Performance Nutrition for Cycling
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Common Nutritional Issues
- High Energy Demands
  - Energy and carbohydrate intake
  - Fueling during training/competition
  - Recovery
- Energy Deficiency in Sport
  - Health & performance consequences
  - Treatment strategies
  - No start criteria

Other Nutrition Issues
- Iron Status
- Dietary/Sport Supplements

Periodization of Eating
Changes must occur:
- Energy intake
- Carbohydrate intake
- Protein intake
- Fat intake
- Fluid intake
- Workout Foods/Fluids
- Dietary Supplements

Energy Expenditure Variability Throughout The Week

Problematic Approaches
- Extreme energy restriction, skipping meals, sleeping through recovery, extra training outside of plan, prolonged fasting, following fads
- Low carbohydrate intakes
- Low protein intakes
- Dietary supplements (e.g., energy drinks, ergogenics etc)
- Intense training w/ lack of recovery

Carbohydrates: Effects on Muscle Glycogen

Energy Deficiency
High CHO During Intensified Training Results in Better Maintenance of Performance
Achten et al. 2003

<table>
<thead>
<tr>
<th>11-day trial</th>
<th>10-day Wash-Out</th>
<th>11-day trial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy: 60 min at 75% HRmax</td>
<td>Lab Trials: 30 min @ 58% VO2max; 30 min @ 77% VO2max, 8k</td>
<td>Hard: maximal effort 16k</td>
</tr>
</tbody>
</table>

Randomized, Cross-Over Diet Treatments
High CHO: 8.5 g/kg/d
Low CHO: 5.4 g/kg/d

High CHO during intensified training results in better maintenance of performance

Decreased performance on low CHO diet

Achten et al. 2003
Current trends in manipulation of CHO availability and metabolism in sport

**Exercise / Diet Strategy**

**Chronically low CHO:** Chronic reduction in CHO availability, immune and CNS system effects, performance effects

**Twice a day training:** Reduced CHO availability for 2nd session from endogenous and exogenous sources, immune and CNS system effects, chronic performance effects

**Training after overnight fast:** Reduced CHO availability from exogenous sources and reduced CHO availability from endogenous sources (previous intake), immune and CNS system effects, acute performance effects

Burke, 2011

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**Exercise / Diet Strategy**

Prolonged training with or without overnight fast and/or withholding CHO during session: Reduced exogenous CHO sources for muscle for session, acute reduction of CHO availability, immune and CNS system effects, acute performance effects

Withholding CHO during first hrs of recovery: provides adequate fuel during session but may amplify post/exercise signaling due to short but targeted time of low CHO availability – perhaps achieving “training harder” effect. Could interfere with refueling and readiness for next session. Should not be attempted if sessions are <8 hrs apart, immune, CNS, and acute & chronic performance effects

Burke, 2011

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**Before, During, and After Exercise**

Athletes Need More Protein than Nonathletes!

- ↑ Protein turnover in athletes
- Protein breakdown
- Protein synthesis
- ↑ Need for protein
- Exercise ↑ synthesis and breakdown
- Protein intake ↑ synthesis, ↓ breakdown
- Synergistic effect: ↑ Net balance
- Timing and Amount
  - 20-25 g 5x per day

Protein increases satiety and energy expenditure:
- Weight control

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**Fat in Muscle: A Great Energy Source**

2 hrs of submaximal cycling depleted muscular fats by 50% in trained cyclists and a low fat diet was unable to replete these fats within 48 hrs

Average stores ~ 2-10 mmol/kg w.w.
or estimated mixed muscle IMTG content of 0.2 kg (~1850 kcal)

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**Eating before Training**

Eating before or during training:
- What's available?
- Sports nutrition products or high carbohydrate snacks
- Carbohydrate-rich
- Low fat, moderate protein
- Low in fiber

<60 min before

Drink ~ 2 cups of fluid
Carbohydrate-rich
Low fat, moderate protein
Low in fiber

Drink as preferred; if urine dark
Drink more
Carbohydrate-rich
Low fat, little protein
Low fiber
Carbohydrate Supplementation during Exercise

- Ingesting CHO during exercise > 45 min improves performance
- Delays fatigue/Increases time to exhaustion
- Improves time-trial performance

Blood glucose during cycling at 74% VO2max (CHO vs PLA)

CHO oxidation during cycling at 74% VO2max (CHO vs PLA)

Muscle Glycogen during cycling at 74% VO2max (CHO vs PLA)

Effects of Mouth Rinse

- 2-3% performance improvement w/ 10 sec mouth rinse (glu or maltoleucrin) @ 12.5% time trial completion, repetitive ingestion
- Effect of nutritional status prior to mouth rinse most critical for effect
- Fasted or no food within 3-4 hrs prior to event

Applications
- Short duration exercise
- GI issues
- Weight control

Artificial Sweetener
Carbohydrate Supplementation during Exercise

CHO Oxidation Rates w/ Glucose and Fructose

Active Transport

Superior Endurance Performance with Ingestion of Multiple Transportable Carbohydrates

Training the Gut to Absorb & Oxidize more!

Carbohydrate Recommendations

Cox et al., 2010; effect of carbohydrate intake during exercise training on carbohydrate oxidation
- highly trained athletes
- 1 group who consumed glucose during each of their workouts over a 4-week training block increased their ability to oxidize this carbohydrate, while muscle oxidation of carbohydrate consumed during exercise remained constant in a matched group
- Carbohydrate, water and electrolytes all work together to drive absorption!

Pfeiffer et al. 2010 also showed similar responses of CHO intake on oxidation rates in running; No difference btw solid vs liquid sources (Pfeiffer et al., 2010)
When to Add a Sport Drink, Gel or Bar

- Depends on last meal and goal of training session
- For prolonged and/or intense exercise > 2 hrs
- In the heat, cold, at altitude
- During acclimatization
- Sodium is key!
- When tired...
- To prevent muscle wasting
- To support immune system
- In competition

Dehydration and Performance

Weight loss from body water of as little as 2% of BW can lead to ↓ performance and impaired thermo-regulation

Sweat rate is highly variable!

Hydration Strategies

Fluid Replacement Guidelines:
- According to Sweat Rate
- When thirsty

Sodium!!

Depend on environmental factors, ~ 8 oz ml every 15-20 min

Maximal fluid consumption during exercise: ~32-35 oz per h more if you sweat a lot!

Sweat Rate Assessment

1. Step: Record environmental condition
2. Step: Weight (before) - Weight (after) = Fluid loss
   150 lbs - 148 lbs = 2 lbs or 32 oz
   (1 lb = 16 oz, if you use kg use 1L for each kg lost)
3. Step: Add workout fluids consumed:
   32 oz during 2 hrs cycling
   32 oz + 32 oz = 64 oz or 2L
4. Step: divide by number of hours trained:
   64 oz/2 hrs = 32 oz/hr (or 1L/hr)
5. Step: record in log
   Avoid losing more than 2% of BW

Dehydration: Feedback

- Daily Weight Fluctuations > 1%
- Low urine volume in AM
- Thirsty
- Elevated AM heart rate
- Moody & lethargic
- Headaches
- Urine Color
- USG

To Optimize Performance....

Sport drink, gels, blocs, bars, food

1. Sweat rate determines fluid and carbohydrate
   - 40-50 g/hr of carb’s from sport drink
2. Optimizing for intense training and racing
   - Adding gels, bars etc. to get 60-90 g/hr carb’s
   - Mixed carb’s (glucose, fructose, sucrose)
3. Test your strategies in training!
4. GI issues
**Glycogen Resynthesis**

- Recovery: 24-48 hrs to replete muscle glycogen stores.
- The longer or harder your exercise, the longer the time you need for recovery of glycogen stores.
- Window of opportunity: Faster repletion within first few hrs of exercise.

**Relative Energy Deficiency in Sport (RED-S)**

- The IOC Consensus Statement: Beyond the Female Athlete Triad – Relative Energy Deficiency in Sport (RED-S).

**Energy Balance, Energy Availability**

- Energy Deficiency
  - Energy Intake
  - Exercise Energy Expenditure
  - $2500 \text{ kcal} - 1500 \text{ kcal} = 1000 \text{ kcal}$
  - $< 30 \text{ kcal/kgFat}$

- Enough to maintain basic physiologic function and health?

**Energy Availability in Cyclists**

- Significant difference between male and female cyclists, $p < 0.01$.
- Restricted eating (TFEQ) increased during off-season.
- No differences in BMD across season.
One Consequence of Energy Deficiency is Low Bone Mass

- Low BMD in endurance athletes (cyclists > runners; Rector et al., 2008)
- Loss of BMD throughout the season in cyclists (Barry and Kohrt, 2008)
- Reduced gonadal hormones in endurance runners (De Souza et al., 1994)

Relative Energy Deficiency in Sport (RED-S)

Assessing Risk of RED-S IOC Clinical Practice Models

Risk Assessment & No Start Criteria

- GREEN
  - Healthy eating habits with appropriate energy availability
  - Normal hormonal and metabolic function
  - Healthy BMD as expected for sport, age and ethnicity
  - Healthy musculoskeletal system

  Full training and competition allowed with no stipulations

- YELLOW
  - Moderate risk; caution yellow light
  - Full training and competition allowed with no stipulations
  - Partially supervised training with a medical treatment plan
  - May compete once cleared under supervision
  - Re-evaluation at regular intervals (1-3 months)
  - Regular reassessments for compliance and progress
Risk Assessment & No Start Criteria

- RED
  - Clearance to participate in sport denied
  - Athlete to receive treatment
  - Use of a treatment contract advised

Treatment of Energy Deficiency

- Treatment Team
  - Treatment team: MD, Psychologist, Sport Dietitian (CSSD), Physiologist, Physical Therapist, Coach
- Nutrition: Increase in energy availability (EA) 
  - RED-S
    - 300-600 kcal/day (Duick et al., 1996, Kopp-Woodruff et al., 1999, Guebels et al., 2013)
    - Normalizing eating patterns and behaviors
    - Depending on the cause of LEA, psychological support

Bone Building Nutrients

Dietary Reference Intakes

<table>
<thead>
<tr>
<th></th>
<th>14-18 y</th>
<th>19-30 y</th>
<th>RED-S</th>
<th>Best Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium (AI)</td>
<td>1300 mg</td>
<td>1000 mg</td>
<td>1500 mg</td>
<td>Dairy products</td>
</tr>
<tr>
<td>Vitamin D (RDA)</td>
<td>800 IU</td>
<td>800 IU</td>
<td>800 IU</td>
<td>Fish, milk</td>
</tr>
<tr>
<td>Newer recomm.</td>
<td>1000 IU</td>
<td>1000 IU</td>
<td>1000 IU</td>
<td>Supplements D3</td>
</tr>
<tr>
<td>Vitamin K (AI)</td>
<td>70 IU</td>
<td>90 IU</td>
<td>60-90 IU</td>
<td>Green leafy veggies</td>
</tr>
</tbody>
</table>

* *probably too low (Weaver, 2004)

Bone Mass related to Calcium in Sweat in Cyclists

Measured sweat calcium loss at ~140 mg per 2 hour ride (Dueck et al., 2007)

Supplementation with calcium can replace lost calcium, possibly improving BMD (Dueck and Koch, 2011)

Ingest 1000 mg of Ca before long workouts

Bone Loading to Prevent Osteoporosis

Resistance Exercise

- Progression up to 8-10 reps x 2-3
- Barbell: squats, lunges
- Leg press
- Adductors, adductors, hip extension
- Calf raise
- Seated row
- Lsit pull down (posterior)
- Perform after endurance exercise not before
- Integrate recovery nutrition

Jumping

- Insert multiple times per day
- Volume is not important (MES)
- Progression is necessary to prevent injury
- Walking downstairs
- Skipping
- Box jumps up
- Vertical counter-movement jumps
- 1 legged alternates
- Hurdles (low...high)
- Box jumps down (progression)

Iron Deficiency

- Causes
  - Blood loss
  - Increased altitude, training load
  - Poor Eating Habits
- Symptoms
  - Fatigue (during training)
  - Weakness
  - Short of Breath
  - Increased Heart Rate

Diagnosed based on blood test (CDC, serum ferritin) Best treated with iron supplementation
Supplement Concerns

- Regulatory Issues
- Contamination and Impurities
- Mislabeing
- Potential Side Effects
- Banned Substances
- Ineffectiveness

http://www.supplementsafetynow.com/


Do Cyclists Need Supplements?

- Set the basic conditions for optimal training
  - Adequate calories, CHO, PRO
  - Removal of fad diets
  - Optimal hydration
  - Adequate bone nutrients
  - Adequate iron intake
- Supplement to meet additional needs
  - Calcium + vitamin D
  - Iron?
  - Multivitamin/minerals
  - Caffeine, Nitrates, Beta Alanine

Eat, Drink & Fuel Well!!

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