Running on Empty

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How Athletes Eat

- 90% report that they are not eating properly
- 84% do not eat an hour before working out
- 76% wait an hour or longer to eat after exercise
- Only 10% of athletes eat 6 times per day
- 45% report having days when they don’t have enough energy to exercise……

Energy Intake

An Important Consideration for Health AND Performance

- Athletes need adequate EI during periods of HIT
  - to maintain body weight & health, and
  - to maximize training effects.
- Inadequate EI relative to EE
  - compromises performance & negates the benefits of training;
  - fat and lean tissue are used for fuel;
    - Loss of strength & endurance
    - Compromised immune, endocrine & musculoskeletal function
    - Poor micronutrient intake
    - Metabolic dysfunctions
    - Lowered RMR

Women Athletes

- Often consume fewer kcal than predicted requirements;
- Olympic Marathon Trials mean intake of 2397 kcal (55% CHO –13% PRO –32% FAT);
  - mean CHO 323 g
  - Inadequate intake of kcal means more protein is required;
  - Inadequate energy + PRO intake impairs recovery;
  - Inadequate fat intake
    - low muscle TG & reliance on limited stores of muscle glycogen = poor endurance performance
    - low vitamin intakes - A,D,E,K = poor recovery

Low Energy Intake

- **Compulsively**
  - Tendency to supply needed energy AFTER it is needed
    - Exercise to eat vs. eat to exercise
- **Intentionally**
  - Body weight concerns (aesthetic or performance related)
    - » Restrictive eating patterns
    - » Restrained eating patterns
    - » Disordered eating patterns
- **Inadvertently**
  - poor biological drive to match energy intake to exercise energy expenditure
  - tight food budget/poor shopping or food preparation skills

Energy Assessment

- Prediction equations based on RMR and energy cost of daily activities;
  - Simple version = RMR x general activity factor

PAL {1=sed; 1.12=low active; 1.27=active; 1.45=very active}

  - Complex version = factorial method summed up over the course of the day (considerable potential for error)

- Alternative field method
  - Energy availability model
    (Loucks, A. J Sport Sciences, 22, 1-14; 2004)

Concept of Energy Availability

EA = Total DEI – Exercise EE

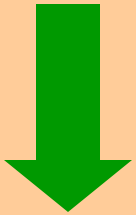
- Energy available for metabolic processes OR
- Input to the body's physiological systems

Energy Availability

- Energy balance at EA = 45 kcal/kg FFM;
- EA < 45 kcal/kg FFM:
  - impairments of metabolic and hormonal function;
  - affect performance, growth and health.

Low Energy Availability

Low EA



Hypoestrogenemia

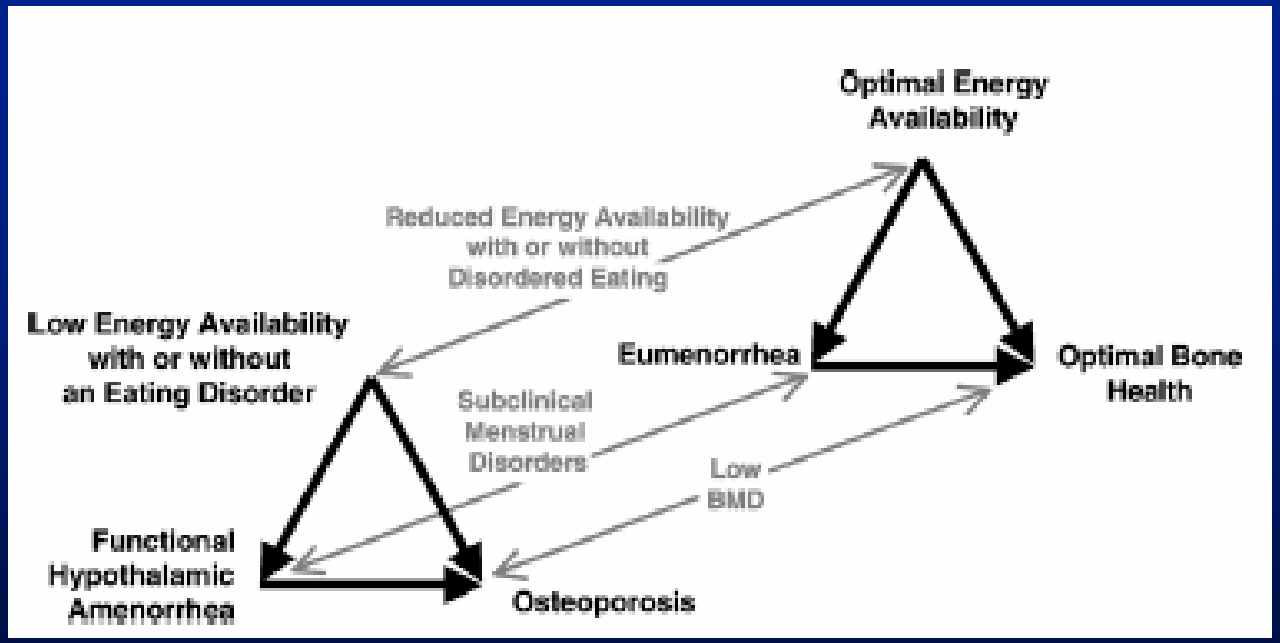
- **Amenorrhea, osteoporosis**[1]
  - –Stress fractures with prolonged interruption to training
  - –Impaired immune function
- **Cardiovascular effects**[2]
  - –Low grade inflammation
  - –Endothelial dysfunction and related poor performance
  - –Unfavorable lipid profiles (elevated LDL-C)[3]

[1] American College of Sports Medicine 2007- Position Stand – The Female Athlete Triad

[2] O'Donnell E and DeSouza MJ. Sports Med. 2004; 34(9):601-627.

[3] Zeni Hoch et al.,Med Sci Sports Exerc. 2003, 35:377–383

Continuum of Energy Availability



American College of Sports Medicine 2007- Position Stand – The Female Athlete Triad

Risk Factors for LEA

1. Any factor that increases energy expenditure or reduces energy intake:
   - prolonged exercise training to develop greater endurance or to promote weight loss;
   - restrictive eating behaviours;
   - dieting to lose weight or fat for health or for participation in sports that require a thin body or weight classes, to improve performance, or to improve appearance in revealing uniforms (e.g., swimsuits or bikinis);
   - the attitude that excessive exercise and weight loss are "normal" or even "desired" characteristics of "good athletes.“

Loucks, Anne B. Sports Medicine, 2007, Vol. 37 Issue 4/5, p347-352

Risk Factors for LEA

2. Athlete is unable to identify body composition and eating goals for their sport AND their individual make-up;
3. Athlete is unable to monitor these separate components:
   - body composition changes vs. body weight vs. optimal fuel stores
4. Athlete restricts EA to a level that interferes with metabolic and hormonal function (< 30 – 35 kcal/kg FFM).

Energy Availability Issues

1. EI must provide adequate energy for sport training AND leave EA to support FFM.
   - Many female athletes appear to NOT meet this requirement
2. Maintenance of overall EB in athletes can be assessed by monitoring body weight, body composition and food intake.
   - Techniques have not led to confident assessments of EB, especially for female athletes
3. In low body weight advantage sports, many athletes practice weight loss techniques that place skeletal and reproductive health at risk.
   - Low energy availability is the hazard with dose dependent effects
4. Limiting factor for performance is carbohydrate intake.
   - Carbohydrate availability (intake-oxidation during exercise)

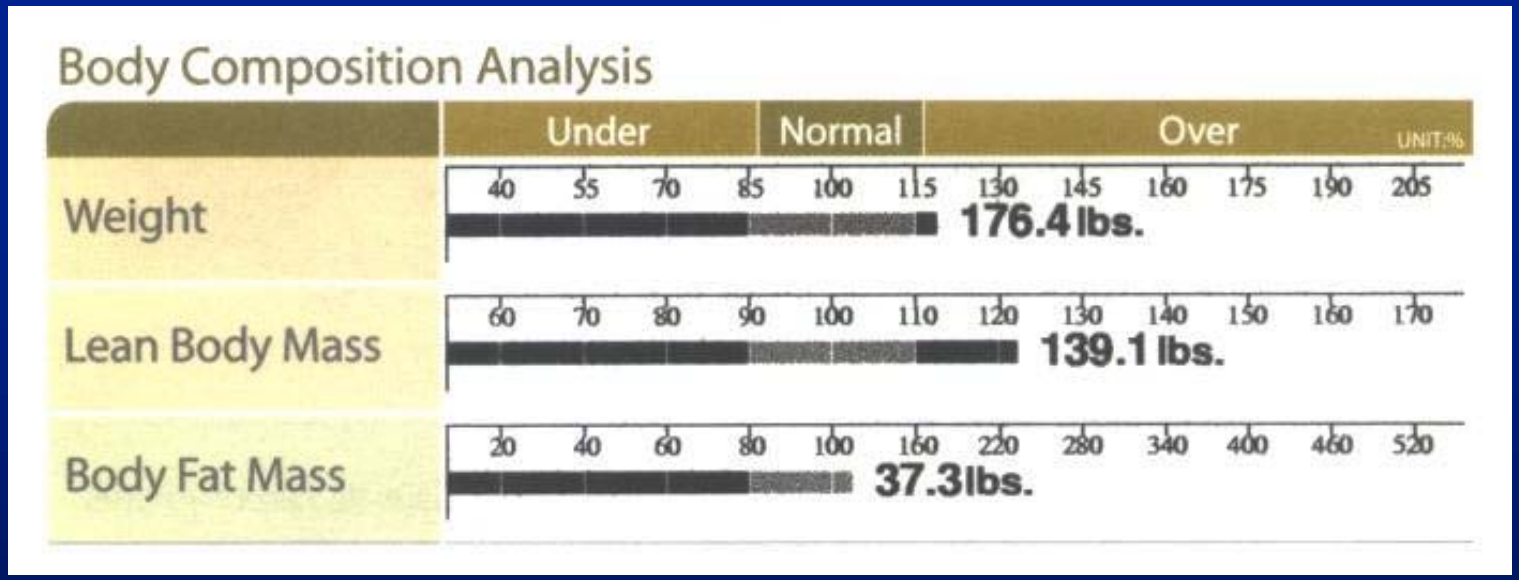
Managing EA

- Maintain EA
  - Minimum of 30-35 kcal/kg FFM for weight loss;
  - Above 45 kcal/kg FFM for muscle growth and CHO loading;
  - Near 45 kcal/kg FFM at other times.

– In female athletes, a diagnosis of functional hypothalamic amenorrhea is a bioassay for under nutrition, **“the dead canary in the physiological mineshaft.”**

Anne Loucks, LEA in the marathon and other sports Sports Med 2007; 37 (4-5):348-352

LEA Example - Cyclist



176 lb (80 kg) female cyclist with 21% BF

FFM = 139 lbs = 63 kg Transition b/n seasons

Goal: weight loss (fat loss)

Example of LEA

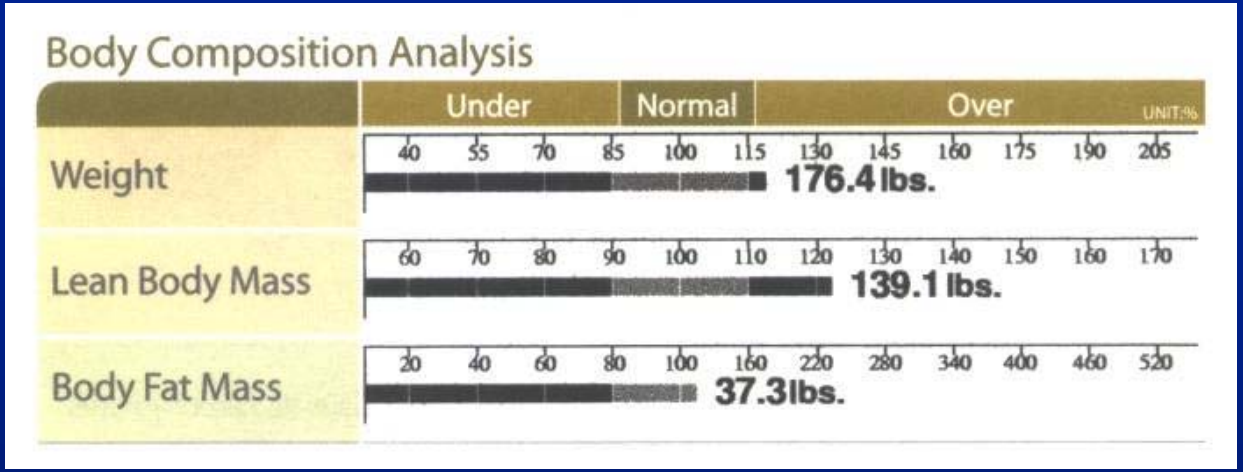
- 80 kg female cyclist with 21% BF = 63 kg FFM
  - DEI is restricted to 2000 kcal
  - Cost of training 650 kcal/day
    300-1200 kcal/day range
- EA = 2000-650 = 1350 kcal
- EA = 1350/63 = 21.5 kcal/kg FFM
- 3 lb weight loss/week = 9 lbs
  - Fast weight loss, compromised training
  - Chronic fatigue, no period next month

Case study cont'd…

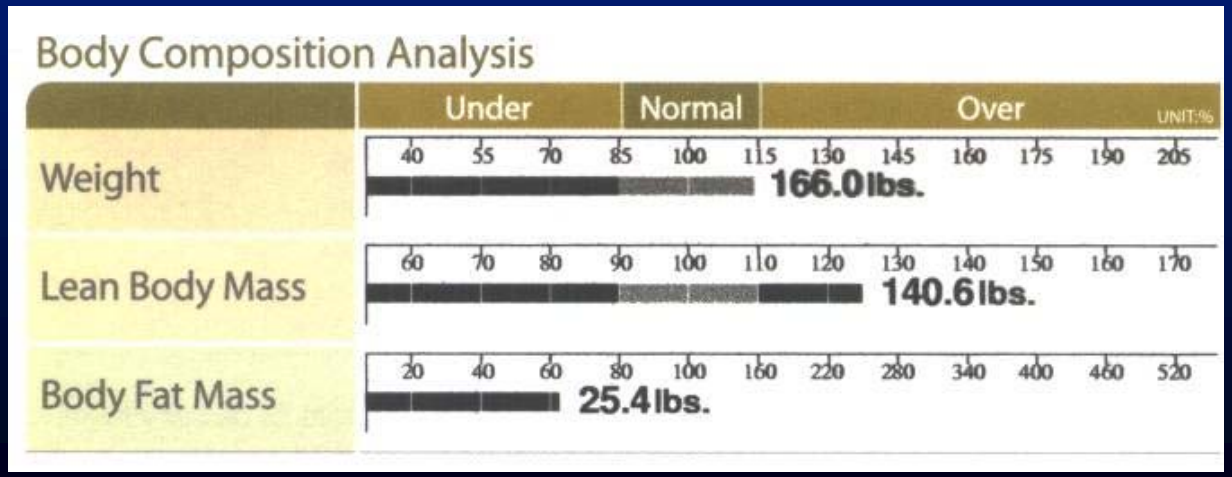
- Too low for body fat loss (only)
- Minimal EA needs: 30-35 kcal/kg;
  - 1890-2205
  - (+) 540-855 kcal/d to be added to energy budget
- Healthy physiological adaptation to EA
  - Maintain menstrual function
  - Slower rate of weight loss, maintenance of FFM
  - Better recovery from training

(+) Outcome

Before



After

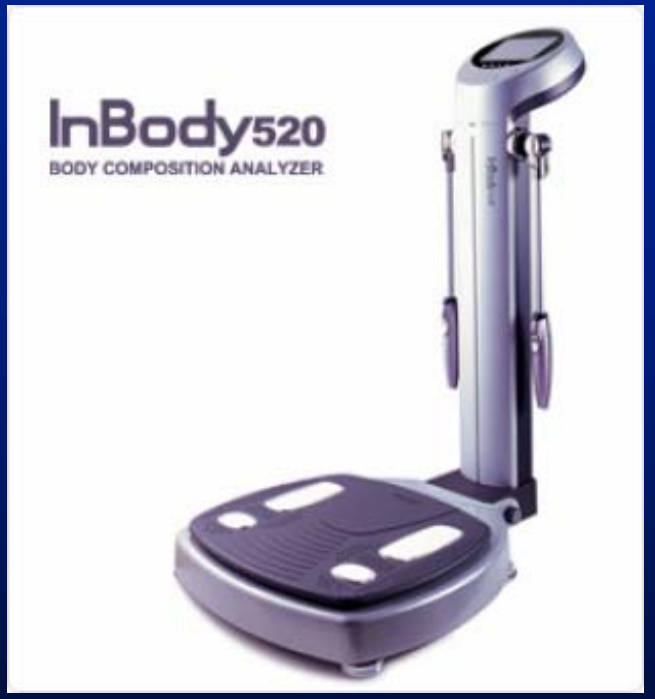


Sport Dietitians' Role

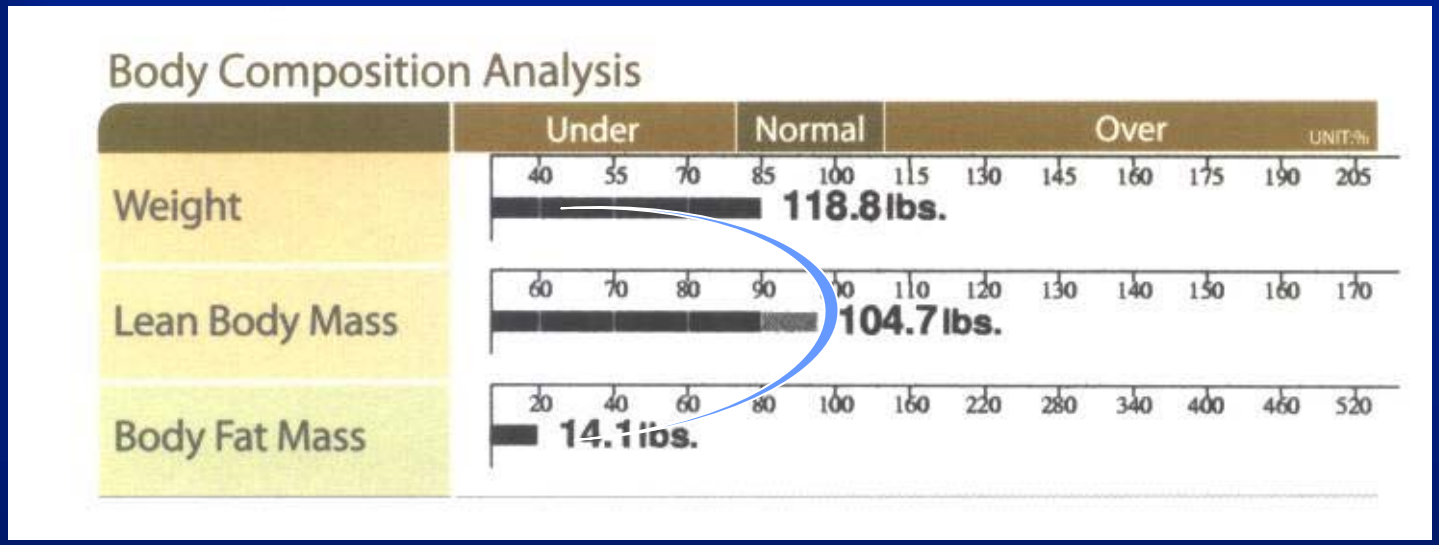
1. Generate a valid body composition assessment;
   - Bioelectrical impedance is affordable and credible
2. Design a baseline energy budget;
   - Assess EA
   - Focus on macronutrients: CHO 1st
   - Focus on micronutrients: Fe, Ca, vitamin D
3. Periodize changes in diet & eating behaviours to match changes in the training program
   - Refine your expertise with an understanding periodization principles

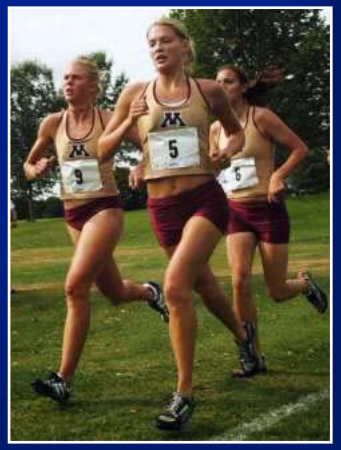
Body Composition Assessment

- Generate a valid body composition assessment;
- Bioelectrical impedance is now affordable and credible.



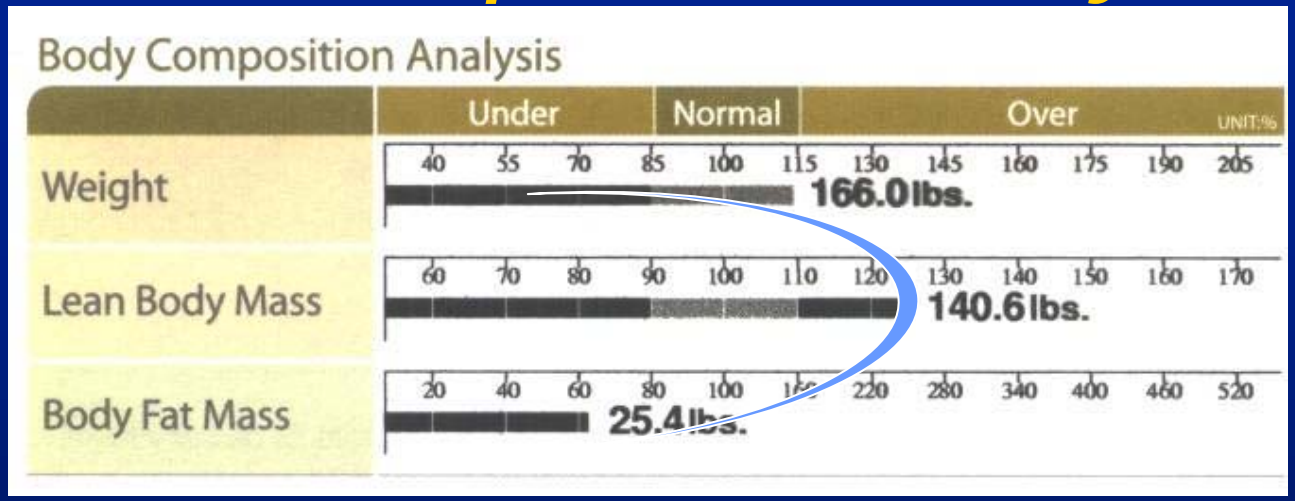
Elite female runner





- Difficulty eating enough food when training increases:
  - –Runs out of gas after 3 days of training;
  - –Carbohydrate intake too low for optimal recovery.

Recreationally competitive cyclist

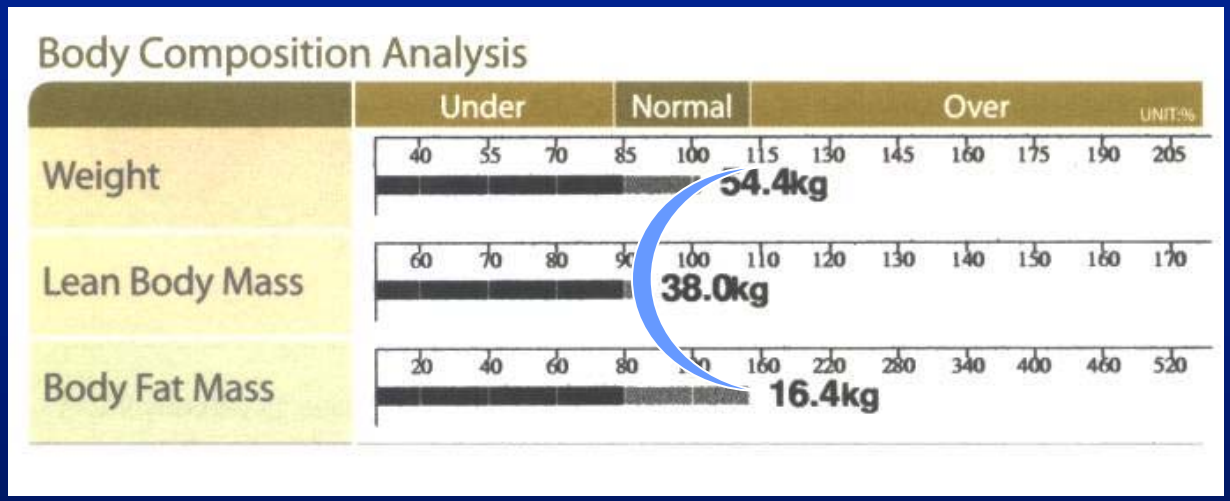


5’9” and 166 lbs

BMI = 25 LBM = high & BF = low

BF = 15% typical for athlete

Restrictive eating Triathlete age-grouper



- History of stress fractures in hip, constant fatigue

Energy Budgeting Step by Step

- **Step 1** - Body composition assessment
  - Make an evidence based goal
- **Step 2** – Baseline energy budget
  - Determine EA needs
  - Calculate CHO needs for current training needs

Determine EA Needs

- Base requirements on body weight.
  - between 30-45 kcal/kg FFM for weight loss;
  - Above 45 kcal/kg FFM for muscle growth and CHO loading;
  - Near of 45 kcal/kg LBM for energy balance + training EE at other times.
  - **EXAMPLE:**
    - female athlete FFM 53 kg x 45 kcal/kg = 2385 kcal
    - DEE in training 1000 kcal
    - TOTAL: 2385 + 1000 = 3385 kcal

Focus on CHO Needs

Table I. Guidelines for CHO intake by athletes

Situation	Recommended CHO intake[a]
Short term/single event	
Optimal daily muscle glycogen storage (e.g. for post-exercise recovery, or to fuel up or CHO load prior to an event)	7-10 g/kg BM/day[8,9]
Rapid post-exercise recovery of muscle glycogen, where recovery between session is <8h	1 g/kg BM immediately after exercise, repeated after 2h[10,11]
Pre-event meal to increase CHO availability prior to prolonged exercise session	1-4 g/kg BM eaten 1-4h pre-exercise[12-14]
CHO intake during moderate-intensity or intermittent exercise of >1h	0.5-1.0 g/kg/h (30-60 g/h)[15-17]
Long term or routine situation	
Daily recovery/fuel needs for athlete with moderate exercise programme (i.e. <1h, or exercise of low intensity)	5-7 g/kg/day
Daily recovery/fuel needs for endurance athlete (i.e. 1-3h of moderate to high intensity exercise)	7-10g/kg BM/day[8,9]
Daily recovery/fuel needs for athlete undertaking extreme exercise programme (i.e. >4-5h of moderate to high intensity exercise such as Tour de France)	10-12+ g/kg BM/day[18,19]

a Key references have been provided in the form of original studies, except in the case of CHO intake during exercise where reviews or consensus papers summarising data from numerous studies are available.

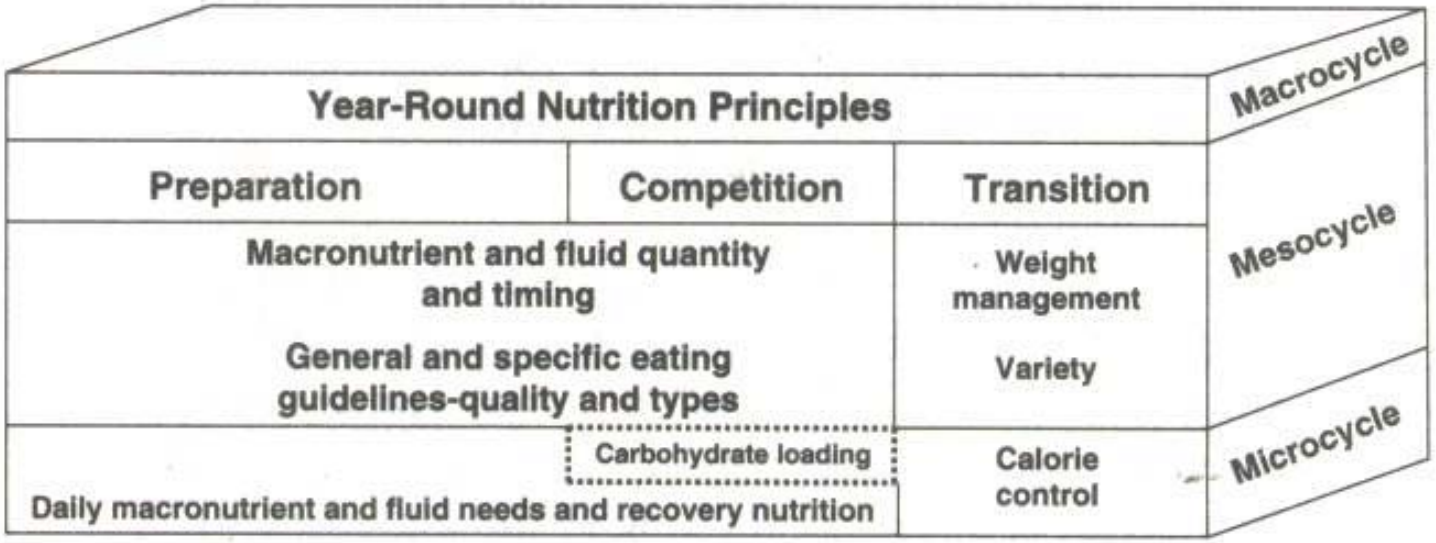
BM = body mass; **CHO** = carbohydrate.

Sports Med 2001; 31 (4)

Energy Budgeting Step by Step

- **Step 1 -** Body composition assessment
  - Make an evidence based goal
- **Step 2 –** Baseline energy budget
  - Determine EA needs
  - Calculate CHO needs for current training needs
- **Step 3 –** Periodize the plan

Nutrition Periodization



Adapted from Tudor Bompa, Theory and Methodology of Training, York University

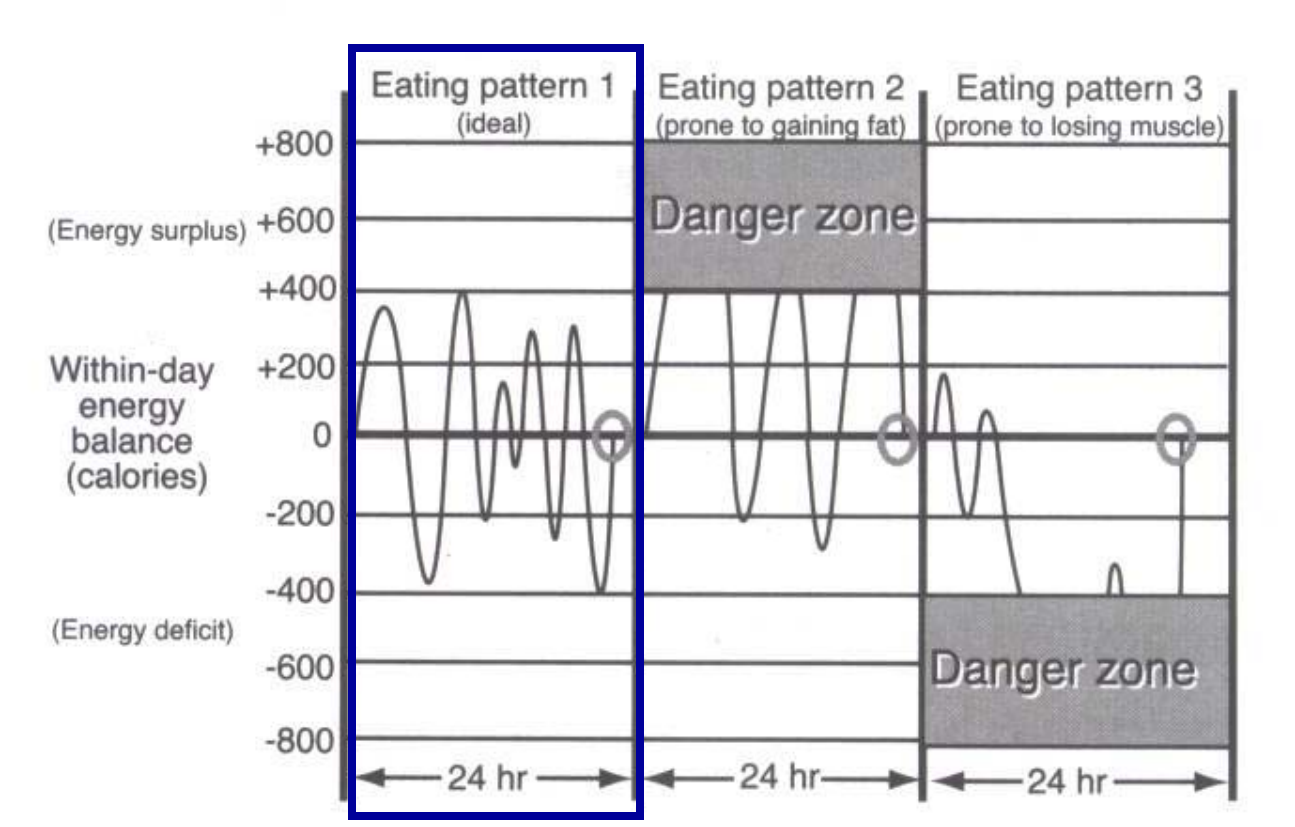
Energy Budgeting Step by Step

- **Step 1 -** Body composition assessment
  - Make an evidence based goal
- **Step 2** – Baseline energy budget
  - Determine EA needs
  - Calculate CHO needs for current training needs
- **Step 3** - Periodization schedule of the athlete
- Step 4 – Plan a schedule
  - Eat enough and on time
  - Pre, during and post-workout strategies

Enough and On Time

- Lower body fat
- Maintain muscle mass
- Lower weight on higher caloric intakes
- Lower stress response/higher immunity
- Faster recovery
- Less chance of overtraining and injury

Ideal Eating Pattern



Pre-exercise Strategies

- Goals:
  - **To optimize the availability of CHO and fluid;**
    - CHO 3-4 hrs prior increases liver and muscle glycogen stores
    - Enhances endurance performance
  - **To minimize the potential ergolytic effects of CHO depletion**

Pre-Exercise Manipulations

- Low GI CHO pre-exercise
  - may sustain BG during
  - beneficial for those who cannot consume CHO during
- High GI CHO pre-exercise
  - Transient hypoglycemia and hyperinsulinemia
  - Athletes need to evaluate responses & if they react (-)
    - use low GI before
    - Eat CHO a few minutes pre-exercise, OR
    - Wait until exercising to consume high GI CHO
  - Convenience and tolerance are more crucial

Glycemic Load Improves the Glycemic Index

- Body's glycemic response is dependent on both the type AND the amount of carbohydrate consumed.

  GL = GI/100 x Net Carbs (minus Dietary Fiber)

- Control the glycemic response by consuming larger servings of low-GI foods or smaller servings of high-GI foods.

Pre-Workout Nutrition

- 1 hour or less before competition
  CHO 1g/kg
- 2 to 3 hours before competition
  CHO 2-3 g/kg
- 3 to 4 hours before competition
  CHO 3-4 g/kg

Pre-workout examples

Meal (2 - 3 H <)	Large Snack (1 – 2 H <)	Small snack (20 - 60 min <)
French toast with fruit and yoghurt	Hard cooked egg or cheese with crackers	shredded wheat with raisins and almonds
Grilled chicken and veggie kabobs on rice	Low fat yoghurt with granola	Granola bar with a fruit juice or fresh fruit and water
Low fibre cereal with fresh fruit and milk, toast with peanut butter and banana	Fresh fruit with cottage cheese	A few crackers with fruit/vegetable juices, water

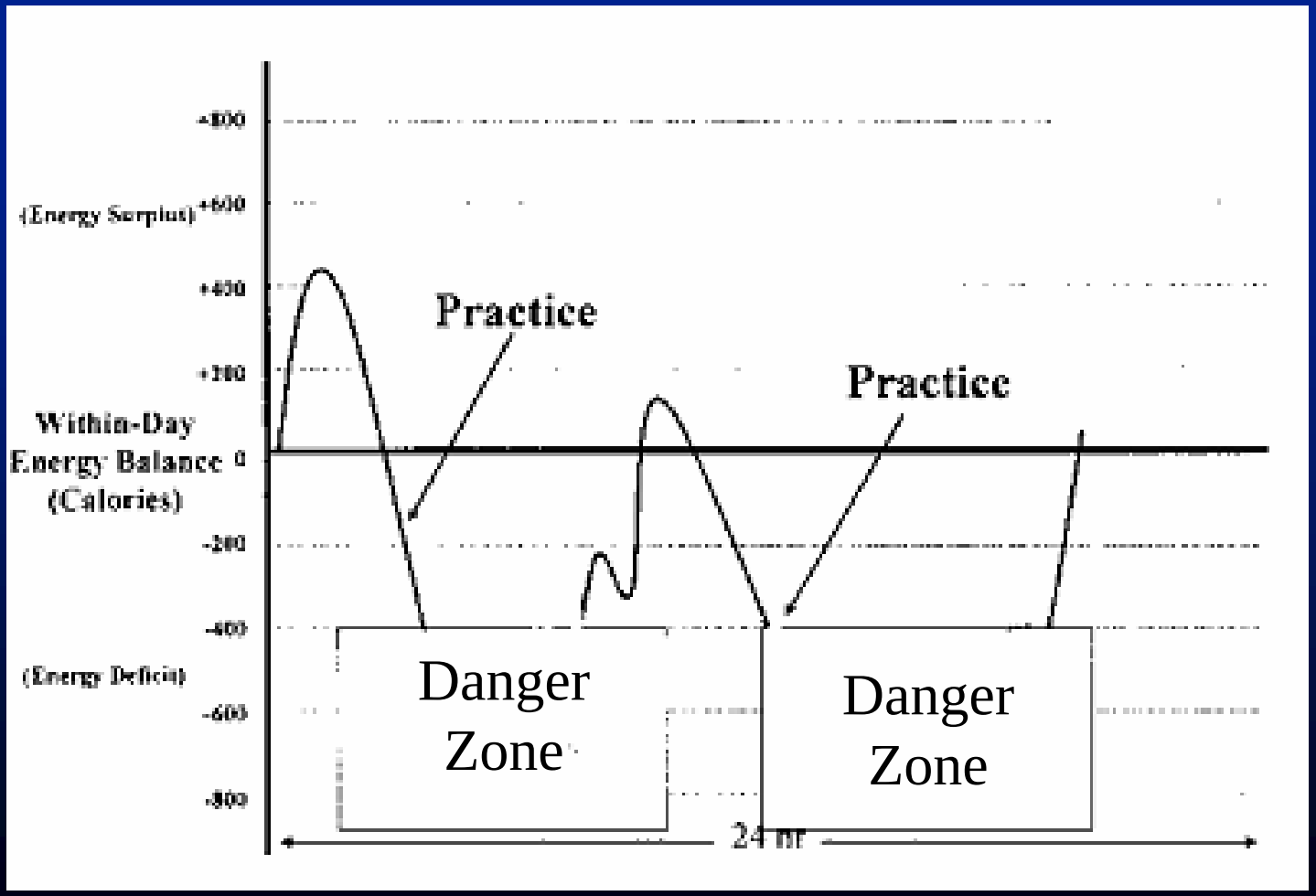
During Workout Nutrition

- Purpose:

  to keep the athlete hydrated

  to maintain blood sugar levels (to avoid fatigue, reduced endurance)

Eating Enough and On Time



During Workout Nutrition

- Fluids:
  drink 125 - 250 ml (½- 1 cup) of fluid every 10-20 minutes
  - Needs vary between sports

  ⇒ drink more if you sweat heavily

  ⇒ drink more if you are training in hot/humid conditions
  - electrolytes may be needed for iron man type distances

- Food:
  less than 60 minutes : WATER
  more than 60-90 minutes : WATER + 30-70 g CHO/hour

  ½ - 1 liter of sport drink,
  ½ - 1 liter water + 1-3 sport gels,
  ½ - 1 liter water + carbohydrate rich food (2-3 fig bars, 1-2 date squares, 1 sport bar – e.g. Power bar, Gatorade bar)

Optimal Recovery

- Replacing what you've lost during exercise;
  - moving from a “catabolic” state into an “anabolic” state.
- Can train at a higher level without illness/injury or risk of overtraining.

- Train hard – Recover fully – Repeat.

Post Workout Nutrition

- PURPOSE: to reduce recovery time between sessions and improve the quality of training during subsequent sessions.

- 15-30 minutes after exercise : muscles most receptive to refueling

  - “ The Recovery Window"

Glycogen Repletion

- Occurs much faster after exercise
  - Muscle cell is empty and thus more likely to restock
  - Muscle cell is > sensitive to insulin which promotes glycogen synthesis
- NSD between solid or liquid feedings, simple or complex, low vs. high GI
  - High GI and/or High GL via frequent snacking
- Glucose and sucrose 2x > effective vs. fructose (liver glycogen)

Fueling Up With Carbs

- How much is enough?
  0.5-1.0 grams/kg body weight (moderate – tough training session)
  20 - 80 grams for most of us
  80 - 320 kcal of carbohydrate

- Fluids
  - water, sport drinks, milk, chocolate milk, smoothies and yogurt
- Foods
  - Carbohydrate rich with some protein for optimal muscle recovery
  - Small amounts of protein help to repair muscle cells, enhance immunity and regenerate new muscle and red blood cells

Biochemical Balance

- Get inflammation and oxidation under control
  - Omega-3 fats: flax seed, encapsulated fish oils in foods
  - Flavonoids: brightly colored berries, fruit juices, apples
- Enhance tissue repair
  - Protein rich foods as part of post workout nutrition

Omega-3 Enhanced Foods

Use carb/protein combinations for optimal recovery

- Choose milk, kefir smoothies and probiotic rich yogurt
- Use enriched plant based beverages (Calcium, Vit D, B12 and A) if you have an allergy to cows milk

Carb + Protein Snacks

- Vegetables with hummus
- Apple with cheese
- Low fat yogurt with berries & flaxseed
- Omega-3 chocolate milk
- Bagels with nut butter
- Whole grains cereals with nuts, seeds, and dried fruit

Restore Immune Function

- Glutamine and branched chain amino acids valine, leucine, and isoleucine
  - whey protein (in milk based foods) is a decent source of all 4 of these amino acids
  - Whey protein isolate (10-20 g/day) as a daily supplement (ion exchange filtration)

Probiotics

- Restore immune function
  - Probiotic enhanced milks, yogurts, juices
  - Over the counter probiotics (> 1 billion CFU's)

Is the She/He Eating Enough?

- Ability to train without undue fatigue?
- Fast recovery between training sessions?
- Maintenance of body composition?
- Optimal biological functioning?
- Absence of health & performance issues?

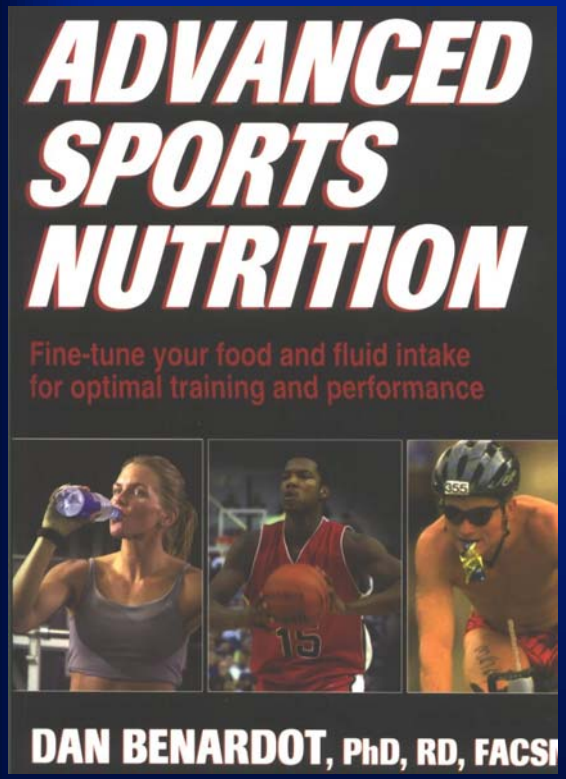
"A great diet cannot make an average athlete elite, but a poor diet can make an elite athlete average."

Dave Costill, 1977

A questionable small boost from several ergogenic aids

Established benefits from using CHO rich sport foods to fuel & refuel for training and competition

Resources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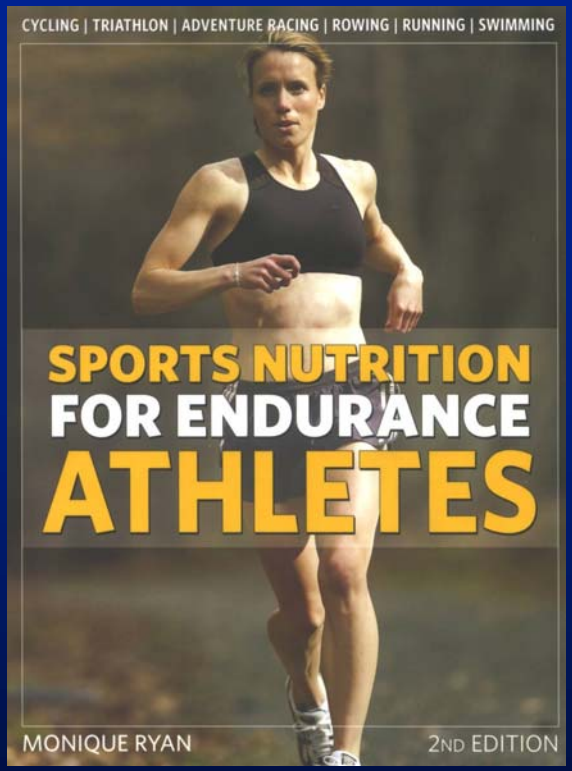
NUTRITION
Fine-tune your food and fluid intake
for optimal training and performance
DAN BENARDOT, PhD, RD, FACSM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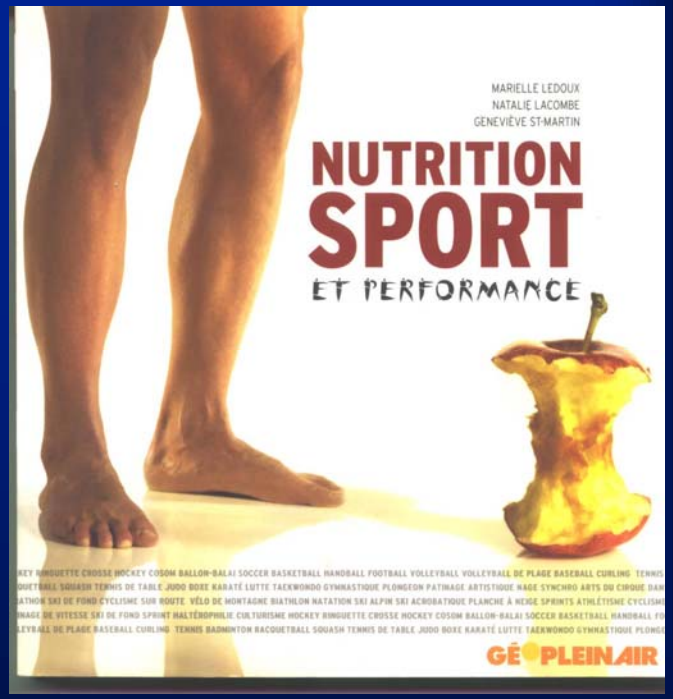
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