Calculating Energy Needs

Sports dietitians are often asked by athletes, "How many calories do I need?" Factors that must be considered when estimating energy needs include age, stage of growth and development, gender, height, weight, body composition, time spent in exercise (both training and competition), other activities of daily living, and amount of time resting and sleeping. This worksheet provides several methods for estimating energy needs in athletes.

Energy Expenditure Tables

McArdle, Katch, and Katch have published extensive tables of energy expenditure in household, occupational, recreational, and sports activities (1). These tables are found in most sports nutrition and exercise physiology textbooks and are useful to determine how much energy an athlete of a specific weight expends in exercise per minute.

To use the tables most effectively, an athlete should keep a detailed record of the amount of time spent in all activities in 24 hours. The record should track both training and competition days. However, few athletes are willing to complete the detailed records.

Even without a complete record of the athlete's activity, a sports dietitian can use the tables to estimate the energy cost of exercise. The tables list body weight in 10-pound increments, so you will have to select the weight that most closely matches the weight of the athlete.

The tables do not include every sport or type of exercise. For example, the popular activity of spinning is not included in the tables. Therefore, estimates for spinning have to be made from the cycling data.

Estimated Energy Requirement

Dietary Reference Intakes for Energy, Carbohydrates, Fiber, Fat, Protein, and Amino Acids (Macronutrients) (2) includes formulas for calculating an individual's estimated energy requirement (EER) (see tables). The EER is predicted to maintain energy balance in a healthy adult of a defined age, gender, weight, height, and physical activity level consistent with good health.

Estimated Energy Requirement (EER) Formulas*

	EER, kcal
Boys, age 9-18 y	88.5 – 6.19 × Age + [PA × (26.7 × Wt) + (903 × Ht)] + 25
Girls, age 9-18 y	135.3 – 30.8 × Age + [PA × (10.0 × Wt) + (934 × Ht)] + 25
Men, age > 19 y	662 – 9.53 × Age + [PA × (15.91 × Wt) + (539.6 × Ht)]
Women, age > 19 y	354 – 6.91 × Age + [PA × (9.361 × wt) + (726 × Ht)]

*Age is in years; weight (Wt) is in kilograms; height (Ht) is in meters. PAL = Physical Activity Level; PA = Physical Activity Coefficient (see Physical Activity Level table).

Physical Activity Level (PAL) Categories for Estimated Energy Requirements (EERs)

	Physical Activity Coefficient (PA)			
PAL Category	Men, Age > 19 y	Women, Age > 19 y	Boys, Age 8-19 y	Girls, Age 8-19 y
Sedentary	1.0	1.0	1.0	1.0
Low active	1.11	1.12	1.13	1.16
Active	1.25	1.27	1.26	1.31
Very active	1.48	1.45	1.42	1.56

Cunningham Equation

The Cunningham equation was estimated from data on 120 men and 103 women in the 1919 Harris-Benedict database who were identified as athletes. The formula was found to predict resting metabolic rate most accurately in endurance athletes. The equation uses three components: resting energy expenditure (REE), energy expenditure during nontraining physical activity (NTEE), and energy expenditure during training (TEE) (3).

Daily Energy Expenditure (kcal) = REE + NTEE + TEE
Where: REE (kcal) = 22 × fat-free mass (kg);
NTEE for light activity = 0.3 × REE;
NTEE for moderate activity = 0.4 × REE;
NTEE for heavy activity = 0.5 × REE;
and TEE = energy expenditure (kcal) found in physical activity charts.

Extrapolations from Macronutrient Recommendations

This method extrapolates daily energy needs from recommendations for carbohydrate, protein, and fat intake (4).

- *Carbohydrate:* The daily recommendation is 5 to 10 g/kg body weight (the lower end of the range is appropriate for off-season and recreational athletes; the higher end for athletes who train for several hours a day and for ultraendurance athletes). Multiply recommended intake in grams by 4 to calculate energy intake from carbohydrate (there are 4 kcal per gram of carbohydrate).
- *Protein:* The daily recommendation is 1.2 to 1.7 g/kg body weight (the lower end of the range is appropriate for endurance athletes; the higher end for strength and power athletes at the early stages of training). Multiply recommended intake in grams by 4 to calculate energy intake from protein (there are 4 kcal per gram of protein).
- *Fat:* The daily recommendation is ≥1 g/kg body weight. Multiply recommended intake in grams by 9 to calculate energy intake from fat (there are 9 kcal per gram of fat).

Handheld Devices for Measuring Resting Metabolic Rate (RMR)

The BodyGem (HealthTech, Inc, Golden, CO) is a handheld device that can be used to measure RMR. Limited research is published to validate the device, but initial studies indicate that it gives accurate and reproducible RMR measurements in nonobese and obese males and females (5).

Online Resources

Information from Katch and McArdle on calculating energy needs is available online from the Weight Loss Information.com Web site (6). To calculate energy expenditure per hour of activity, the CaloriesperHour Web site is useful (7).

Comparing Energy Expenditure Estimates: Case Studies

The following two case studies compare energy expenditure estimates calculated using (*a*) the Cunningham equation; (*b*) carbohydrate, protein, and fat intake recommendations; and (*c*) EERs. Remember, these are estimates. Clinical judgment plus an athlete's goals must be used to determine the individual's best energy intake level.

Case Study 1: Woman Professional Soccer Player

- Age = 22 years
- Weight = 82.6 kg
- Height = 1.73 meters (68 inches)
- Fat weight = 18.3 kg
- Fat-free weight = 64.3 kg

Case Study 1: Woman Professional Soccer Player

	Cunningham Equation	Sum of Recommended Carbohydrate, Protein, and Fat Intakes	EER
Formula	REE + NTEE + TEE REE = 22 × fat-free mass (kg); NTEE for heavy activity = 0.5 × REE; TEE = 10.8 kcal/min	Carb: 8 g/kg body weight × 4 g/kcal Pro: 1.2 g/kg body weight × 4 g/kcal Fat: 1 g/kg body weight × 9 g/kcal	354 – 6.91 × Age + [PA × (9.361 × wt) + (726 × Ht)]
Calculation	REE: 22 × 64.3 = 1415 NTEE: 1415 × 0.5 = 707 TEE: 120 min soccer @ 10.8 kcal/min = 1296	Carb: 82.6 × 8 × 4 = 2644 Pro: 82.6 ×1.2 × 4 = 396 Fat: 82.6 × 1 × 9 = 747	354 – 6.91 × 22 + [1.45 × (9.361 × 82.6) + (726 × 1.73)]
Estimated Energy Expenditure, kcal/d	3418	3787	2464

Case Study 2: Male High School Boxer

- Age: 16 years
- Weight = 73.2 kg
- Height = 1.78 meters (70 inches)
- Fat weight = 9.3 kg
- Fat-free weight = 64 kg

Case Study 2: Male High School Boxer

	Cunningham Equation	Sum of Recommended Carbohydrate, Protein, and Fat Intakes	EER
Formula	REE + NTEE + TEE REE = 22 × fat-free mass (kg); NTEE = 0.5 × REE; TEE = 10.8 kcal/min	Carb: 8 g/kg body weight × 4 g/kcal Pro: 1.7 g/kg body weight × 4 g/kcal Fat: 1 g/kg body weight × 9 g/kcal	88.5 – 6.19 × Age + [PA × (26.7 × Wt) + (903 × Ht)] + 25
Calculation	REE: 22 × 64 = 1408 NTEE: 1408 × 0.5 = 704 TEE: 1497 (60 min stationary cycling @ 8.5 kcal/min + 30 min weight training @ 10.9 kcal/min + 60 min sparring @ 11 kcal/min)	Carb: 73.2 × 8 × 4 = 2344 Pro: 73.2 × 1.7 × 4 = 496 Fat: 73.2 × 1× 9 = 657	88.5 – 6.19 × 16 [1.48 × (26.7 × 73.2) + (903 × 1.78)] + 25
Estimated Energy Expenditure, kcal/d	3609	3497	5284

References

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