The Importance of Nutrition in Extreme Sports - Feeding the Beast

Inigo San Millán, PhD
Assistant Professor, Department of Physical Medicine and Rehabilitation
University of Colorado School of Medicine
Director, Sports Performance Division
Director, Physiology and Metabolism Lab
CU Sports Medicine and Performance Center
Inigo.sanmillan@ucdenver.edu
@doctorinigo
Why do Athletes Eat?

For Performance

To Recover and Build
Mitochondria are Key for Cellular Respiration and ATP Synthesis
Mitochondria and Athletic Performance
Fatty Acids and Carbohydrates Oxidative Capacity
Carbohydrates are the most important Fuel in Extreme Sport Athletes
Carbohydrates Public Enemy #1??
Are they really that bad for you??
Carbohydrates Weren’t sent by Aliens from otter Space 10 years ago to exterminate humankind!
In fact….Paleo diet was rich in Starchy foods!


94% of the 50 sets of teeth found in a Paleolithic cave in Morocco had Caires and Tooth Decay as a result of starchy foods

Hardy et al. Dental calculus reveals potential respiratory irritants and ingestion of essential plant-based nutrients at Lower Palaeolithic Qesem Cave Israel. Quaternary International 2015.

Starch granules found in teeth show evidence of plants and starchy foods in Paleolithic diets.
Systematic review: Carbohydrate supplementation on exercise performance or capacity of varying durations


- 61 published studies on Carbohydrate and Performance
- 82% Shows Statistically significant performance benefits (50 studies)
- 18% of studies shows no change compared to placebo
- NO study shows detrimental performance with CHO

What Does Science Say?
Glycogen Will Be Utilized During Exercise

Multiple scientific studies show the direct relationship between glycogen levels and performance
The relationship of muscle glycogen content, work time and dietary carbohydrate intake (adapted from Borgström et al. 1967).

Glycogen Intake and Performance

Effects of Carbohydrates in a 40k time trial after a 120min at 55% WMax

- Glucose + Fructose (90g/h): 275W, 56:07:00
- Glucose (90g/h): 254W, 60:47:00
- Placebo: 231W, 67:00:00

Currell and Jeukendrup, 2008
Competition Nutrition Practices of Elite Ultra-Marathon Runners

By Trent Stellingwerff in LJSNEM, June 2015

IN 2014
10 ultramarathons with a total of 970 miles, including winning the prestigious Western States Endurance Run 100-Miler

DURING THE 100-MILE RACES
Throughout their respective 100-mile races, athletes consumed 1162±350g of CHO (77±26g/1), with minimal fat and protein intakes

Total CHO intake during the race (g)

Runner #1 (66g/4)
Runner #2 (55g/7)
Runner #3 (54g/1)

Athletes also consumed 912±322mg of caffeine and 6.9±2.14g of sodium

Commercial products accounted for 93±12% of energy intake (sports drinks, gels, candies & commercial colas)

However, one athlete did mention increasing contributions of real food to his fueling plan. "I increasingly use and experiment with real food for races over 52 hours, and I do try and take in a bit of protein and fat. This largely comes down to trying to avoid flavor fatigue." A second athlete noted "at crewed aid stations I also picked up ~1oz. salted chocolate covered almonds. They are an easy way to get some calories and protein in, especially later in the race when gels become less and less appealing."

PRE-RACE BREAKFAST

PRO (29g)

CIO (70g)

Total caloric intake during the 100-mile

5530 ± 1673 KCAL

2 athletes consumed 12.5 and 4.2g of ginger throughout their races

INTRAMUSCULAR TRIGLYCERIDES

GLYCOGEN

GLUCOSE

FREE-FATTY ACIDS

Substrate requirements of elite ultra-marathoner winning the 100-km world-championships

Conclusion:
All three athletes practice nutrition strategies providing high CHO availability throughout their races. Furthermore, substrate oxidation estimates demonstrated a high CHO vs. fat dominant race performance while winning the World 100km Championships.
Kenyan runners have dominated for decades and are the skinniest athletes in the world.
Kenyan runners have dominated for decades and are the skinniest athletes in the world

Kenyan’s diets
Energy Intake: 2987Kcal
- Carbohydrates: 76.5%!!
- 10.7g/kg/day!!
- Fat: 13.4%
- Protein: 10.1%
- 20% Simple sugars!!
HIGH CHO and LOW FAT diet!!

Carbohydrates during the Tour de France

Garmin Riders at TdF
Total Energy Intake: 6000-9000 Kcal/day
- Carbohydrates: 70-75%
- About 1,000 g/day of CHO
  - 400g simple sugars!!!
- 4000 kcal/day of CHO
  - 1600 Kcal/day Simple Sugars!
- 13-14g/kg/day!!
Glycogen Regulates Muscle Contraction

Glycogen Content Regulates Muscle Contraction

A 25% decrease in Glycogen in the legs will decrease Ca++ release from SR by a 10!
The Importance of CHO and Glycogen Storage

Muscle with plenty of glycogen

Muscle Glycogen depleted
The Importance of CHO and Gycogen Storage

During High Exercise intensities (Competition, hard training)

Muscle Protein (BCAA’s)

Muscle Glycogen depleted

With normal Glycogen, protein utilization ~3-5%
With low Glycogen content protein utilization can be up to 20%!
The Importance of CHO and Glycogen Storage

Catabolism

Muscle Glycogen depleted
Muscle Damage Can Result from Low Glycogen Content

Low glycogen levels during hard training and competition will not only decrease performance but can also cause muscle damage.
Muscle Damage Can Result from Low Glycogen Content

Damaged muscle impairs proper muscle glycogen storage capacity!...
This may create a vicious cycle and lead to overtraining!


Muscle Damage

Not a good combination!
Skeletal Muscle Ultrasound To Measure Glycogen Content
Skeletal Muscle Ultrasound To Measure Glycogen Content
Skeletal Muscle Ultrasound To Measure Glycogen Content

**Clinical Features**

Validation of Musculoskeletal Ultrasound to Assess and Quantify Muscle Glycogen Content. A Novel Approach


John C. Hill, and Ihigo San Millán

1 University of Colorado School of Medicine, Aurora, CO

Correspondence: John Hill, DO, FAAFP, FACSM, CU Sports Medicine, 2000 S Colorado Boulevard, Tower 1, Suite 4500, Denver, CO 80222. Tel: 720-848-8200. Email: john.hill@ucdenver.edu
INDIRECT ASSESSMENT OF GLYCOGEN STATUS IN COMPETITIVE ATHLETES

I. San Millán1, C. González-Haro2, J. Hill, FACSM1,

1School of Medicine, University of Colorado Denver, Denver, CO.; 2Department of Pharmacology and Physiology, School of Medicine, University of Zaragoza, Spain

INTRODUCTION: Proper glycogen storage is of great importance for athletic performance. Multiple studies show the positive correlation between glycogen storage and performance. Nevertheless, glycogen assessment is difficult to determine due to the invasive and impractical nature of muscle biopsies. Therefore, it is difficult to identify suboptimal glycogen levels in athletes. Throughout the measurements of maximal blood lactate levels ([La]max) and maximal carbohydrate oxidation rates (CHOox max) it could be possible to indirectly estimate muscle glycogen status in competitive athletes and identify suboptimal glycogen levels. The purpose of this study was to assess indirectly muscle glycogen status through measurement of [La]max and CHOox max.

METHODS: 82 competitive men (28 professionals and 54 non-professionals) and 17 competitive carried out a bicycle ergometer test, starting at 2 W·kg−1 with increments of 0.5 W·kg−1 until exhaustion, the duration of three first steps was 5 min, and then 10 min. Oxygen uptake (VO2) and carbon dioxide (VO2) were measured (ParvoMedics TrueOne 2400, Sandy, UT) throughout the test and blood lactate concentration ([La]max) (YSI 1500, Yellow Springs Instruments, Ohio) at the end of each step. [La]max was considered the value at the end of last step of exercise. Fat and carbohydrate oxidation rates (FATox and CHOox) were estimated by means of Frayn’s equations. A cutoff of 1 SD respect to the ([La]max) was suggested in order to classify the subjects in two groups: GO (Optimal [La]max) and GS (Suboptimal maximal [La]max) with [La]max of >5.27 mM in men and <4.00 mM in women respectively as the cutoff. A Student t-test for independent data was used to compare groups, the determination of the Pearson correlation coefficient was used to verify the existence of relationships between variables, level of statistical significance was set at p<0.05.

RESULTS: The results of the present study showed that 30% for men and 24% for women showed suboptimal [La]max (GS). The correlation between [La]max and CHOox max was high in men (r=0.771, p<0.05) and low in women (r=0.373). In men, [La]max, CHOox max, and RER max were significantly higher in GO vs. GS, whereas FATox max was significantly lower in GO vs. GS. In women, there were not found significant differences neither in CHOox max nor in FATox max. Nevertheless [La]max, and RER max were significantly higher in GO vs GS.

CONCLUSION: The measurement of [La]max and CHOox max in competitive athletes could be a good and practical approach to indirectly evaluate glycogen status as well as to identify suboptimal glycogen storages that can ultimately affect athletic performance.

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How Much CHO Athletes Need?

<table>
<thead>
<tr>
<th>Exercise Intensity and Time</th>
<th>Carbohydrate Targets</th>
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<tbody>
<tr>
<td>Light Low-intensity or skill-based activities</td>
<td>2-3 g per kg BM</td>
</tr>
<tr>
<td>Moderate Moderate exercise training (~1 hr / day)</td>
<td>3-4 g per kg BM</td>
</tr>
<tr>
<td>Moderate-High Endurance training (i.e. moderate-to-high intensity exercise of 1-3 hr / day)</td>
<td>4-6 g per kg BM</td>
</tr>
<tr>
<td>High Competitive Level (i.e. moderate-to-high intensity exercise of 3-4 hr / day)</td>
<td>6-8 g per kg BM</td>
</tr>
<tr>
<td>Very High Professional/Elite (i.e. moderate-to-high intensity exercise of &gt;4 hr / day)</td>
<td>8-10 g per kg BM</td>
</tr>
</tbody>
</table>
Recommendations during exercise

Carbohydrate intake during exercise

- Carbohydrate type
  - < 60 g/h: Single or multiple transportable carbohydrates
  - > 60 g/h: Multiple transportable carbohydrates

- Carbohydrate recommendation
  - Small amounts or mouth rinse
  - 30 g/h
  - 60 g/h
  - 90 g/h

- Time intervals
  - 0 min
  - 30 min
  - 60 min
  - 75 min
  - 2h
  - 2.5h
  - 3h

Carbohydrate recommendation dependent on duration (and intensity)

Nutritional training recommended

Nutrition to Recover and to Build/Grow - PROTEIN

- Protein intake should be higher in an athlete
- A good amino acid profile is important
- Leucine is the main amino acid driving growth
PROTEIN

Daily Recommended Intake for Sedentary is 0.8 g/kg per day

American College of Sports Medicine Recommendations for Athletes:

- Endurance: 1.2 to 1.4 g/kg per day
- Strength athletes: 1.2 to 1.7 g/kg per day
NUTRITIONAL SUPPLEMENTS

- No Comments!
Carbohydrates are key for performance

For the past 50 years CHO and Glycogen have been shown to improve performance

NO study shows that CHO restriction improves performance

Glycogen content is not just important to prevent “bonking” but also a key element in muscle contraction and therefore Power and Speed

Restricting CHO poses higher risk of overtraining and increases risk of muscle injuries.

Protein Intake should be increased in Extreme Sport Athletes
Iñigo San Millán, PhD
Assistant Professor, Department of Physical Medicine and Rehabilitation
University of Colorado School of Medicine
Director, Sports Performance Division
Director, Physiology and Metabolism Lab
CU Sports Medicine and Performance Center
Inigo.sanmillan@ucdenver.edu
@doctorinigo