# HEALTH AND WELLNESS SUMMIT

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# FUELING FOR ACTIVITY: A GUIDE TO BASIC SPORTS NUTRITION


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# #1 RULE OF SPORTS NUTRITION

- Tolerance, tolerance, tolerance
  - Consider each person's tolerance

# LONG-TERM SPORTS NUTRITION GOALS

- Adequate energy intake
  - Meet the energy demands of training and performance
- Adequate carbohydrate (CHO)
  - Replenishment of muscle and liver glycogen
- Adequate protein intake
  - Growth and repair of tissue
- Adequate hydration
- Adequate overall diet to maintain good health
- Appropriate weight and body composition

# SHORT-TERM SPORTS NUTRITION GOALS

- Consumption of food and beverages
  - Delay fatigue during training and competition
- Minimization of dehydration and hypohydration
- Utilization of dietary strategies beneficial for performance
  - Precompetition meal
  - Appropriately timed caffeine intake
  - CHO loading
- Intake of nutrients that support recovery
- Appropriate timing of nutrients

# BASIC SPORTS NUTRITION GUIDELINES TO SUPPORT TRAINING, PERFORMANCE, AND HEALTH

- Adequate energy intake
  - Energy intake needed to maintain energy balance
  - Adjustments to energy intake (e.g. change body composition)
- Adequate carbohydrate intake
  - 3-12 g/kg body weight daily
  - Proper timing of intake
- Adequate protein intake
  - 1.2-1.7 g/kg body weight daily
  - Proper timing of intake

# BASIC SPORTS NUTRITION GUIDELINES TO SUPPORT TRAINING, PERFORMANCE, AND HEALTH

- Adequate fat intake
  - Fat intake is typically 20-35% of total calories
  - Last macronutrient determined
- Vitamin and mineral intake
  - Meet the DRI
  - Emphasis on nutrient dense foods
- Fluid intake
  - Match fluid intake with fluid loss
  - Body water loss of 2-3% can hurt performance

# BASIC SPORTS NUTRITION GUIDELINES TO SUPPORT TRAINING, PERFORMANCE, AND HEALTH

- Appropriate body weight
- Healthful weight loss practices
- Avoidance of disordered eating or eating disorders
- Evaluating dietary supplements and ergogenic aids
- Flexible eating plan
- Each athlete's sport or position within the sport must be considered when planning dietary intake

# CHO RECOMMENDATIONS FOR ATHLETES

- Athletes should consume 3-12 g CHO/kg/day
  - Goal = replenish depleted glycogen stores
  - Light, low-intensity training: 3-5 g/kg
  - Moderate-intensity training: ≥5 g/kg
  - High-intensity, rigorous training: 6-10 g/kg
  - Ultraendurance athletes: 8-12 g/kg
    - Moderate-high intensity exercise for 4+ hours/day
  - Not just endurance athletes that should be concerned about CHO intake

# CHO RECOMMENDATIONS FOR ATHLETES

| Exercise intensity and duration | Examples of sports | Daily CHO recommendation (energy intake must be adequate) |
|---|---|---|
| Low-intensity or short-duration skill-based activities | Curling<br>Shooting<br>Archery | 3–5 g/kg |
| Low-intensity, long-duration (>1 hour) | Golf<br>Baseball<br>Softball | 5–7 g/kg |

# CHO RECOMMENDATIONS FOR ATHLETES

| Exercise intensity and duration | Examples of sports | Daily CHO recommendation (energy intake must be adequate) |
|---|---|---|
| Very high-intensity, very short-duration (<1 minute) | Field events such as shot put, discus, or high jump<br>Track sprints (50–200 m)<br>Swimming sprints (50 m)<br>Sprint cycling (200 m)<br>Weight lifting<br>Power lifting<br>Bobsled (running start) | 5–7 g/kg |

# CHO RECOMMENDATIONS FOR ATHLETES

| Exercise intensity and duration | Examples of sports | Daily CHO recommendation (energy intake must be adequate) |
|---|---|---|
| High-intensity, short-duration (1-30 minutes continuous) | Track (200–1,500 m)<br>Swimming (100–1,500 m)<br>Cycling (short-distance)<br>Rowing (crew)<br>Canoeing/Kayaking (racing)<br>Skiing (downhill racing)<br>Figure skating<br>Mountain biking | 5–7 g/kg |

# CHO RECOMMENDATIONS FOR ATHLETES

| Exercise intensity and duration | Examples of sports | Daily CHO recommendation (energy intake must be adequate) |
|---|---|---|
| High-intensity, short-duration (1 to 30 minutes with some rest periods) | Gymnastics<br>Wrestling<br>Boxing<br>Fencing<br>Judo<br>Tae kwon do | 5–7 g/kg |
| Moderate-intensity, moderate-duration (30-60 minutes) | 10 km running (elite runners finish in <30 minutes) | 6–8 g/kg |

# CHO RECOMMENDATIONS FOR ATHLETES

| Exercise intensity and duration | Examples of sports | Daily CHO recommendation (energy intake must be adequate) |
|---|---|---|
| Intermittent high-intensity, moderate- to long-duration (>1 hour) | Soccer (football)<br>Basketball<br>Ice hockey<br>Field hockey<br>Lacrosse<br>Tennis<br>Water polo | 6–8 g/kg;<br>8–10 g/kg during heavy training and competition |
| Moderate- to high-intensity, long-duration (1 to 3 hours per day) | Distance running (marathon)<br>Distance swimming<br>Distance cycling<br>Nordic (cross country) skiing | 6–10 g/kg during periods of heavy training and competition |

# CHO RECOMMENDATIONS FOR ATHLETES

| Exercise intensity and duration | Examples of sports | Daily CHO recommendation (energy intake must be adequate) |
|---|---|---|
| Moderate-intensity, ultralong-duration (more than 4 to 5 hours per day) | Ultradistance running<br>Ultradistance swimming<br>Ultradistance cycling<br>Triathlon<br>Adventure sports | 8–12 g/kg depending on the stage of training |
| Other | Bodybuilding | 5–10 g/kg depending on the stage of training |
| | American football | 5–8 g/kg; Varies according to position |

*Source:* Thomas et al., 2016.

# CHO INTAKE PRIOR TO TRAINING AND COMPETITION

- Pre-training and competition dietary goals (most related to CHO)
  - Avoid hunger
  - Delay fatigue
  - Minimize GI distress
  - Prevent hypohydration
- Must consider
  - Time of event
  - Environment
  - Food availability
  - Jitters

# CHO INTAKE PRIOR TO TRAINING AND COMPETITION

- Timing
  - 1-4 g CHO/kg
  - 1-4 hours prior to training or competition
    - "Top off" glycogen stores
    - Avoid hunger during exercise
  - Individual considerations
    - Hunger level
    - Food preferences
    - GI tolerance
    - Time prior to exercise

# CHO INTAKE PRIOR TO TRAINING AND COMPETITION

- Timing
  - Glycemic Index
    - Low-GI before exercise beneficial because of maintenance of BG 1-2 hours into exercise
    - Most athletes seem to do OK with high GI CHO
      - Avoid consuming <1 hour prior to exercise
  - Many specialized products exist, but may not be necessary

# CHO INTAKE DURING TRAINING AND COMPETITION

- CHO intake plan should consider
  - Exercise duration and intensity
  - Type of exercise
    - How easily food/fluid can be obtained
  - Food/fluid preferences
  - Availability of CHO sources

# CHO INTAKE DURING TRAINING AND COMPETITION

- Individual tolerance must be determined
  - Too much CHO slows gastric emptying → GI distress
    - Distance runners have more GI distress vs cyclists
    - Trial and error
    - Competition can add more stress
- Sports drinks can be a good option (6-8% CHO)
  - Leave stomach more quickly
  - 1 liter will provide 60-80 g CHO

# CHO INTAKE DURING EXERCISE TRAINING AND COMPETITION

| Exercise intensity and duration | Sport or event | Recommended CHO intake to enhance performance* |
|---|---|---|
| High-intensity exercise less than 45 minutes | Running (sprints up to 10 km); cycling (track cycling, short criteriums); swimming (sprints up to 1500 m); crew (rowing) | None |
| High-intensity exercise (continuous or intermittent) approximately 45–60 minutes | Team sports, such as basketball, lacrosse, water polo, or ice hockey; cycling time trials | 0–30 g/h, or mouth rinse |

# CHO INTAKE DURING EXERCISE TRAINING AND COMPETITION

| Exercise intensity and duration | Sport or event | Recommended carbohydrate intake to enhance performance* |
|---|---|---|
| High-intensity exercise (intermittent) approximately 90 minutes | Team sports, such as soccer; skilled recreational tennis players; team or individual handball, racquetball, or squash | 30–60 g/h |
| Moderate to vigorous exercise more than 2 hours | Backpacking, hiking; recreational cycling | 30–60 g/h** |

# CHO INTAKE DURING EXERCISE TRAINING AND COMPETITION

| Exercise intensity and duration | Sport or event | Recommended carbohydrate intake to enhance performance* |
|---|---|---|
| High-intensity exercise more than 2 hours | Marathon running; sprint and Olympic distance triathlon; 50 km ski racing; professional tennis match | 30–60 g/h** |
| Ultraendurance competitions lasting many hours or repeated over days | Ironman® length triathlons; cycling stage races, adventure racing | up to 90 g/h** |

# CHO INTAKE DURING TRAINING AND COMPETITION

- Mouth rinse w/CHO solution
  - Research shows performance benefit for 30-60 minute high-intensity endurance exercise
  - Central effect?
    - CHO in the mouth stimulates reward centers in brain
    - Mechanism?
  - Questions
    - How much, how often?
    - CHO status of athlete

# CHO INTAKE DURING TRAINING AND COMPETITION

- Commercial CHO products
  - Sports drinks
    - Provide fluid, electrolytes, and CHO
    - <10% CHO
    - Glucose or maltodextrins more beneficial vs fructose
      - Maltodextrin → slow, sustained CHO delivery to blood
      - Fructose is used
        - For flavor → more fluid consumed
        - GI comfort
        - Increase ability to absorb CHO
    - When CHO need is high, consume variety of CHO sources

# CHO INTAKE DURING TRAINING AND COMPETITION

- Commercial CHO products
  - Sports drinks (20 oz bottle, 36 g CHO)
    - Sodium (270 mg)
      - May enhance glucose absorption
      - Replace sodium lost in sweat
  - Low-CHO sports drinks
    - Provide fluid and electrolytes
    - CHO content sufficient?

# CHO INTAKE DURING TRAINING AND COMPETITION

- Commercial CHO products
  - Gels
    - 1 packet = 100 kcal, 20-23 g CHO
      - 2-3 packets/hour
  - Solid CHO sources
    - If tolerated
    - Helps w/hunger
    - Sports/energy bars
      - Usually contain CHO, fat, and protein (tolerance?)
      - Good for adventure racers
- Individual must be aware of CHO content and what they need

# CHO INTAKE AFTER TRAINING AND COMPETITION

- Glycogen, glycogen, glycogen
- Some glycogen will be resynthesized because of depleted glycogen stores (even w/o eating)
  - Make glucose in the liver
  - Still need much more glycogen resynthesis
    - Carbohydrate and insulin are necessary
    - Insulin activates glycogen synthesis

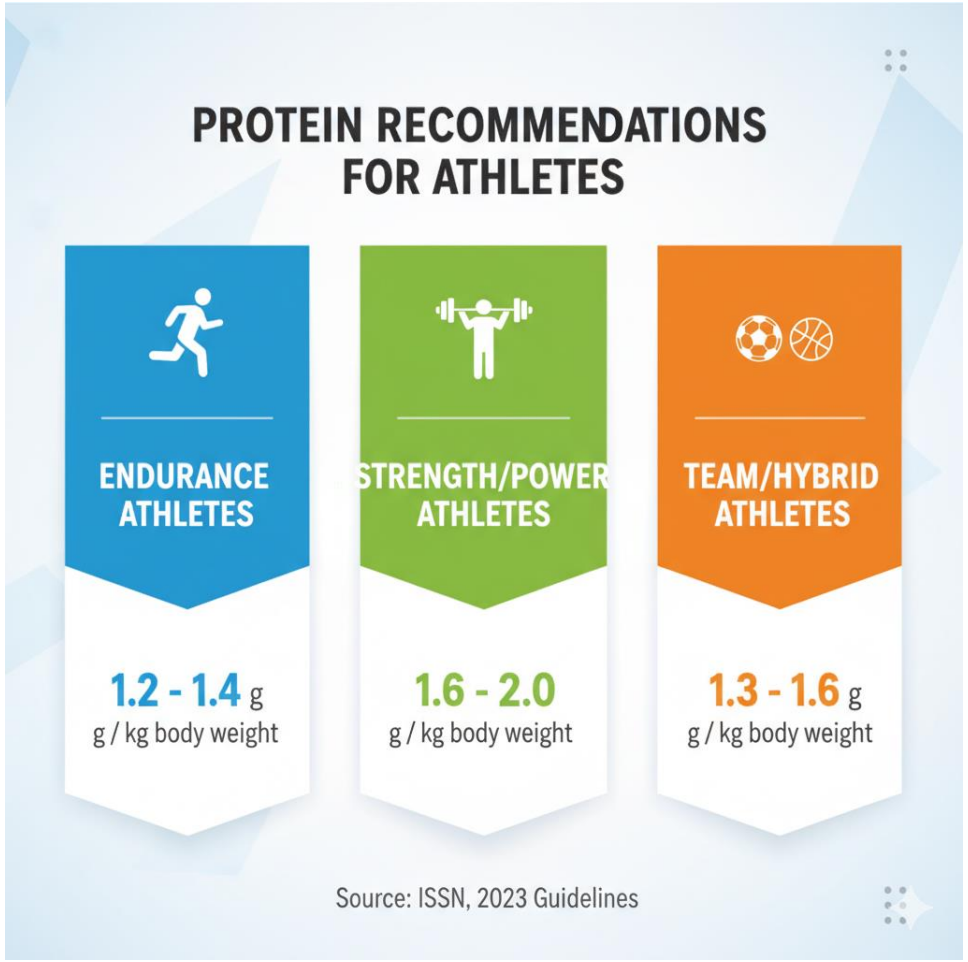
# CHO INTAKE AFTER TRAINING AND COMPETITION

- Optimal muscle glycogen resynthesis
  - Timing
    - ASAP after activity
    - >2 hours after activity → reduced muscle glycogen synthesis
  - Meal size
    - Small, frequent meals over hours vs one large meal
      - Insulin remains elevated
  - Type of CHO
    - Beverages w/glucose or sucrose (minimize fructose)
    - High-GI CHO may enhance muscle glycogen resynthesis vs low-GI CHO
      - Higher BG and insulin

# CHO INTAKE AFTER TRAINING AND COMPETITION

- Optimal muscle glycogen resynthesis
  - Type of CHO
    - Commercial recovery products available
      - Usually contain CHO and protein (Gatorade, Endurox)
  - Amount of CHO
    - 1.5 g CHO/kg (~120 g) during first hour after exercise
      - 1-1.2 g CHO/kg/hour over next 3 hours
      - If <8 hours before next exercise session, 1-1.2 g CHO/kg for 1st 4 hours
  - Protein/AA
    - Some research indicates that also consuming protein after exercise may enhance glycogen synthesis rate
      - Adding protein does not hurt

# PROTEIN RECOMMENDATIONS FOR ATHLETES




- Consider daily intake, protein quality, distribution, and timing
- General recommendations for athletes should be individualized
  - Assume adequate energy intake & good quality protein

# PROTEIN RECOMMENDATIONS FOR ATHLETES

- During periods of low energy intake, protein intake should be 1.8 g/kg to maintain skeletal muscle mass

- Bodybuilders
  - Typically high protein intake of 2.5-3.5 g/kg
  - Because of the upper limit of urea synthesis, a limit of 2.5 g/kg is recommended
    - >2.5 g/kg risks increasing blood ammonia levels
    - No evidence of building more muscle tissue

# PROTEIN RECOMMENDATIONS FOR ATHLETES

- Different proteins = different ability to stimulate muscle protein synthesis
  - Proteins that maximize muscle protein synthesis
    - High quality proteins
      - Dairy, meat, fish, eggs, soy
        - Food or supplement sources
- Distribution
  - 25-35 g Pn/meal
    - 3-5 meals or snacks throughout the day

# PROTEIN RECOMMENDATIONS FOR ATHLETES

- Timing of protein intake
  - Exercise induces a catabolic state
    - Followed by an anabolic state
      - Allows for recovery from the acute effects of exercise and for skeletal muscle growth
      - 2-hours after exercise = “anabolic window”
        - Optimal skeletal muscle protein synthesis (MPS)
        - Muscle still sensitive to protein intake for 24-48 hours
      - Consuming protein after exercise elevates amino acid levels in blood
        - Activates signaling molecules that promote MPS
        - Leucine

# PROTEIN INTAKE AFTER RESISTANCE EXERCISE

- Beneficial for MPS, strength, power, body composition
  - ASAP up to 2 hours after exercise
  - 0.25 to 0.3g/kg within 2 hours of exercise
    - 15-25 g of protein
- High-quality protein w/indispensable AA
  - Egg white, whey, casein, soy
- Maximum protein synthesis
  - 1.7-2.4 g leucine
    - Dairy, eggs, whey protein
- Maximum amount of protein after resistance exercise
  - 25 g

# PROTEIN INTAKE AFTER RESISTANCE EXERCISE

- Milk
  - Contains whey and casein
    - Each have benefits
- Soy
  - Fast-acting protein like whey
  - Whey may promote skeletal muscle increase more quickly over time

# CHO-PROTEIN CONSUMPTION AFTER EXERCISE

- CHO stimulates insulin secretion
  - Insulin increases AA uptake into the muscle and inhibits muscle protein degradation
- Good options
  - Chocolate milk, fruit yogurt, sports beverages w/both CHO and protein
- Endurance athletes would benefit in terms of glycogen, MPS, and calorie intake
  - Other benefits not demonstrated

# CHO-PROTEIN CONSUMPTION DURING EXERCISE

- Few studies in strength-trained athletes
  - Theory: Consuming protein or AAs may:
    - Offset muscle protein breakdown?
    - Enhance MPS postexercise?
- Endurance athletes
  - Theory: Consuming protein or AAs may:
    - Offset damage from exercise
    - Mixed research results

# PROTEIN INTAKE BEFORE…

- Protein intake before resistance exercise
  - Insufficient evidence to support the idea that protein before exercise would benefit performance or recovery

- Protein intake before sleep
  - Sleep is typically characterized by protein degradation
  - Protein intake before sleep can
    - Reduce skeletal muscle protein breakdown
    - Stimulate MPS
  - At least 40 g

# EFFECT OF ENERGY INTAKE ON PROTEIN INTAKE

- Adequate energy intake
  - Spares protein from being used for energy
  - Helps maintain nitrogen balance
    - Nitrogen balance necessary to maintain muscle mass
    - Positive nitrogen balance to increase muscle mass
- Amount of protein needed during an energy deficit depends on
  - Magnitude of energy deficit
  - Whether energy deficit is acute or chronic
- Higher protein intake recommended to dieting athlete

# DIETARY MANIPULATIONS TO ENHANCE FAT METABOLISM

- "Fat loading"
  - Increase fat oxidation and spare CHO use?
  - Endurance performance not likely to improve
- Research shows high fat diets (p. 208-209):
  - Can favor fat oxidation at rest, and light to moderate-intensity exercise
  - Result in low endogenous carbohydrate availability
  - Limits intensity of exercise
- Newer strategy
  - "Training low"
  - Short-term CHO-restricted diet followed by CHO restoration prior to exercise

# EFFECT OF CAFFEINE ON FAT USAGE

- May enhance fat mobilization
  - Fat oxidation is not significantly increased
  - Muscle glycogen not spared
- Central nervous system stimulant
  - Increases sense of awareness
  - Decreases perceived effort

# FAT RECOMMENDATIONS FOR ATHLETES

- Appropriate fat intake depends on
  - Calorie needs (assume weight maintenance)
  - Macronutrient balance
    - Higher CHO/protein intake typically means lower fat intake
    - Severe restriction of fat intake not recommended
- Fat needs often expressed as a % of total energy intake
  - 20 to 35% total caloric intake
  - May be expressed on g/kg body weight basis
    - ~1.0 g/kg daily

# FAT RECOMMENDATIONS FOR ATHLETES

- Determining fat intake for an athlete
  - Determine energy needs
  - Determine CHO needs
  - Determine protein needs
  - …then determine fat needs

  - Energy needs – CHO kcals – Pn kcals = fat kcals
  - fat kcals/9 = grams of fat needed

# FAT RECOMMENDATIONS FOR ATHLETES

- Assuming energy and macronutrient balance, the general guideline for daily fat intake: 1g fat/kg
- Endurance athletes:
  - Up to 2 g fat/kg
    - Replace intramuscular triglycerides (IMTG)
- Some athletes do not meet CHO and protein recommendations
  - May need to reduce fat intake to be able to increase CHO and/or protein
  - Do not overly restrict fat intake
    - Can affect performance

# FAT RECOMMENDATIONS FOR ATHLETES

- Emily, 64 kg runner
  - Needs
    - Kcals: 64 kg x 42 kcal/day = ~2700 kcal/day
    - CHO: 64 kg x 7 g CHO/kg = ~445 g CHO/day
    - Pn: 64 kg x 1.4 g Pn/kg = ~89 g Pn/day

    - Calculate Emily's recommended fat intake in grams

# INADEQUATE FAT INTAKE CAN NEGATIVELY AFFECT TRAINING, PERFORMANCE, AND HEALTH

- Effects of an inadequate fat intake
  - Inadequate replenishment of IMTGs
    - Reduced after endurance exercise and need replenishment
  - Inability to manufacture sex-related hormones
    - Testosterone, estrogen?
  - Changes in HDL:LDL ratio
    - <20% of kcals from fat can lower HDL
  - Inadequate fat-soluble vitamin intakes
    - <0.75 g fat/kg/day

# REDUCING CALORIC INTAKE BY REDUCING DIETARY FAT INTAKE

- At some point, an athlete may want to be in an energy deficit to lose body fat
  - May benefit performance
  - First reduce alcohol calories, if present in diet
  - Since CHO and protein can affect performance, reduction of fat intake is logical

# REDUCING CALORIC INTAKE BY REDUCING DIETARY FAT INTAKE

- Kevin, 100 kg bodybuilder
  - Usual intake
    - 5500 kcal/day (55 kcal/kg)
    - 150 g fat/day (1.5 g fat/kg)
  - Pre-contest diet (6-12 weeks)
    - 3500 kcal/day
    - Slight increase in protein intake
    - Slight decrease in CHO intake
    - Substantial decrease in fat intake (0.65 g fat/kg)
      - Further reduction 1 week prior to contest

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# Resources

## CU System:

CU Advantage - Employee Perks (system wide)
advantage.cu.edu
CU Employee Services
www.cu.edu/employee-services

## CU Boulder:

CU Boulder Health & Wellness Services
colorado.edu/health
CU Boulder Employee Wellness
colorado.edu/health/WorkWell
CU Boulder Office of Institutional Equity and Compliance (OIEC)
colorado.edu/oiec
CU Boulder Benefits, Perks, and Resources
colorado.edu/hr/faculty-and-staff-perks

## UCCS:

UCCS Gallogly Recreation & Wellness Center
recwellness.uccs.edu
UCCS HealthCircle Clinics
healthcircle.uccs.edu
UCCS Lyda Hill Institute for Human Resilience
resilience.uccs.edu
UCCS Office of Institutional Equity
equity.uccs.edu

## CU Denver:

CU Denver Wellness & Recreation
ucdenver.edu/wellness
CU Denver Counseling Center
ucdenver.edu/counseling-center
CU Denver & Anschutz Office of Equity
ucdenver.edu/offices/equity
CU Denver HR
ucdenver.edu/offices/human-resources/current-faculty-staff

## Anschutz:

Anschutz Health & Wellness Center
medschool.cuanschutz.edu/health-and-wellness
Anschutz Student Health & Wellness
www.cuanschutz.edu/student/health-wellness
CU Denver & Anschutz Office of Equity
ucdenver.edu/offices/equity
Anschutz HR
cuanschutz.edu/offices/human-resources/current-faculty-and-staff

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