

Nutrition for Athletes



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Welcome

- Brief review macronutrients
- Fluids + Electrolytes
- Constructing a Proper Nutrition Plan
- The breakfast of champions
- Energy drinks + bars
- Pre + Post Training

?

- Why eat bran fibre if we can't digest it?
- When glucose runs out do we stop performing?
- Does fat burn in a carbohydrate flame?
- Is there such thing as a “fat burning zone”?
- Do we need to take a vitamin supplement?
- How important is Protein?
- What is “healthy eating”?

Challenge me!

Nutrition Historically

- *“our food should be our medicine and our medicine should be our food.”*
HIPPOCRATES, 400BC
- *“unfortunately, everything the experts tell us about diet is aimed at the whole population, and we are not all the same.”*
THE SCIENTIST MAGAZINE, 2007
- *...“today, more than 95% of all chronic disease is caused by food choice, toxic food ingredients, nutritional deficiencies and lack of physical exercise.”*
MIKE ADAMS, AUTHOR, INVESTIGATIVE JOURNALIST, 2010
- *...“those who think they have no time for healthy eating, will sooner or later have to find time for illness.”*
EDWARD STANLEY, 1860
- *“man is what he eats”*
LUCRETIUS, 40BC

Macronutrients

- CARBOHYDRATES – 4 cal/g
- PROTEIN – 4 cal/g
- FATS/LIPIDS – 9 cal/g



Basic Functions of Energy Substrates

Carbs	Energy + Muscular Fuel
	Cholesterol + Fat Control
	Digestion Assistance
	Nutrient + Water Absorption
Protein	Energy Source
	Deliver essential amino acids
	New Tissue
	Maintain existing tissue
	Manufacture enzymes, antibodies and hormones
	Fluid balance (osmosis)
	Transportation in blood
Fat	Fat soluble vitamins (A,D, E, K)
	EFA's
	Satiety
	Hormones, nerve transmission

Energy Metabolism

System	Characteristics	Duration
Phosphocreatine (PCr)	Anaerobic production of ATP from stored phosphocreatine	Max Intensity <10s
Anaerobic Glycolysis (lactic acid system)	Anaerobic production of ATP from breakdown of GLYCOGEN: by product is lactic acid	Extremely high intensity Exceeding ability to deliver O ₂ <2 mins
Aerobic Glycolysis	Aerobic production of lots of ATP from breakdown of GLYCOGEN	High intensity but within the capability to utilise O ₂
Oxidative System (Aerobic metabolism)	Aerobic production of lots of ATP through breakdown of CARBS + FAT	Lower intensity longer duration without self limiting by products

Carbohydrates



SIMPLE

- Monosaccharides – glucose, fructose, galactose
- Disaccharides - sucrose (table sugar) maltose, lactose: 2 monos bound together

COMPLEX

- Polysaccharides - >10 Monos bound together– only glucose units, but many of them

Glucose → Glycogen

- 1g of glycogen is bound to 2.7g H₂O forming a bulky molecule which is difficult for the body to store in large amounts

The Carbohydrate stores, in a male weighing 68kg with an average body composition are as follows:

Muscle Glycogen:	300g - 1200 kcal
Liver Glycogen:	100g - 400 kcal
Blood Glucose:	20g - 80 kcal
TOTAL CHO:	420g - 1680 kcal
TOTAL Glycogen:	400g - 1600 kcal

75% Glycogen found in the muscle

25% Glycogen found in the liver & blood

Gluconeogenesis

- Lactic Acid
- Triglycerides – fat through oxidative pathway
- Catabolized Muscle Protein – not desirable
- Glucose is needed to free energy from fat otherwise the body catabolizes muscle to free up alanine and convert this in the liver to glucose

Why keep glycogen topped up?

- 1 litre of oxygen yields 5 calories from Carb but only 4.7 calories from Fat sources
- Aerobic glycolysis yields more ATP faster than fat oxidation
- Conclusion: Fat DOES burn in a carb flame *and*
- When glycogen runs out, we stop performing **OPTIMALLY**

What else affects blood sugar?

- **Epinephrine** (adrenaline) causes rapid breakdown of liver glycogen for energy
- **Cortisol** (adrenal gland) causes protein catabolism and breakdown of amino acids
- Both can be mediated through carb consumption – strong case!

Carbohydrate Requirements

- 130g (520 kcal) per day minimum usage of glucose by brain
- 45-65% total caloric intake
- Food labels are based on 60% consumption
- 25% of carbs max coming from sugar (mono/disaccharides)

Carbohydrate Requirements

- Fibre: 38g men 25g women
- Endurance Athletes: 7-8g per KG mass per day
- 1hr training: 5-7g per KG mass per day
- 5-10g per KG per day: 20-40 kcal per KG = 70kg athlete 1400-2800 calories from carbs (60% total) = 2300-4700 kcal per day

Activity or Timing	Recommended Intake	EG: For a 70kg Athlete
Immediate recovery post workout (0-4 hr after)	1g CHO per KG BW per hour	70g (280 kcal) carb immediately post workout and each hour thereafter for 4 hours
Daily recovery from moderate duration, low intensity programme	5-7g CHO per KG BW per day	350-490g (1400-1960 kcal) over a whole day
Daily recovery from moderate to heavy endurance training	7-12g CHO per KG BW per day	490-840g (1960-3360 kcal) over whole day
Daily recovery from extreme 4hr+ per day training	10-12g CHO per KG BW per day	700-840g (2800-3360 kcal) over whole day

Glycemic Index and Glycemic Load

GI—SPEED OF UPTAKE OF
CARBS INTO BLOOD
IN DIFFERENT FOODS,
RELATIVE TO GLUCOSE

GL – $GI \times \text{CARBS (g)}$



Food Values: Glycemic Index/Glycemic Load

	Low GI	Med GI	High GI
Low GL	All-bran cereal (8,42) Apples (6,38) Carrots (3,47) Peanuts (1,14) Strawberries (1,40) Sweet Corn (9,54)	Beets (5,64) Cantaloupe (4,65) Pineapple (7,59) Sucrose, i.e. table sugar (7,68)	Popcorn (8,72) Watermelon (4,72) Whole wheat flour bread (9,71)
Med GL	Apple juice (11,40) Bananas (12,52) Fettucine (18,40) Orange juice (12,50) Sourdough wheat bread (15,54)	Life Cereal (16,66) New potatoes (12,57) Wild rice (18,57)	Cheerios (15,74) Shredded wheat (15,75)
High GL	Linguine (23,52) Macaroni (23,47) Spaghetti (20,42)	Couscous (23,65) White rice (23,64)	Baked Russet potatoes (26,85) Cornflakes (21,81)

Source: Revised International Table of Glycemic Index (GI) and Glycemic Load

(GI). The Glycemic Load is calculated as follows: GI x grams of carbohydrate per serving ÷ 100 = GL

Protein

- Composition includes Nitrogen
- Amino acid structures
- Essential – must come from food
- Non-essential – can be synthesised from others
- Do not confuse non essential with not needed!
- All digested, transported and reassembled – consuming specific types not recommended!

Protein Requirements, grams per KG BW per Day

RDA Sedentary Adult :	0.8
Recreational exerciser	0.8 -1.5
Endurance athlete:	1.2 - 1.6
Teenage athlete	1.5 - 2.0
Adult building muscle mass	1.5 - 1.7
Athlete restricting calories	1.8 - 2.0
Estimated upper limit	2.0

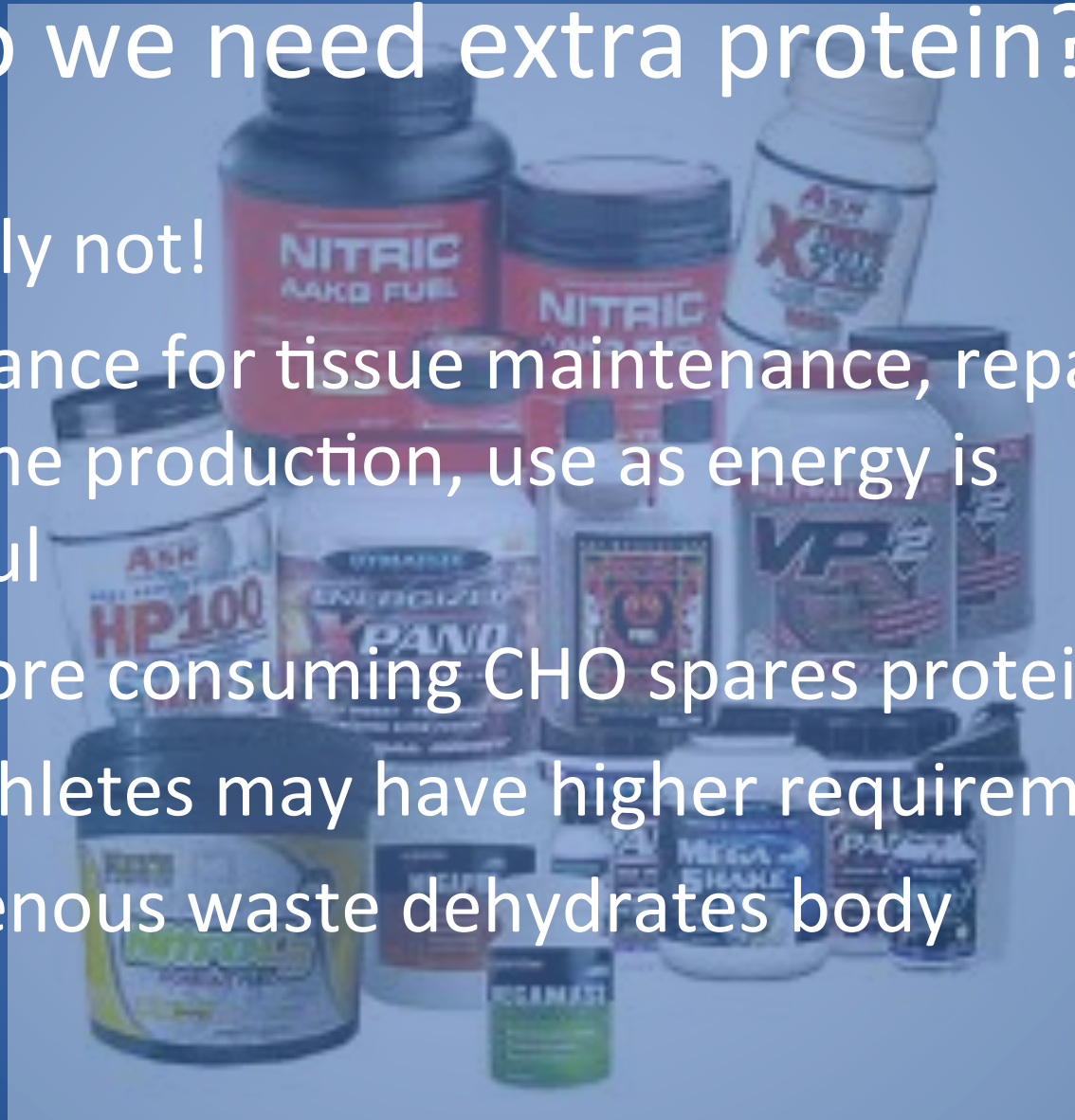
Therefore 75kg Athlete requires 130 grams (520 kcal) per day

Who needs to monitor their consumption?

- Young athletes – growth + energy
- Those on a restrictive diet for weight/body composition
- Vegetarian athletes who exclude fish eggs + dairy
- Those who restrict food intake for religious or cultural reasons

Do we need extra protein?

- Probably not!
- Importance for tissue maintenance, repair and hormone production, use as energy is wasteful
- Therefore consuming CHO spares protein
- END Athletes may have higher requirement
- Nitrogenous waste dehydrates body



Protein – take home message:

**Experiment with the macronutrient guidelines
(relatively inexpensive and decidedly safe)
before supplementing with extra (potentially
expensive and not as good as claimed!)**

Functions of Fats

- Fat – solid @ room temp
- Oil – liquid @ room temp
- A,D,E + K delivered in a fat parcel
- Essential Fatty Acids –growth, cell membranes
- Satiety + longer gastric emptying
- Taste

Fat Metabolism

- Even leanest athletes have substantial fat reserves
- Av storage is 50-100 000 calories + 3000 in muscle tissues
- Max fat oxidation occurs @ 65% VO₂max
- Reliance on fat oxidation increases with training status
- Interval training with maintenance at LEAST as high as 65% VO₂max represents best fat loss strategy

Fat requirements

- 20-30% total calories from Fat, predominately mono/polyunsaturated sources

OMEGA-3

Improved delivery of oxygen + nutrients to muscles

Improved Aerobic metabolism

Improved Release of Somatotropin

Reduction of inflammation

Prevention of tissue inflammation

Fibre

High Fibre Foods

Take longer to eat

Cause greater distension of the stomach

Help to avoid over eating

Low Fibre Foods

Take less time to eat

Often contain more energy

Cause less distension of the stomach

Can lead to overeating

Fluids + Electrolytes

- 66% av BW
- 65% total water intracellular
- 35% total water extracellular
- Well hydrated muscles are 75% water
- Bones 32% water
- Fat 10%
- Blood 93%
- Av male 60% av female 50%
- Obese 40%
- Athletes – 70%

Benefits of Maintaining Fluid Balance

- Attenuation of increased heart rate
- Attenuation of increased core temp
- Improved Stroke Volume
- Improved Cardiac output
- Improved skin blood flow
- Attenuation of higher plasma sodium, osmolality and adrenaline
- Reduced net muscle glycogen usage

Hydration Facts

- Athletes can lose 2.5 l per hour
- Exercise can produce 20x the heat of rest
- Body temp can rise 1° f every 5 mins
- Upper limit for survival is only 11.4° higher than normal temp
- Underhydrated athlete risks heatstroke and death <1 hr after initiating exercise in the heat

Amount of CHO

- 6-7% CHO solution best tolerated during exercise
- 420-660 ml in the hour prior to practice/competition
- Followed by frequent sipping
- Cool, not cold – leave stomach faster
- Carbonation? Doesn't affect time but can make you feel more full hence probably best avoided
- Mental Stress reduced gastric emptying time – so practice and choose fast acting CHO!

Weigh yourself naked!!



- Pre and post training – 1 pint for each 1lb lost

Event	Fluid Break	Requirements
<30 min	Between events but not within 15 min of event	Between
<60 min	Between events runners – fluid every 3 miles more if hot	Before, during + After + CHO
Endurance (Tennis, Marathon)	Marathon – every 3 miles, Triathletes every 6 miles cycling and 2 miles running Every opportunity	Fluid, CHO + Electrolytes (sodium)
Ultra Endurance	Every 10 mins	Fluid, CHO + Electrolytes (sodium)
90 min team sports	Every 10-15 + at all breaks	Fluid, CHO + Electrolytes (sodium)





Average Male Teen athlete with 60-90 minutes of intense training

Time	Recommendation
Daily Needs	8-10 g CHO per KG BW per day, or 65% total kcal 2g PRO per KG BW per day Drink fluids to maintain clear urine
Pre-Training/Race	High CHO meal, 3-4 hrs before match Avoid high fat esp fried foods Avoid too much fibre Avoid solids just before game Sip liquids
During Event	CHO + Electrolyte beverage sipped throughout Halftime: drink sports beverage to maintain pregame BW
Post-Training/Race	Fast acting CHO immediately after, + .3g per KG protein EG: 70g CHO + 21g Protein in a shake 1 Pint fluid for every 1lb weight lost over 2-3 hrs post game

What does a healthy day look like?

Meal	Example
Breakfast	2-3 poached eggs, 2 piece rye toast, 2 oranges, green tea, fish oil capsules
Snack	3-5 oatcakes spread thick with nut butter, banana
Lunch	Free range Chicken breast with 1-2 cups wild rice, raw veg, avocado and olive oil
Snack	Palm sized Lean turkey slices, 1 apple, handful of nuts
Dinner	Baked salmon fillet, large leafy salad with peppers, cucumber, feta cheese, drizzled with olive oil, mashed sweet potato
Snack	Handful of nuts/pumpkin seeds

Mineral	Daily Intake	FUNCTION	LOST THROUGH	GOOD FOOD SOURCES
Calcium	1300-1500 mg/day	Bone structure Acid balance Nerve + muscle Enzyme	Inactivity Hormone status Lack of Vit D Energy restriction	Dairy, dark green leaves, calcium fortified foods
Iron	15-18 mg/day	O2 delivery Oxidative function Aerobic metabolism	Pregnancy, vegetarians, menstrual cycle, hemolysis, sweat, blood volume	Meat, fish, poultry, leaves, sesame seeds, oats, iron cookware
Magnesium	450mg/day food, 350 supp	Protein Synthesis Glucose Metabolism Bone + Muscle	Sweat	Milk, meat, nuts, whole grains, leaves, fruits
Zinc	11-15 mg/day	Energy metabolism, protein synthesis, immunity + sexual function/maturation	Endurance, overtraining, sweat, poor diet	Meat, fish, poultry, shellfish, eggs, whole grains, nuts

Breakfast (of Champions)	Lunch	Dinner	Snacks
Oats Porridge + cinnamon	Fowl, meat or fish with green veg	As lunch, with ½ to ¾ the starchy carbs	Whole-wheat tortilla or pitta with nut butter and banana
Eggs, poached boiled or scrambled on whole-wheat or rye toast	Large salad of couscous, mixed raw veg and tofu		Oatcakes and nut butter or cold cuts of meat
Salmon and Rice	Sweet potato and Meat/Fish		2x large handful of nuts and seeds
Oatcakes , peanut butter and natural yoghurt	Brown/wild rice with meat/fish		Smoothie with yoghurt, one scoop whey protein and frozen raspberries
Healthy pancakes with spelt flour, oatbran, eggs and blueberries	Whole-wheat pasta or spaghetti with protein source		Cold chicken breast and rye toast with humus

Supplements

- Plain glucose/dextrose powder, dissolved in water to achieve 6/7% solution is adequate
- Beware all energy bars, gels and supplements, look at the ingredient list
- Most are 5 types of sugar
- Stable Blood glucose is key – this is achieved through balanced meals
- Don't underestimate the power of marketing!

RMR

- To check if your calorie calculations tie in:
(WHO 1985)

Males 18-30	Females 18-30
$(15.3 \times \text{BW}) + 679$	$(14.7 \times \text{BW}) + 496$

Eg: 75kg male athlete:

$$(15.3 \times 75) + 679 = 1826\text{kcal RMR}$$

Energy Cost

Multiples of RMR for different levels of activity				
Activity Level	Males – Average	Range	Females – Average	Range
Bed Rest	1.2	1.1-1.3	1.2	1.1-1.3
Very Sedentary	1.3	1.2-1.4	1.3	1.2-1.4
Maintenance	1.4	1.3-1.5	1.4	1.3-1.5
Light	1.5	1.4-1.6	1.5	1.4-1.6
Light - Moderate	1.7	1.6-1.8	1.6	1.5-1.7
Moderate	1.8	1.7-1.9	1.7	1.6-1.8
Heavy	2.1	1.9-2.3	1.8	1.7-1.9
Very Heavy	2.3	2-2.6	2	1.8-2.2

EG:

- EG: 75kg Athlete (RMR – 1826 kcal) @ moderate exercise level:
- $1826 \times 1.8 = 3287 \text{ kcal}$

Put another way

- CHO @ 7g/kg/day = 525 (x 4 cal yield) = 2100
- PRO @ 2g/kg/day = 150 (x 4 cal yield) = 600
- 2700 cal + remaining 18% (587 cal) from Fat

Eat like a Warrior, Eat like an Adult, Eat like an **ATHLETE!**

Something to remember

- Female rhythmic gymnasts, even in energy depletion (-800kcal) have higher bodyfat %'s than same level artistic gymnasts, middle and long distance runners
- Infrequent meals with a large end of day meal is poor choice for body composition

Frequent Eating Patterns

- Strongly associated with lower fat + higher muscle mass
- Isocaloric diets x2 vs x6 per day = sig reduction LBM in x2 meal group
- (Bernadot et al 2005) 60 male + female collegiate athletes added 250 calorie snack or non caloric placebo after every meal for total +750 cal in daily snacks
- @ 2 weeks, snack group sig ↓ BF, sig ↑ LBM, anaerobic power, aerobic END
- No change in weight, no change in total caloric intake
- Spontaneous reduction in meal sizes involuntarily

Bodyfat %

- Average male: 3% essential, 12% storage = 15%
- Average female: 15% essential, 11% storage = 26%
- 17-22% in women is needed to avoid menstrual cycle dysfunction

Thermodynamics

- Logic dictates that -25% energy intake should = 25% reduction in weight
- **BUT! This is not the case**
- With inadequate energy intake, the body catabolises muscle to survive on less energy
- Less you eat, the less you CAN eat to maintain weight
- Body eventually returns to original weight on the reduced intake
- Overfeeding is more logical; the weight gain is proportional to the surplus

Thermodynamics

- Major energy deficits and surplus during the day are the causes of undesirable fluctuations in composition
- Staying within the ideal energy balance (never more than 400 cal more or less than ideal) through the day is key
- 6 meals over 3

Strategies to Achieve Sensible Weight Loss

- Recommended rate of loss is 0.5-1kg per week
- Equates to 500-1000 kcal deficit per day
- Diets emphasising nutrient rich, low energy density foods
- Be careful with sports foods as energy density is high, satiety is low and nutritional status is low
- Low GI CHO only
- Fibrous food
- Higher end of Pro spectrum
- Calcium intake of up to 1300mg/day or 3-4 servings of dairy highly effective in reducing fat in obese subjects – up to 11% BW in 24 weeks

Take home message:

- Always eat REAL food
- Always eat breakfast, with a mix of CHO + PRO
- Snack (healthily) mid morning and mid afternoon
- Keep hydrated – go to the loo often and make sure it's clear!
- Pay particular attention to POST workout nutrition
- Avoid fizzy drinks, sweets and takeaways

Thank you for listening!

