per kg of body weight
- Adult Athletes: 1.5 to 2.0 grams per kg of body weight; Endurance athletes have a slightly lower requirement than strength athletes (Tipton, 2004)

Recommended intake of protein as percent of total caloric intake.

- 12 to 15% of total kilocalories

Good sources of protein:

- Meat, poultry, fish, yogurt, eggs, milk; combinations of legumes (beans and dried peas) with cereal grains.

Sample of Good High Protein Snacks

- Cheese
- Tuna sandwich
- Chicken
- Hamburger
- Cooked beef
- lamb, or pork strips
- Soy burger
- Milk
- Cottage cheese
- Yogurt
- Turkey sandwich

Fat

Description

Fats and Oils

Fats are solid at room temperature and usually contain a high proportion of saturated fatty acids. Oils are liquid at room temperature and typically (there are notable exceptions) contain a high proportion of unsaturated fatty acids.

Types of Fat

Triglycerides

Triglycerides are the most common form of dietary fats and oils.

Fats with Possible Positive Benefits

Polyunsaturated fatty acids

These fatty acids have a tendency to lower blood cholesterol. The good thing about these fats is that they're typically associated with lots of vitamin E, which athletes need. (Found in vegetable and cereal oil, such as corn oil).

Monounsaturated fatty acids

These fatty acids tend to lower blood cholesterol while maintaining high-density lipoproteins (HDL). (Found in olive oil and canola oil).

Fats with Possible Negative Effects

Saturated fatty acids.

These fatty acids tend to increase LDL cholesterol. (Found in meats and dairy products)

Trans fatty acids

These are man-made fats produced to increase the shelf-life of many common foods. Most research has shown these fats to function negatively in the body also increasing LDL cholesterol while lowering HDL.

Fat

Fat Functions

Source of Energy

Fats provide 9 kilocalories of energy per gram (compared to 4 kilocalories per gram from both carbohydrates and proteins).

Provide essential fatty acids (Omega -3s and Omega -6s)

Like essential amino acids these fatty acids cannot be made by the body are must e consumed by the diet. Essential fatty acids are vital for proper function and appear to be involved in inflammatory responses such as those resulting from exercise.

Provide Insulation and Cushion From Extreme Temperatures and Concussive Forces

Fats protect organs against sudden concussive forces, such as a fall or a solid 'hit in football. Fats also have excellent insulation capacities.

Satiety control

Because they stay in the stomach longer than other energy nutrients, fats provide a fuller feeling longer.

Transportation of Essential Nutrients

Fats carry necessary fat-soluble vitamins (A, D, E, and K) and essential fatty acids, which are found in vegetable and cereal oils.

Fats in the Diet

Americans tend to consume too much fat, and now many athletes have the mistaken belief that high fat intakes can enhance athletic performance. The generally accepted fat intake for athletes is 20% of total daily kilocalories. For an athlete consuming 2,500 kilocalories per day, this amounts to 500 kilocalories per day as fat.

There has been a great deal of attention given to high fat, high protein, low carbohydrate diets recently, but there is little evidence that these diets are useful for enhancing athletic performance.

Fat

Fat Quick Facts

- Fat intake should provide approximately 20% of total kilocalories.
- Linoleic acid (and alpha-linoleic acid) are the most essential fatty acids, and must be provided in consumed foods. These fatty acids are found in corn, sunflower, peanut, and soy oils.
- Fat is the carrier of the fat-soluble vitamins: vitamins A, D, E, and K
- Fats provide more than twice the kilocalories, per equal weight, than carbohydrate and protein (9 kilocalories vs. 4 kilocalories per gram)
- High fat intakes (not just high cholesterol intakes) result in higher circulating blood cholesterol levels.
- Fat sources: Oil, butter, margarine, fatty meats, fried foods, prepared meats (sausage, bacon, salami), and 'whole milk' dairy products.

Sample of High Fat Foods

- Whole milk
- Pie crust
- High fat dairy products
- Nuts
- Fried Foods
- Peanut butter
- "Crispy" snacks
- Regular cheese
- Margarine, butter, lard, and oil
- Potato chips

Vitamins and Minerals

Description

Vitamins and minerals are substances that help essential body reactions take place. The best strategy for assuring an adequate intake of all the vitamins and minerals is to eat a wide variety of foods, and consume lots of fresh fruits and vegetables daily.

Types of Vitamins and Minerals

Some vitamins are water soluble, while other vitamins are fat-soluble. See the following tables for a summary of major vitamins and minerals.

Vitamins and Minerals in the Diet

Remember that nutrient balance is a key to optimal nutrition, so athletes should avoid single-nutrient supplementation unless this has been specifically recommended by a physician to treat an existing nutrient deficiency disease. If a nutrient supplement is warranted because of a poor quality food intake, athletes should try a multi-vitamin, multi-mineral supplement that provides no more than 100% of the Recommended Dietary Allowance (RDA) for each nutrient. The scientific literature suggests that vitamin and mineral deficiencies are uncommon for athletes, but if they exist, they are most likely for vitamin b-6 and other b-complex vitamins, iron, and calcium.

Caloric intake can be a strong determinant of adequate vitamin and mineral status. Athletes consuming subcaloric diets, or diets low in energy compared to energy expenditure are at risk of vitamin and mineral deficiency.

Water Soluble Vitamins

Vitamin – Adult Requirement	**Functions**	**Food Sources**
Vitamin C 60 mg / day	• Antioxidant • Collagen formation • Iron absorption	Fresh fruits and vegetables. Particularly high in citrus fruits and cherries.
Thiamin (Vitamin B-1) 0.5 mg / 1000 kilocalories	• Oxidation of carbohydrates • Nerve conduction	Seeds, legumes, pork, enriched/fortified gains and cereals.
Riboflavin (Vitamin B-2) 0.6 mg / 1000 kilocalories	• Oxidation of carbohydrates & fats • Normal eye function • Healthy skin	Milk, liver, whole and enriched grains and cereals
Niacin	• Oxidation of carbohydrates & fats	Enriched grains and cereals.
Vitamin B-6	• Protein synthesis & breakdown • Glycogen breakdown	Meat, fish, potatoes, sweet potatoes, bananas, vegetables
Pantothenic Acid 4 – 7 mg / day	• Energy reactions for carbohydrates, proteins, and fats • Fatty acid synthesis	In almost every food (deficiency is very rare)
Biotin 50 – 100 micrograms / day	• Carbon-dioxide transfer (normal respiration)	Egg yolk, nuts, legumes, bacterial synthesis in the gut
Vitamin B-12 2 micrograms / day	• Red blood cell formation	Foods of animal origin and intestinal synthesis. (Pure vegetarians may be at risk for deficiency)
Folic Acid (Folate) ~ 200 micrograms / day	• Cell division • Maturation of red blood cells	Organ meats, green leafy vegetables, whole-grain foods. (This may be the most common vitamin deficiency)

Fat Soluble Vitamins

Vitamin – Adult Requirement	**Functions**	**Food Sources**
Vitamin A (Retinol) 0.8 – 1.0 mg / day	• Vision • Growth • Reproduction • Immune Function • Healthy Skin	Fish liver oils, liver, butter, vitamin A+D added milk, egg yolk Pro-vitamin A (Beta-carotene: in dark-green leafy vegetables, yellow vegetables and fruits, and fortified margarines.
Vitamin D 0.01 mg / day	• Calcium absorption • Phosphorus absorption • Mineralization of bone	Fish-liver oils, fortified (A & D) milk, skin synthesis with exposure to light. Small amounts found in butter, liver, egg yolk, and canned salmon and sardines.
Vitamin E 8 – 10 mg / day	• Powerful antioxidant • Involved in immune function	Vegetable oils, green leafy vegetables, nuts, legumes. (Foods of animal origin are NOT good sources.)
Vitamin K 0.06 – 0.08 mg / day	• Involved in blood clotting	Green leafy vegetables.

Minerals

Minerals – Adult Requirement	**Functions**	**Food Sources**
Calcium ~1,300 mg / day	• Structure of bones and teeth • Blood coagulation • Nerve impulse transmission • Muscle contraction • Acid-base control	Milk and other dairy foods, dark green leafy vegetables, canned fish (with bones), calcium fortified orange juice.
Phosphorus ~1250 mg / day	• Structure of bones and teeth • Component of ATP and other energy-yielding compounds • Acid-base control	Meats, cereals, grains, and dairy products
Iron ~15 mg / day	• Involved in oxygen transfer to cells (hemoglobin in blood; myoglobin in muscle) • In numerous oxidative enzymes	Most absorbable iron: Meats, poultry, fish, egg yolk Less absorbable iron: dark-green vegetables, legumes, peaches, apricots, prunes, raisins
Zinc ~15 mg / day	• Immune system • Wound healing • In over 70 enzymes involved in energy metabolism	Seafood, organ meat, meat, wheat germ, yeast. (Most plant foods are not good sources).
Magnesium ~ 400 mg / day	• Energy metabolism of carbohydrate and fat • Protein synthesis • Water balance • Muscle contractions	Available in many foods, but highest in meats, who grain cereals, seeds, and legumes.

Fluids

Description

Water is a carrier of nutrients to cells, and is the carrier of waste products away from cells. It serves as a body lubricant, and through sweat, helps to maintain body temperature. Lean tissue (muscles and organs) is over 70% water, and about 60% of total body weight is water. Water is so critical to human existence that a failure to supply sufficient water is likely to cause death more quickly than a failure to supply any other nutrient.

Fluids in the Diet

A key to athletic success is avoidance of a state of under-hydration. This is not as easy as it may seem, because many athletes rely on thirst as the cue for when to drink. Thirst however, is a delayed sensation that does not occur until the athlete has already lost 1 to 2 liters of fluid. Because of this, athletes should learn to consume fluids on a fixed time interval. Staying optimally hydrated and fueled during exercise has multiple benefits, including (Manore & Thompson, 2000):

- A less pronounced increase in heart rate.
- A less pronounced increase in core body temperature.
- Improved stroke volume and cardiac output.
- Improved skin blood flow (enabling better sweat rates and improved cooling).
- Maintained blood volume.
- Reduced net muscle glycogen usage (improving endurance).
- Improved Performance.

Water can be lost through breath, skin, urine, sweat, and feces. It is critically important to consume sufficient fluids to maintain body water stores, yet most people rarely stay optimally hydrated. In fact, athletes commonly wait until they become extremely thirsty (indicating a state of dehydration) before they consume fluids.

Fluids

Fluid Consumption Guidelines

The National Athletic Trainers' Association (NATA) has the following fluid consumption guidelines (Casa et al., 2000):

Before Training and Competition

Drink adequate fluids the day before. Drink at least 2 cups (17 – 20 ounces) of fluid 2 to 3 hours before exercise or competition

During Training and Competition

Replace Sweat Losses. Drink 7 – 10 oz every 10 to 20 minutes.

After Training and Competition

Monitor fluid losses. Drink 3 cups (24 oz) for every 1 lb weight loss through sweat. You should replace 150% of sweat losses, because you are continuing to sweat (Shirreffs, 2004).

Rehydrate within 2 hours post-exercise

Fluids

What to Look for in a Sports Beverage

- 4 – 6% percent carbohydrate concentration (approximately 14 grams of carbohydrate per 8 oz)
- A combination of sucrose, glucose, and fructose
- 50 – 60 Kilocalories per 8 oz
- A minimum of 100 mg sodium per 8 oz
- A minimum of 28 mg potassium per 8 oz
- No carbonation and no caffeine

Fluids

Considerations for Two-A-Day Practices

According to recent recommendations generated by sports scientists, heat-related deaths in football can be prevented and heat illness-related performance deficits can be reduced if athletes and those working with them take specific actions (GSSI, 2002). The principles for reducing heat-related death and illness that are outlined in this consensus include:

Risks

Heat Acclimation

Poor acclimation to heat and poor cardiovascular fitness are major contributors to heat illness in football players. The first several days of preseason football practice represent the greatest danger for heat related problems because of inadequate acclimatization and poor fitness. Practices should be less intense and shorter in duration during the first couple days of acclimation. Acclimation usually takes somewhere between 8 – 10 days.

Dehydration

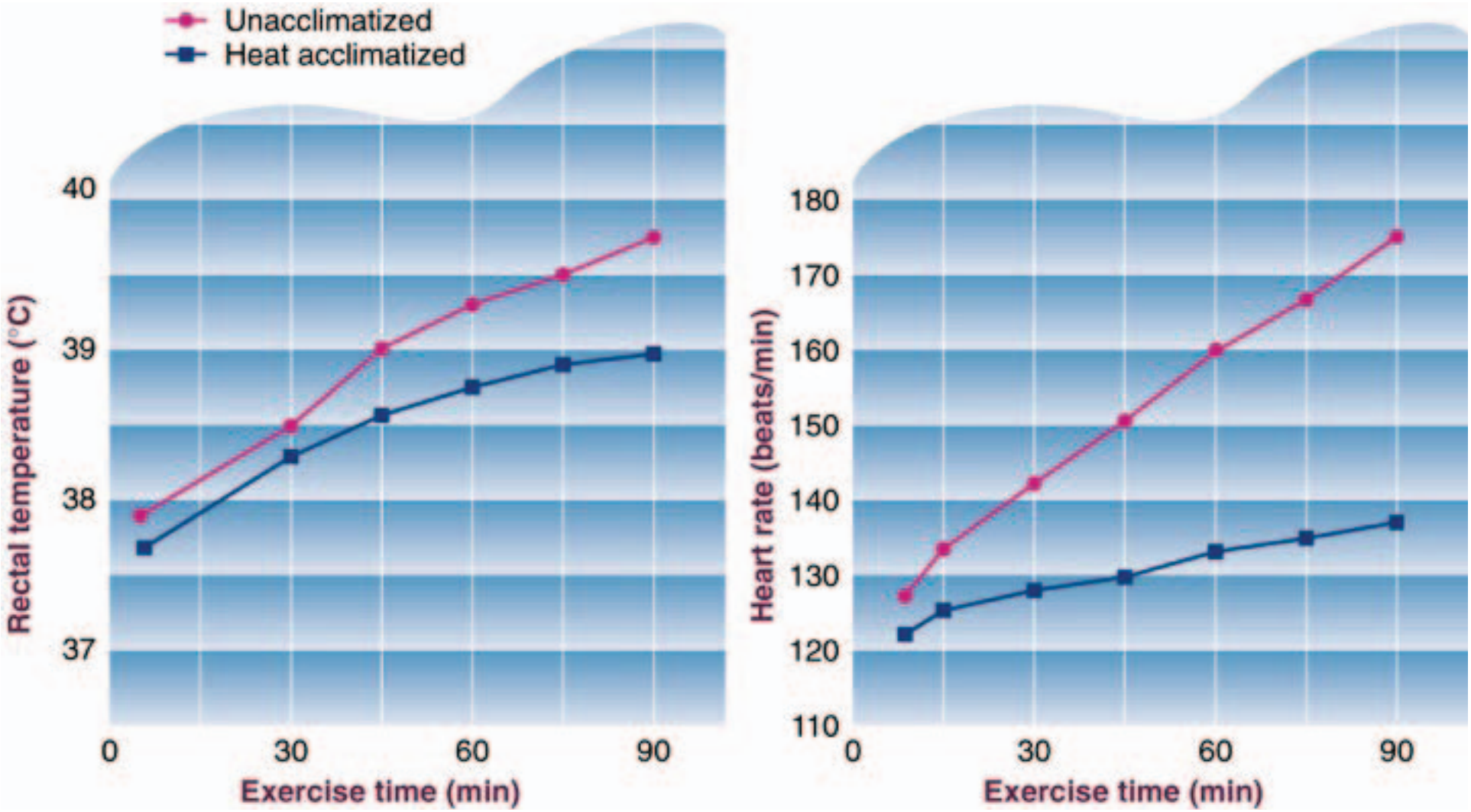
Large athletes may lose nearly 2 gallons of sweat during a practice session, but rarely do they adequately replace all the fluid and electrolytes that are lost. It is impossible to adapt to inadequate fluid intake, and as little as a 2% reduction in body weight from fluid loss may predispose an athlete to heat illness. Since football uniforms make it more difficult to dissipate body heat, inadequate fluid intake creates a formula for disaster.

Electrolyte Balance

Sodium can be lost in large quantities through sweat, and unless the sodium is replenished it becomes impossible to maintain blood volume and sweat rates. This makes heat cramps more likely. Consumption of salty snacks and fluids that contain sodium becomes critically important in high heat and humidity environments.

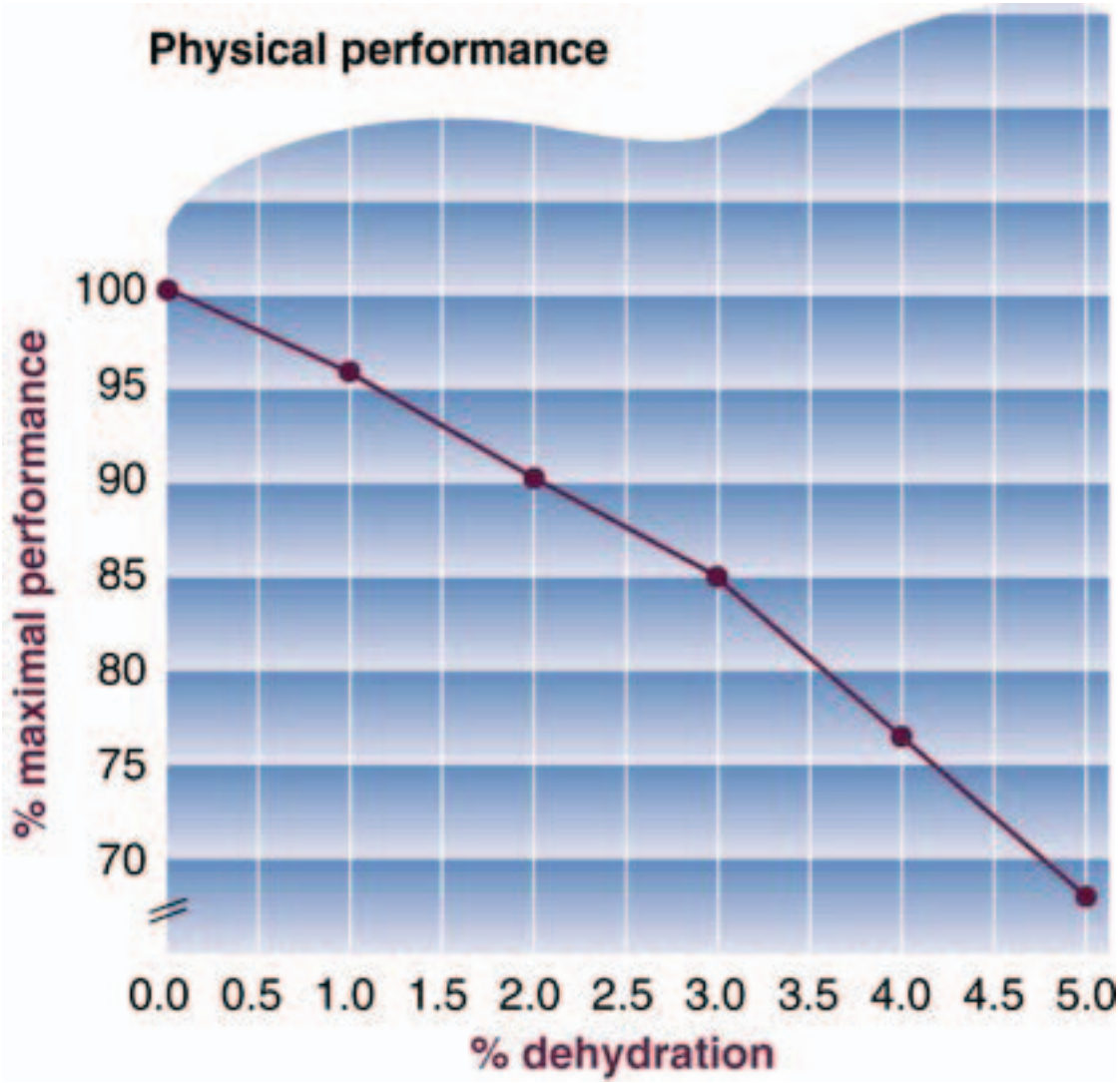
Fluids

Heat Acclimatization



Fluids

Dehydration and Performance



Considerations for Two-A-Day Practices (continued)

Past History of Heat Illness

Athletes who have experienced heat-related illness in the past may be at increased risk for future heat illness.

Practice Intensity

The intensity of a practice contributes to the risk of heat illness. Regardless of how hot the weather, heat illness can be prevented if the intensity of a practice is low.

Two-A-Day Practice

These double practices can contribute to heat illness, particularly during the first 2 days of practice if the athletes do not adequately cool down and hydrate between practices. Athletes who show signs of heat illness on one practice are more likely to be susceptible to a more serious heat illness on subsequent practices.

Dietary Supplements

Supplements containing ephedra or other stimulant drugs may increase body heat production, and therefore increase the risk of heat illness.

Heat Index

The heat index is a good measure of how hot the environment feels, but is not a good indicator of heat stroke or other heat-related illness in football players. Coaches and sports medicine staff must be alert to signs of heat illness, because there is no environmental measure that can adequately predict risk.

Dehydration Prevention

Recommendations

When to hold practice

Two-a-day practices should be held in the coolest parts of the day, and there should be a long rest period between practices. Athletes should be able to adequately cool themselves before the second practice begins. Consideration should be given to alternating days of single and double practices.

Illness and drugs

Players who are vomiting, have diarrhea, have fevers, are over weight and/or are unfit, or take diuretic drugs or stimulants are a much higher risk for heat illness and should be restricted from playing in the heat or, at the least, monitored carefully.

Uniform

Wearing a full uniform during the first few days of preseason practice in the heat should be avoided. Portions of the uniform should be gradually added over the first week of practice. Whenever possible, players should remove their helmets and raise their jerseys to facilitate heat loss.

Coaching

Players should not be pressured or embarrassed into overexertion by coaches. High intensity drills to prove a player's ability should be avoided early in preseason training. If wind sprints (gassers) are done at the end of practice, they should be done without helmets and pads, and athletes should be carefully monitored for signs of heat illness.

Hydration and Electrolyte Balance

Education of the dangers of heat illness and the importance of proper hydration should be a primary focus for players throughout the season. Parents, coaches, and sports medicine staff should monitor the fluid intake of players to assure adequate fluid consumption, and there should be frequent breaks to offer players an opportunity to hydrate and to cool themselves in shaded areas with fans. Before and after practice players should be weighed to monitor fluid loss. Players who experience significant weight loss (more than 1% of body weight) should be counseled and monitored to improve fluid intake during practice.

Dehydration Prevention

Early Detection of Heat Illness

All teams should have immediate access to a certified athletic trainer to educate players about heat illness, to detect signs of heat illness, and to initiate emergency treatment if needed. Sports medicine staff (team physician, athletic trainer, etc.) should have the authority to remove athletes from practice if heat illness is suspected. This should not be under the authority of the coach unless there are no sports medicine staffs present.

Warning Signs of Dehydration, Heat Exhaustion, and Heat Stroke: What To Do

Dehydration w/ Loss of Energy & Performance
Drink carbohydrate and electrolyte-containing sports drinks. Avoid beverages with carbonation, which can cause GI distress.

Dehydration w/ Muscle Cramps
Immediately stop exercising and massage the cramping muscle(s). Consuming a sports beverage that contains sodium may help to relieve the cramp.

Heat Exhaustion w/ Dizziness, light-headedness, and Cold, Clammy Skin
Immediately replace fluids while in a cool, shaded area until the dizziness passes. Stretching may improve circulation and prevent fainting. Lying with the legs elevated will improve blood circulation to the head, thereby alleviating the dizziness.

Heat Exhaustion w/ Nausea/Headaches
Rest in a cool place until the nausea passes. Drinking fluids to rehydrate is critical. Lying down may help to relieve headaches.

Heat Stroke w/ high body temperature & dry skin
Immediately get out of the heat and seek immediate medical treatment. Feeling chilly with arms tingling and with goose bumps means skin circulation has shut down and heat stroke is imminent. This is an extremely serious condition that must be immediately treated.

Heat Stroke with confusion or unconsciousness
Confusion strongly suggests, and unconsciousness confirms, heat stroke. This is a medical emergency that calls for fast cooling with ice baths or any other available means to lower body temperature.

Adapted from: Fluids 2000, The Gatorade Company

Weight Gain & Weight Loss

Optimal body weight and body composition can have a dramatic impact on performance. For contact sports such as football, basketball, and lacrosse greater mass is generally more beneficial, where as for lean-build sports such as cross-country, cycling, and gymnastics maintaining a relatively low but healthy body weight is important. Athletes must realize that body weight, shape, and composition are all highly variable and dependent upon genetic predisposition.

Weight can be maintained without dieting or restricting food intake. Consider the following criteria to help you determine an optimal body weight:

- What weight allows for optimal performance?
- What weight is appropriate for age and level of physical development?
- What weight allows an athlete to train at optimal intensities and volumes?

Weight gain and weight loss are a matter of caloric balance. In order to gain weight athletes must consume more calories then they are burning and in order to lose weight athletes must burn more calories then they are consuming.

Weight Gain & Weight Loss

Weight Gain Principles

- Calories In must be more than Calories Out
- 500 – 1000kcal in positive energy balance
- Suggested rate of weight gain .5 – 1 lb per week
- Utilize a proper resistance training protocol
- Include nutrient/energy dense foods
- Multiple feedings throughout the day (5 – 7)
- Balanced Food Choice

Weight Gain & Weight Loss

Weight Loss Principles

- Calories In must be less than Calories Out
- Suggested Deficit 500 – 1000kcal
- Deficit combination of
  ⇩Food Intake & ⇧Activity
- ⇧Activity—Must be sports specific
- Resistance Train to prevent loss in Lean body mass
- Limit Hi Fat Foods, Adequate CHO, ⇧PRO
- Maintain Balanced Diet
  —Eat Nutrient Dense Foods
- High in Fruits and Vegetables
- Hi-Fiber, Foods
- Slow and Steady Weight Loss,
  .5 – 1lb / week

Considerations

No one formula for weight loss or weight gain is perfect for everyone and equations are only an estimation of caloric need. Therefore, it is important that results dictate dietary changes. Some individuals will respond to increasing caloric intake by 500kcal per day in order to gain weight, however, others may take increases in calorie intake of 1000kcals or more. The same can be said of weight loss.

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