CEC ARTICLE 3, 2009: Sports Nutrition: Part 1 Carbohydrate, Proteins, and Fats

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Eating for athletic performance includes not only what we eat, but also how it is distributed during the day and around athletic events like training or races. It also depends on the type of event for which we are training. The nutritional requirements for endurance athletes versus power athletes have some distinct differences. We can all learn something about our eating habits and how to improve our eating habits from the research done on athletes.

Three basic concepts for sports nutrition include

1. Drinking the right amount of fluid at the right time.
2. Eating the right amount and variety of foods at the right time.
3. Using safe proven supplements at the right time.

We will be investigating how these concepts need to be applied for top physical performance.

First there are 50 nutrients that the body needs to function efficiently. These nutrients are broken down into 6 groups: proteins, carbohydrates, fats, vitamins, minerals and water. The groups that fuel the body are the carbohydrates, fats and protein. Vitamins and minerals are what keep the body running smoothly. Water is an essential for cooling the body and for being the medium for many reactions. Other substances like fiber and phytochemicals are needed for the body to function at its best.

When calculating the number of calories an athlete needs we need to know the total number of calories they expend from resting energy and active energy. The resting energy includes the energy needed to keep the cells, heart, muscles, liver, brain and all organs and tissues functioning at rest, the energy needed to regulate temperature, and the energy for maintaining fluid balances in the body. The resting energy is gender, height, weight, body composition and age dependent. The activity energy is the amount of additional energy over the resting energy to perform physical tasks.

So for our resting energy calculations we have:

Males calories/day = 66.47+13.75x(weight in kg)+5x(height in cm)-6.76x(age in years)

Females calories/day = 655.1+9.65x(weight in kg)+1.84x(height in cm)-4.68x(age in years)

To convert lb to kg divide your weight in lb by 2.2

To convert inches to cm multiply your height by 2.54.

For basic active energy calculations, we can multiply the resting calories by the activity factor and the fraction of the day spent in that activity mode.

Mode	Male Factor	Female Factor
Resting/Sleeping	1	1
Sedentary/Reading	1.3	1.3
Light/Walking	1.6	1.5
Moderate/Dancing	1.7	1.6
Very Active/Hiking uphill with backpack	2.1	1.9

Extremely Active/Sawing Down a tree or Construction
2.4 2.2

Female Total Calories/day = (Hours sleepingx1+Hours Sedenaryx1.3+Hours Lightx1.5+Hours Moderate x1.6+Hours of very activex1.9+Hours of Extremely Activex2.2)xResting Energy/24hours

Male Total Calories/day = (Hours sleepingx1+Hours Sedenaryx1.3+Hours Lightx1.6+Hours Moderate x1.7+Hours of very activex2.1+Hours of Extremely Activex2.4)xResting Energy/24

Next we will look at the protein requirements per day and how protein is used and how to distribute it during the day. Protein has 3 functions where energy is the 3rd in the level of importance. The main function of protein is the growth development and repair of muscle tissue. Its secondary function is to regulate metabolism by regulating enzyme controlled reactions. Muscle is composed to 22% protein, 72% water and 6% fat. The body needs approximate 12-15% of its total calorie intake to be from protein. The following chart refines the amount of protein needed per lb of body weight based on the activity level an individual.

Activity	Protein in grms/lb of body weight
Sedentary, Recreational 4-5 times per week For 30 min below aerobic zone, or Recreational resistance training	0.36
Moderate intensity endurance for 4-5 times per week for 60 min in aerobic zone	0.54
Elite female endurance athlete or Resistance/Strength training athlete In maintenance mode	0.53-0.63
Elite male endurance athlete	0.72
Cross-training/Interval training, or Basketball/Soccer/Hockey players	0.63-0.77
Resistance/Strength training athlete In muscle building mode	0.68-0/81

Pre-exercise meals (1-4 hours before training) should contain low-fat forms of protein. However there is a relationship between how much protein to consume and how

close to exercise the protein is consumed. The closer to the exercise session, the lower the amount of protein because it takes longer to digest and will end up staying in the stomach during exercise. The best pre-exercise meal contain low-fat protein like lean turkey or low-fat yogurt with carbohydrates so the protein is to supply muscle building blocks and the carbohydrates are to supply energy. Also remember that the body needs its protein spread out throughout the day. The body can only really absorb and process the amount of protein in 2 eggs for women and 3 eggs for men in a meal.

For post exercise protein, again research says a combination of protein and carbohydrate is recommended for improved nitrogen balance. When small amounts (0.05 grms/lb of body weight) of amino acids are combined with the post exercise meal protein synthesis increased. It is not recommended to consume free amino acids alone or in excess.

The overall contribution to total energy expended by protein is only 2-5% during exercise. A high protein diet for an athlete means the athlete's body must use more protein for energy since the carbohydrates are not available. This is not beneficial and not recommended especially for endurance athletes. Ingesting protein during exercise can cause an increase in the ammonia levels in the blood from the protein breakdown. This can cause fatigue and hinder performance. Protein also remains longer in the stomach and can cause cramping or intestinal distress.

Carbohydrates are the preferred energy source during exercise again calculating how much is needed before, during and after exercise. The body has a limit on the amount of carbohydrate it can store in the liver and muscles. The amount an individual can store is related to their diet, recent activity level, and fitness level. Excess carbohydrate is converted to stored fat and cannot be converted back into carbohydrates. The amount of carbohydrates used during exercise varies, but the highest demands on the carbohydrate stores occur at the beginning. If you do not have enough carbohydrate stores or do not replenish your stores while exercising at an adequate rate, there will be a sudden onset of fatigue, possible nausea and dizziness. It will take the body 24-48 hours to replenish its carbohydrate stores after "hitting the wall" or "bonking". The following table reviews approximate carbohydrate intake recommendations based on hours of exercise per day per lb of body weight.

Exercise Duration in Hours/Day	Grams of Carbohydrate/ lb of Body Weight
1	2.3-3.2
2	3.3-4.4
3	4.5-5.3
4	5.4-5.9

After understanding the total carbohydrate needs per day; we need to understand how to distribute the carbohydrate intake during the day and around exercise session. The next chart looks at how to time the carbohydrate intake before, during and after exercise.

Time before Exercise	Grams of Carbs/ lb or Body Weight
1-4 hours before exercise	0.5-1.8

During Exercise

During Every hour of Exercise	30-60 grams

Time After Exercise	Grams of Carbs/ lb or Body Weight
30 min.	0.5-0.7
2 hours	0.5-0.7

The type of carbohydrate consumed is also important. Consuming carbohydrates that are low in fat and high in other nutrients like vitamins and minerals is very important. The following is a list of foods containing 30 grams of carbohydrates to be used as a building blocks throughout the day.

16 oz Gatorade	1 large banana	1 fruit-flavored bar
¾ of Powerbar	½ c. raisins	½ English muffin & 1 Tbs jam
2 hard Granola bars	2 c. Cheerios	1 c. carrot sticks&6oz chocolate milk
3 fig cookies	1 C 100% apple juice	1 ½ oz pretzels

The final macronutrient we need to look at is fat. Fat has several important functions in the body. It not only provides energy and essential fatty acids, but it aids in the absorption of fat soluble vitamins, insulates and protects organs, helps form the structure of cells, and helps make reproductive hormones. The healthy range of fat in the diet is 20-35% of the total calories per day. Most performance endurance athletes aim for 20-30% of their total calories from fat. Most strength athletes aim for 30-35% of their total calories from fat.

If there is too much fat in the diet it is linked to heart disease, diabetes, and cancer. If there is too little fat in the diet it is linked to disrupted reproductive functions and reduce calories below daily needs, which affects growth, development and endurance. It can also lead to deficiencies in vitamins, essential fatty acids, and other micronutrients.

There are several types of fat. The majority (95%) comes in the form of triglycerides from plants and animals. There are 3 types of fatty acids in the triglycerides; saturated, polyunsaturated and mono unsaturated fats. The saturation of the fatty acid (i.e. the lower the number of double bonds) affects metabolism and health. Essential fatty acids are polyunsaturated and must be supplied through the diet. They are crucial for many biological functions and for the body to work properly. Omega-3 fatty acids are polyunsaturated fats that correlate with positive health and can be found in soybeans, canola oil, and fish.

Naturally saturated fats and polyunsaturated fats that have been synthetically converted to saturated fats are called trans fatty acids and do not correlate positively with health. Natural saturated fats should be eaten in moderation because they increase cholesterol. Sources of saturated fats include butter, lard, coconut and palm kernel oil, cream, sour cream, mayonnaise, gravy, and high fat meats. Some of these foods like milk have many carbohydrates vitamins and minerals that are good for the body, so low-fat options are preferred to eliminating that food item.

The biggest problem with fat is hidden fat in processed, restaurant and fast food that is unknown to the person. It is very easy to go over your recommended fat calories per day with the wrong kinds of fats in nutritionally limited foods. Also remember that

for children, having a “no-fat” diet can be harmful since cholesterol is important in nerve sheath production.

In part 2 of this article we will look at vitamins, minerals and hydration.

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1. What are the 3 basic concepts for sports nutrition?

2. How many nutrients does the body need to function efficiently

3. When calculating the number of calories needed per day, what kinds of energy expenditures do we need to know and what are their definitions?

4. What is the resting energy calculation for males and what information about them do we need to know?

5. What is the resting energy calculation for females and what information about them do we need to know?

6. What are the energy factors for the following and describe what you would do with that information?

Male walking
Female hiking up hill
Male sawing down a tree
Female reading
Male sleeping
Female dancing

7. What are the 3 functions of protein?

8. Which is the least important function or protein?

9. What is muscle composed of?

10. What percentage of the total calorie intake per day should be protein?

11. If you are a recreational exerciser, how much protein per lb of body mass do you need per day?

12. If you are a strength training athlete, how much protein per lb of body mass do you need per day?

13. How much protein can the body absorb at one time?

14. What kinds of combination protein, carbs and fat should be eaten 1-4 hours before exercise?

15. Is this the same for post-exercise?

16. What amount of amino acids should be in post exercise food?

17. What is the total contribution of protein to energy?

18. What is the preferred source of energy during exercise?

19. What happens if you do not have enough carbohydrate stores or enough replenishment during exercise?

20. List the grams of carbohydrates needed per lb of body weight versus number of hours of exercise per day.

Hours	Grams of Carbs/lb of body weight
1	
2	
3	
4	

21. T/F You can eat all your carbs at once.

22. For each time below, list how much carb is required.

1-4 hours before exercise
During exercise
30 min. After Exercise

23. What are the 3 kinds of fat?

24. What is the basis for saturation of a fat?

25. What percent of fat should endurance athletes consume as part of their daily requirements?

26. What are the good natural fats and which need to be consumed in moderation?

27. List sources of the good fats and sources of the moderate fats?

24. Why don't you want to eliminate saturated fats completely?