Applying Sports Nutrition Research for Enhancing Public Health

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1

Analogous To Stock Car Racing

- Car manufacturers race 'standard' cars to better understand what components fail first, resulting in changes to 'at-risk' components.
- Athletes push the body to its limit, allowing for a better understanding of what systems must be improved to achieve enhanced performance. Much of this change is nutrition related.
- Knowing how to improve systems provides information for everyone, athlete or not.

2

Lot's of History...Lot's of Myth

Health promotion guidelines have nearly always included ***physical activity.***

Hippocrates also emphasized the importance of ***nutrition*** to improve performance in the Olympic Games.

Kleisiaris CF, Sfakianakis C, and Papathanasiou IV. Health care practices in ancient Greece: The Hippocratic ideal. J of Medical Ethics and History of Medicine. 2014; 7(6): 1-5

Hippocrates Advice to Athletes:
For Improving Sore Muscles:
"Get **drunk** once or twice"
For weight loss:
"Eat **more** meat"

Pythagoras Advice to Athletes:
For greater physical 'sharpness',
Eat **less** meat and more fresh vegetables.

Shan Sell. Eating was no idle game in ancient Greece. USA Today. 07347456, Aug 13, 2006.

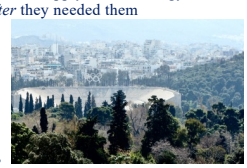
3

All Physical Activity Results In An...

- Increased ***rate*** of energy expenditure
- Increased ***rate*** of body fluid loss

Deena Kastor, Bronze Medal, 2004 Athens Olympic Games

Findings of surveys:
- Physically active people don't eat enough, and they don't drink enough
- Tend to supply needed energy and fluids *after* they needed them



Many Questions...
- What fuels are best?
- When should the fuel be provided?
- What form should the fuel be in?.
- What is the best way to replace fluids?
- What compounds should the fluids contain to sustain performance?

4

There is an Interaction Between Physical Activity and Nutrition

- Altered Energy Requirements
- Altered Energy Substrate Requirements
- Altered Vitamin requirements
- Altered Mineral Requirements
- Altered Fluid Requirements

Far too often the recommendation for more physical activity to reduce disease risk happens without considering how additional activity may influence energy/nutrient needs.

5

Nutrition Problems Related to Physical Activity

- Poor knowledge of foods and inadequate cooking skills
- Poor or outdated knowledge of sports nutrition
- Lack of access to dietitians /nutrition professionals or other credible resources
- Inadequate finances
- Busy lifestyle leading to inadequate time to obtain appropriate foods
- Poor 'making weight' strategies
- Poor *nutritional* role models
- Poor availability of good food choices
- Frequent travel
- Indiscriminate use of large amounts of supplements, or failure to use evidence-based supplements and sports foods in the appropriate way
- Sport-specific limitations to doing it right.

Similar to the eating issues observed in the general public

Importantly, the frequently offered advice of '**Eat Less and Exercise More**' for those concerned about 'weight' is likely to fail.

*Nutrition for Athletes – A practical guide to eating for health and performance. Nutrition working group of the Medical and Scientific Commission of the International Olympic Committee. Revised and Updated June 2016.
*Reale R, Slater G, and Burke LM. Individualized dietary strategies for Olympic combat sports: Acute nutrition. European Journal of Sport Science 2017; 17(6): 727-740weight loss, recovery and competition .

6

Obesity Skyrockets: Mistargeted Focus?

Is it possible there is too much emphasis on important but secondary issues, as the obesity rate and associated morbidities skyrocket?

***FASEB Journal*: May 2012. Sherman H et al.** "Timed high-fat diet re… Findi… resul… ghrel…*

***Sociology of Education*: January 2012. Competitive Food Sales in Schools and Childhood Obesity: A Longitudinal Study by… Children… NO… sch… …Ye… sna… wit…**

- We…
- Ver…
- Fast…

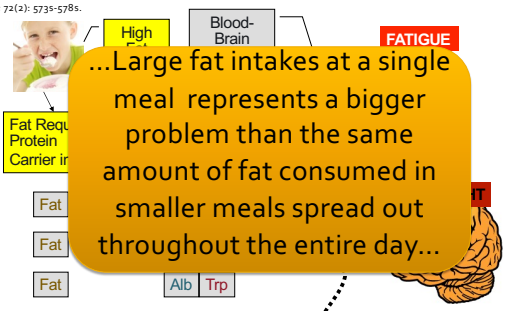
But the obesity ra…

***Pediatrics*: 2012.** Skinner AC, et al. "Changes in energy intake by age between overweight and healthy weight children in NHANES"
Finding: Overweight kids consume fewer calories than normal weight kids.

7

Central Fatigue Theory

Davis M, Alderson NL, and Welsh RS. Serotonin and central nervous system fatigue: nutritional considerations. AJCN. 2000; 72(2): 573s-578s.



…Large fat intakes at a single meal represents a bigger problem than the same amount of fat consumed in smaller meals spread out throughout the entire day…

Large bolus meals nearly always carry a higher fat volume, causing early fatigue or senescence and a reduction in energy expenditure.

8

MISPERCEPTION - *Weight* is a good indicator of health and well-being

Reality: ***Weight*** is the wrong measure for virtually everything that it is commonly used for. It's all about fat mass vs. fat-free (i.e., lean) mass.

9

Weight is the *Wrong* Metric

The critical issue: **What** constitutes weight.

5 lbs of muscle
5 lbs of fat

Important to help athletes and non-athletes do 2 things:

1. Stop doing things that lower metabolic mass
2. Stop doing things that increase fat mass.

10

Wrong to Use Weight-Related Terms 'Obesity' and 'Overweight' Interchangeably

- *Obesity* means having **too much body fat.**
- *Overweight* means **weighing more than the standard weight:height ratio or BMI**

Weight may come from…

- **Lean Mass** (more=good)
- **Bone Mass** (more=good)
- **Fat Mass** (more=**bad**)
- **Body Water** (more=generally good)

11

Body Mass Index

- Intended for *population* assessments of obesity prevalence
- **Not** intended for *individual* diagnosis
- …
- …

Javed A, Lopez-Jimenez F et al. Pediatric Obesity 2015; 10(3): 234-244.

BMI has high specificity but low sensitivity to detect excess adiposity and **fails to identify over a quarter of children with excess body fat percentage.**

…gh BMI …t Not …bese

profile (i.e., BMI~20) but has high body fat and low lean. Definitely IS obese.

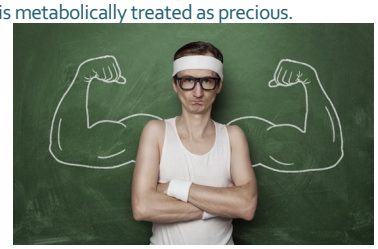
There is a difference between Thinness and Leanness!

Source: Mridha S, and Barman P. Comparison of height-weight matched young-adult female athletes and non-athletes in selected anthropometric measurements. International Journal of Science and Research. 2014;3(1):265-268.

12

MISPERCEPTION-The Energy Cost of Exercise is Always the Same

Reality: Humans are always finding ways to become more energy efficient. Exercise more and we eventually find a way to burn less energy to do this exercise. Energy (kcal) is metabolically treated as precious.



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Chronic training improves mitochondrial content and function

This improves oxygen delivery, and greater exercise efficiency (i.e., lower energy utilization doing the same work).

→We find a way to use less energy doing the same activity.

→Calculating energy utilization via standard means (i.e., mass x distance; heart rate; etc.) can be misleading.

Sources:

- Bangsbo J. Physiological factors associated with efficiency in high intensity exercise. Journal of Sports Medicine 1996; 22:299 doi:10.2165/00007256-199622050-00003
- Morgan W, Martin PW, Krahenbuhl GS. Factors affecting running economy. Sports Medicine 1989; 7: 310–30
- Banks L, Thompson S, and Lewis EJH. Efficiency of energy transfer during exercise: What are the limiting factors? Journal of Physiology 2015; 593: 2113-2114
- Broskey NT, Boss A, Fares E-J, Greggio C, Gremion G, Schlüter L, Hans D, Kreis R, Boesch C, and Amati F. Exercise efficiency relates with mitochondrial content and function in older adults. Physiological Reports 2015 **Vol.** 3 (e12418)
- **DOI:** 10.14814/phy2.12418

14

MISPERCEPTION – Only Eating Too Much Will Make You Fat.

Reality: Humans are amazingly effective fat manufacturing machines. Eat too much food, you make fat. Eat too little food, you lose muscle and make fat.

15

Traditional View of Energy Balance

Macro-Economic View

Energy Intake (24 hours) / Energy Expenditure (24 hours) → Ratio → Energy Balance

- Positive Energy Balance=Wt Gain (i.e., greater intake than expenditure)
- Negative Energy Balance=Wt Loss (i.e., greater expenditure than intake)

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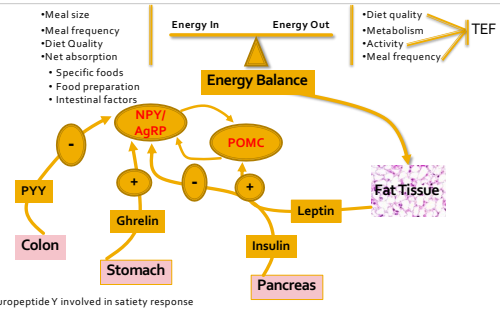
Energy Balance is Complex

Energy In : Energy Out Source: AJCN 2012;95:989-94



PYY=Neuropeptide Y involved in satiety response

NPY/AgRP=Neuronal Derived polypeptideY/Agouti-related peptide involved in increased appetite and decreased metabolism

POMC=Neurons that regulate energy balance

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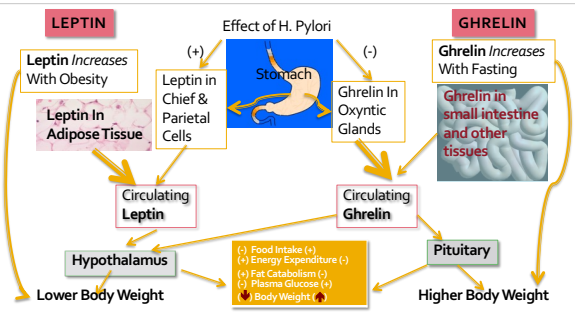
Energy Balance Feedback Mechanisms Following Leptin and Ghrelin



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Poor Within-Day Energy Balance Can Influence Leptin and Ghrelin

- Decreased meal frequency…
  - Correlates with greater daily energy consumption, possibly from up-regulation of appetite and/or tendency toward increased fat intake.
    - Dongen et al., *Journal of Nutrition.* 2008
    - Smith et al., *American Journal of Clinical Nutrition.* 2010
  - The increased energy intake is not matched with higher activity, resulting in higher body fat.
    - Franko et al., *International Journal of Obesity.* 2008
    - Berkey et al., *International Journal of Obesity.* 2003
  - Insulin release typically suppresses ghrelen, which suppresses appetite, but an eating pattern that results in low blood sugar (i.e., long period between eating opportunities) may result in hyperinsulinemia and disrupt ghrelin appetite suppression.
    - Anderwald et al., *Diabetes.* 2003
    - Solomon et al., *British Journal of Nutrition.* 2008

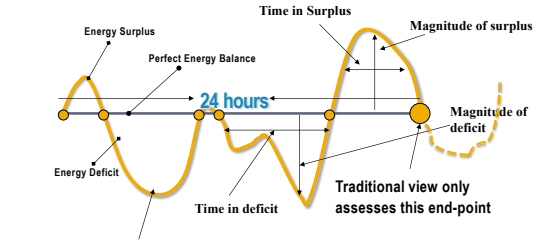
19

Breakfast Skipping Results In Poor Within-Day Energy Balance and Higher Mass

- Subjects who skipped breakfast as adults had significantly higher WC and BMI.
- Subjects who skipped breakfast as children and as adults had even higher WC and BMI, and more cardiometabolic risk factors.
  - Smith et al., *American Journal of Clinical Nutrition*. 2010.
  - Isacco et al., *Child Care Health and Development*. 2010.

20

Micro-Economic View of Energy Balance (Within-Day Energy Balance)



Deviations in within-day energy surpluses and deficits are as important factors in outcome variables (body fat, performance, concentration ability, etc.) as the 24-hour energy balance end-point.

THE PANCREAS WORKS IN 'REAL TIME'. IT DOESN'T WAIT UNTIL THE END OF THE DAY TO DECIDE HOW MUCH INSULIN TO PRODUCE!

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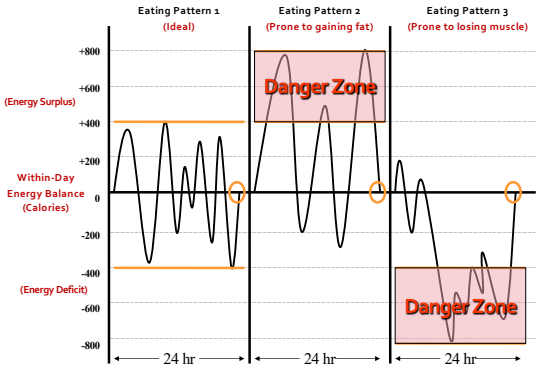
Eating Patterns and Within-Day Energy Balance



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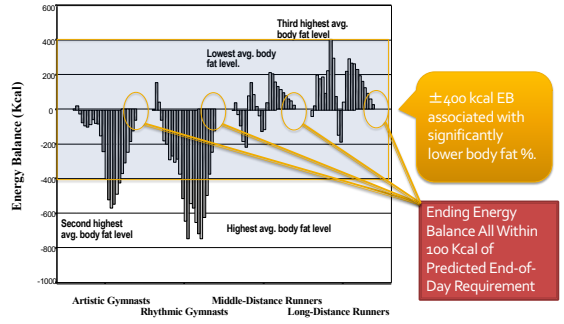
Within-Day Energy Balance & Body Composition in Elite Athletes

Deutz B, Benardot D, Martin D, and Cody M. Relationship between energy deficits and body composition in elite female gymnasts and runners. Medicine & Science in Sports & Exercise 2000; 32(3): 659-668.



±400 kcal EB associated with significantly lower body fat %.

Ending Energy Balance All Within 100 Kcal of Predicted End-of-Day Requirement

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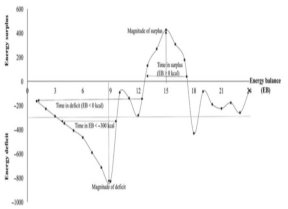
New Studies: Female Athletes (Fahrenholtz et al. 2018) and Male Athletes (Torstveit et al. 2018) With Good 24-Hour Energy Balance but Variable Within-Day Energy Balance



*Fahrenholtz IL, Sjödin A, Benardot D, Tornberg ÅB, Skouby S, Faber J, Sundgot-Borgen J, and Melin A. Within-day energy deficiency and reproductive function in female endurance athletes. Scandinavian Journal of Medicine & Science in Sports 2018: 1-8 doi: 10.1111/sms.13030

*Torstveit MK, Fahrenholtz I, Stenqvist TB, Sylta Ø, and Melin A. Within-day energy deficiency and metabolic perturbation in male endurance athletes. International Journal of Sport Nutrition and Exercise Metabolism 2018: **DOI**: https://doi.org/10.1123/ijsnem.2017-0337

Recent studies suggest that assessing within-day energy balance provides useful performance- and health-based information for athletes… More time in a severe energy balance deficit results in:

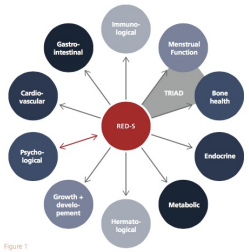
- Female athletes: Significantly higher cortisol and significantly lower estrogen, even when in 24-hour energy balance.
- Male athletes: Significantly higher cortisol and significantly lower testosterone:cortisol ratio, even when in 24-hour energy balance.

24

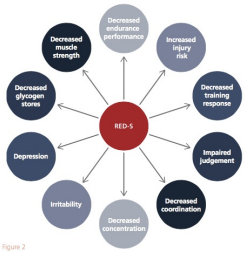
The IOC consensus statement: Beyond the Female Athlete Triad—Relative Energy Deficiency in Sport (RED-S)

Margo Mountjoy, Jorunn Sundgot-Borgen, Louise Burke, Susan Carter, Naama Constantini, Constance Lebrun, Nanna Meyer, Roberta Sherman, Kathrin Steffen, Richard Budgett, Arne Ljungqvist. Br J Sports Med 2014;48:491–497. doi:10.1136/bjsports-2014-093502

Disease Risk



Performance Issues



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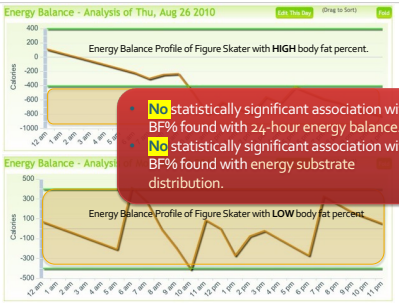
National Team Figure Skaters

Georgia State University: Approved Institutional Review Board Protocol H11178



- No statistically significant association with BF% found with 24-hour energy balance.
- No statistically significant association with BF% found with energy substrate distribution.

N = 10; Female; Age 16-25 (mean age=18.75 yr)

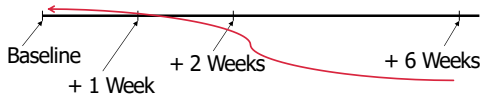
- Hours in deficit > -400 kcal positively associated with body fat % (r=.745; .013). More hours, higher body fat cent
- nificantly higher cortisol (p=.020)
- Significantly lower BMD
  - Pelvis (p=.026)
  - Femur (p=.045)
- Hours + or – 400 kcal negatively associated with body fat % (r=-.745; p=.013). More hours, lower body fat percent.

26

Study Design

Benardot D, et al. Med Sci Sports Exer, 2005; 37(5): S339.

>With Product or Placebo<



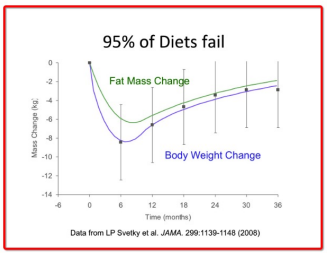
Measured at each assessment opportunity **(Results: Group provided calories)**

- Body composition (DEXA) — **Significantly lower body Fat %**
- IGF-I (Fasting) — **Higher trend (non-signif. p=.08)**
- POMS — **Significantly more vigorous**
- Performance (Wingate) — **Significantly better power & endurance**
- Diet and Energy Balance — **No change in calories (Wt Stable)**

27

MISPERCEPTION – Low Calorie Diets Are an Effective Weight Loss Strategy

Reality: Low calorie diets are doomed to fail. Adaptive thermogenesis leads to same weight on lower energy intake, but the resultant weight has higher fat mass that makes you look bigger and increases cardiometabolic risks.



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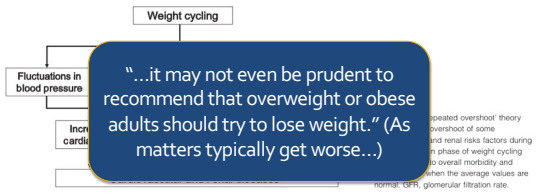
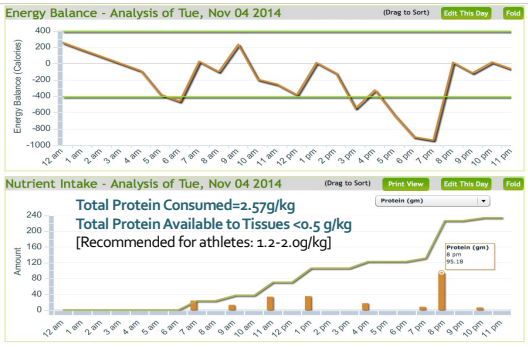
CARDIOVASCULAR AND RENAL DISEASES AND DIET-ASSOCIATED WEIGHT CYCLING



Montani JP, Schutz Y, and Duloo AG. Dieting and weight cycling as risk factors for Cardiometabolic diseases: who is really at risk? *Obesity Reviews*. 2015; 16 (Suppl 1): 7-18.

29

Protein Matched with Hourly Energy Balance



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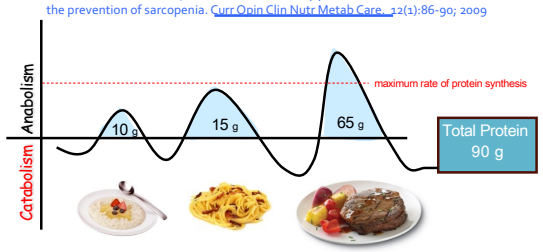
Daily Protein Distribution
- Typical ? -

Source: Paddon-Jones D, Rasmussen BB. Dietary protein recommendations and the prevention of sarcopenia. Curr Opin Clin Nutr Metab Care. 12(1):86-90; 2009



A skewed daily protein distribution fails to maximize potential for muscle growth

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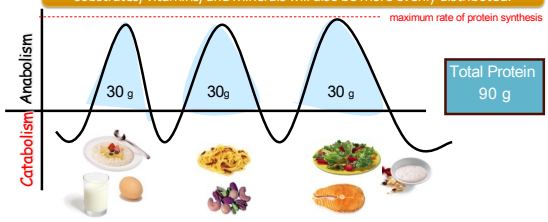
Daily Protein Distribution
- Optimal -

Evenly distributing energy intake increases the inevitability that energy substrates, vitamins, and minerals will also be more evenly distributed.



Repeated maximal stimulation of protein synthesis
→ increase / maintenance of muscle mass

Source: Paddon-Jones et al., 2009

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Negative Energy Balance and Hormones Changes

Tissue/Organ	Hormone/Compound	Expected Change
Adipocytes & Hypothalamus	Leptin	Decreased
Adrenal	Cortisol	Increased
Gastrointestinal Tract	Ghrelin	Increased
Liver	Plasma Glucose IGF-1(1) IGFBP-1(2)	Decreased Decreased Increased
Pancreas	Insulin	Decreased (Fasting) Increased (Eating)
Thyroid	Total T3(3)	Decreased

(1) Insulin-like growth factor-1
(2) Insulin-like growth factor binding protein-1
(3) Triiodothyronine

Sources: Stafford DEJ. Treat Endocrinol. 2005;4(3):147-154
Laughlin GA & Yen SSC. J Clin Endocrinol Metab. 1996; 81(12): 4301-9
Laucks AB et al. J Appl Physiol. 1998; 84(1):37-46
Laucks AB & Callister R. J Appl Physiol. 1993; 264: R924-30
Laucks AB & Heath EM. Am J Physiol. 1994; 266: R817-23

33

Ochner CN, Tsai AG, Kushner RF, and Wadden TA. Treating obesity seriously: when recommendations for lifestyle change confront biological adaptations. *The Lancet Diabetes & Endocrinology Journal*. Online 11 Feb 2015 DOI: http://dx.doi.org/10.1016/S2213-8587(15)00009-1

"Therefore, the current advice to eat less and exercise more may be no more effective for most individuals with obesity than a recommendation to avoid sharp objects for someone bleeding profusely."
Dr Christopher Ochner, lead author

World Rhythmic Gymnastics Championships, Budapest, 1996

34

MISPERCEPTION – Supplements Are An Effective Means of Improving Nutritional Status.

Reality: Very high doses of nutrients (think '*supplements*') lead to lower tissue sensitivity and greater risk of toxicity. More than enough is not better than enough.

Equivalent?

35

Dietary Supplements and Mortality Rate in Older Women (Mean Age = 62 yrs.)

Nutrient Supplement	Absolute Risk Change
Multivitamins	2.4% Increased Risk
Vitamin B6	4.1% Increased Risk
Folic Acid	5.9% Increased Risk
Iron	3.9% Increased Risk
Magnesium	3.6% Increased Risk
Zinc	3.0% Increased Risk
Copper	18.0% Increased Risk
Calcium	3.8% Decreased Risk

Source: Mursu J, Robien K, Harnack LJ, Park K, and Jacobs DR. Dietary supplements and mortality rate in older women: The Iowa Women's Health Study. Archives of Internal Medicine. 2011; 171(18): 1625-1633.

Summary: In older women (N=38,772), several commonly used dietary vitamin and mineral supplements were found to be associated with increased total mortality risk. Calcium is associated with decreased risk. It was noted that in 1986, 66% of women studied took supplements; and in 2004 that increased to 85% of women.

36

Athlete Supplement 'Issues'

- **Taken in large amounts, some supplements may result in opposite of desired effect.**
  - Data indicate that vitamin E supplements (800 IU for 1-2 months) compared with placebo ingestion before a competitive triathlon race event promotes lipid peroxidation and inflammation during exercise. Med Sci Sports Exerc 2004; 36(8):1328-1335
  - > 500 mg leucine/kg/d may increase adverse events. Tolerability of leucine in humans. Branched Chain Amino Acids in Clinical Nutrition: Nutrition and Health 2015. pp 3-13.
- **Many supplements have banned substances not listed on the label.**
  - Kwiatkowska D et al. N,N-dimethyl-2-phenylpropan-1-amine – new designer agent found in athlete urine and nutritional supplement. Drug Testing and Analysis. 2015; 7(4): 331-335.
  - Maughan R. Quality assurance issues in the use of dietary supplements, with special reference to protein supplements. J. Nutrition. 2013. 142: 1843S-1847S.
- **Most young athletes *believe* supplements are necessary to optimize training.**
  - Manore MM et al. Sport nutrition knowledge, behaviors and beliefs of high school soccer players. Nutrients 2017; 9:350 doi:10.3390/nu9040350
- **Nutrition needs of adolescent athletes should be met by foods rather than supplements.**
  - Position: Sports Dietitians of Australia: Sports Nutrition for the Adolescent Athlete. International J of Sport Nutrition and Exercise Metabolism 2014; 24: 570-584.

37

More Than Enough Is Not Better Than Enough…

- After an average of 4 years of supplementation, the combination of beta-carotene and vitamin A had no benefit and may have had an adverse effect on the incidence of lung cancer and on the risk of death from lung cancer. N Engl J Med 1996; 334:1150-5
- There is no convincing evidence that 'immune-boosting' supplements, including high doses of antioxidant vitamins and zinc, prevent exercise-induced immune impairment is currently lacking. J Sports Sci 2004; 22:115-125.
- Data indicate that vitamin E (800 IU for 1-2 months) compared with placebo ingestion before a competitive triathlon race event *promotes* lipid peroxidation and inflammation during exercise. Med Sci Sports Exerc 2004; 36(8):1328-1335
- Cancer patients taking vitamins A and E to boost the immune system may, in fact, keep cancer cells from dying via the natural protective process called apoptosis. Melville www.scienceagogo.com) from UNC-CH.
- Vitamin E had NO significant effect on reducing lower respiratory tract infections in elderly nursing home residents. JAMA 2004; 292(7): 828-36

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Food FIRST Approach

The use of dietary supplements by athletes
Authors: Ronald J. Maughan; Frederic Depiesse; Hans Geyer
Journal of Sports Sciences, Volume 25, Issue S1 December 2007 , pages S103 - S113

- Many athletes use dietary supplements as part of their regular training or competition routine, including about 85% of elite track and field athletes.
- Supplements commonly used include vitamins, minerals, protein, creatine, and various "ergogenic" compounds.
- These supplements are often used without a full understanding or evaluation of the potential benefits and risks associated with their use, and without consultation with a sports nutrition professional.
- A few supplements may be helpful to athletes in specific circumstances, especially where food intake or food choice is restricted. **Vitamin and mineral supplements should be used only when a food-based solution is not available.**
- Sports drinks, energy bars, and protein - carbohydrate shakes may all be useful and convenient at specific times.
- There are well-documented roles for creatine, caffeine, and alkalinizing agents in enhancing performance in high-intensity exercise, although much of the evidence does not relate to specific athletic events.
- **There are potential costs associated with all dietary supplements, including the risk of a positive doping result as a consequence of the presence of prohibited substances that are not declared on the label.**

39

Example: Folate

Concerns have been raised that high folic acid supplementation might accelerate the progression of preneoplastic lesions, increasing the risk of colorectal and possibly other forms of cancer, including prostate cancer, in certain individuals.

- KimYI (2006). Folate: a magic bullet or a double edged sword for colorectal cancer prevention? Gut 55(10): 1387-1389.
- Ulrich CM, Potter JD (2006). Folate supplementation: too much of a good thing? Cancer Epidemiol Biomarkers Prev 15(2): 189-193.
- Mason JB (2011). Unraveling the complex relationship between folate and cancer risk. Biofactors 37(4): 253-260.
- Lee JE, Willett WC, Fuchs CS, Smith-Warner SA, Wu K, Ma J, et al. (2011). Folate intake and risk of colorectal cancer and adenoma: modification by time. Am J Clin Nutr 94(4): 817-825.
- Figueriedo et al. Folic acid and risk of prostate cancer: results from a randomized clinical trial. J Natl Cancer Inst 2009; 101: 432-435.

Which one is better?

- The diet that **meets** the adult DRI for folate (400 mcg/day) over the course of a day?

or

- The diet that **meets** the adult DRI for folate in a single meal or supplement and **exceeds** the DRI for folate for the day?

40

Jump Height Study Comparing Carbohydrate and Creatine Supplements

[Koenig CA, Benardot D, Cody M, and Thompson W. Comparison of Creatine Monohydrate and Carbohydrate supplementation on Repeated Jump Height Performance. The Journal of Strength and Conditioning Research. 2008; 22(4):1081-1086.]

- No difference in first 6 of 10 jumps
- Jump 7, 250 kcal supplement significantly better than all other supplements
- Jump 8 & 9, 250 kcal and creatine supplements better than other supplements
- Jump 10, all supplements better than placebo
- In no case did creatine monohydrate outperform 250 kcal from carbohydrate
- Creatine monohydrate group gained 1.5 kg after 6 days; 250 kcal group gained 0.0kg after 6 days.

Interpretation: Give the body enough energy *and* protein, and it can synthesize the required secondary proteins/polypeptides. Give the body **enough protein *and not enough* energy**, and the protein will be used to satisfy the energy requirement, with a failure to synthesize needed secondary proteins.

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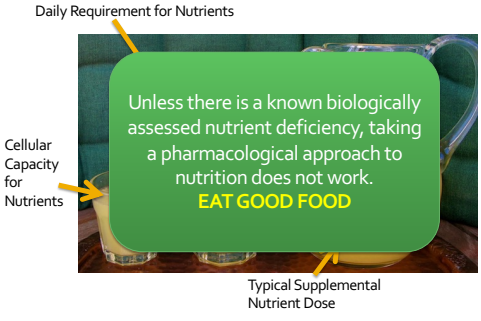
Optimizing nutrient intake to support health and athletic performance requires 'on-time' delivery of nutrients, fluids, and energy…THROUGH WELL-TIMED EATING.



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MISPERCEPTION – Focusing on 'Perfect Foods' Assures Good Nutritional Status

Reality: People who continuously eat the same few foods because they believe these foods are 'healthy' are at risk of malnutrition. There is no perfect food.

Sources:
- Guyonnet S, and Rolland Y. Screening for malnutrition in older people. Clinics in Geriatric Medicine. 2015; 31(3): 429-437
- Murray E, and Manary M. Possible role of the microbiome in the development of acute malnutrition and implications for food-based strategies to prevent and treat acute malnutrition. Food and Nutrition Bulletin. 2015; 36(1): 572-575

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Color Wheel of Foods & Phytochemicals Source: Dr. David Heber, UCLA Center for Human Nutrition		
Color Group	**Phytochemicals**	**Fruits and Vegetables**
Red	Lycopene Phytoene Phytofluene Vitamin E	Tomatoes Tomato Sauce Vegetable Juice Tomato Soup Watermelon
Green	Glucosinolates Isothiocyanates Indole-3 Carbinol Folic Acid	Broccoli Brussel Sprouts Bok Choy Cauliflower Cabbage
Green/Yellow	Lutein Zeaxanthin	Spinach Avocado Kale Green Beans Green Peppers Kiwi Collard Greens Mustard Greens

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Orange	Alpha & Beta Carotene Beta-Cryptoxanthin	Carrots Pumpkins Butternut Squash
Orange/Yel		ice s
Red-Purple		Juice erries erries
White/Green		Chives

In this example, there is NO single food that can supply all of the nutrients/phytonutrients associated with good health.

Only *variety* of intake works:

1. Better assurance of exposing tissues to all nutrients
2. Better assurance of avoiding excess tissue exposure to any nutrient/food substance.

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MISPERCEPTION : High sugar intake will make you fat.

Reality: There are *many* ways to increase insulin and make more fat besides eating refined carbohydrates (i.e., sugar), including letting yourself get really hungry and/or eating large meals.

SUGAR IS 'CONDITIONALLY' BAD

You would be hard-pressed to find anything better to give a hard-working athlete than 'sugar' during exercise.

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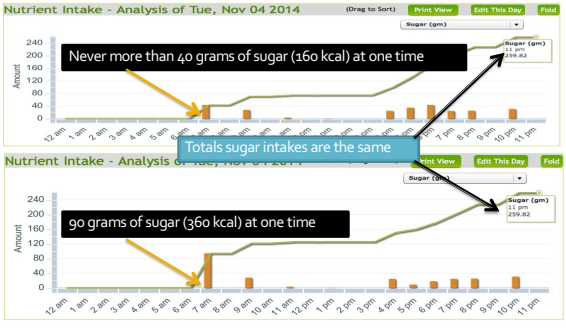
Would You Treat These as The Same?



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Factors Associated with Hyperinsulinemia

FACTORS

- High bolus of simple (refined) carbohydrates
- High blood sugar
- Large bolus meal
- Physiological hunger (low blood sugar)
- Psychological and physiological stress
- High Body Fat Percent

EATING PATTERN

- Delayed meals
- Large meals
- 3 meals/day pattern
- Meals with refined foods
- NO snacking between meals

Insulin, blood sugar, and leptin are controlled with frequent small feedings that dynamically match requirement.

- Leibel RL et al. N Engl J Med 1995; 9:332(10): 621-8.
- Hawley JA, & Burke LM. British Journal of Nutrition 1997; 77:S91-103.
- Blom WAM, et al. American Journal of Clinical Nutrition. *2005; 81*(2): 367-375.
- Bertelsen J et al. Diabetes Care. *1993; 16*(1): 4-7.
- Fogteloo AJ, et al. Hormone Research in Pediatrics. *2004; 62*, 71-78.

Better to have 3 meals of this

than one meal of this

Same calories, but vastly different insulin response

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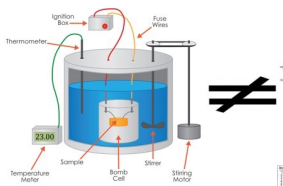
MISPERCEPTION – 3,500 Calories equal 1 pound of body tissue.

Reality: In humans, 3,500 Calories does NOT = 1 pound. Never has, and never will. Humans are not Bomb Calorimeters.

Bomb Calorimeter



Human

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Energy Balance Beliefs Questioned

Source: Am J Clin Nutr 2012;95:989-94

- Weight-loss pleateau at 6-8 mo of intervention from slowed metabolism?
  - Failure to comply with diet?
  - Biological and psychological drives to eat?
- Obesity is due to low metabolism?
  - Maintenance of obesity NOT due to low metabolism (i.e., low T3)
  - Weight loss problems may be due to low energy expenditure
- It takes a reduction of 3500 kcal to lose 1 lb of weight?
  - Math doesn't work because of compensatory effects
  - New model (http://bwsimulator.niddk.nih.gov) includes set point plateau norms
  - Example: 40 kcal/d permanent reduction in energy intake should result in ~20 lb weight loss in 5 years, but new system predicts only 4 lb weight loss.
- Small lifestyle changes can reverse obesity?
  - Walking to lose 100 kcal more each day should result in 50 lb loss in 5 years. Actual loss is closer to 10 lb.

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Within-Day Energy Balance in Children and Adolescents

Georgia State University Approved Institutional Review Board Protocol: H11146

Delfausse L, Benardot D, Nucci A, and Lyn R.

- 12 Children (8-14 yr)
  - End of day EB not associated with body fat %
  - More time spent in an energy surplus (EB >0) significantly associated with higher BF% (
  - More time spent in an energy surplus (EB > 0) was significantly associated with lower body fat % (r=-0.914; *P*<0.001),
  - More time in an energy deficit (EB < 0) was significantly associated with higher BF% (r=0.914; *P*<.001).

No statistically significant association found with 24-hour energy balance

51

Dieting To Achieve 'Weight' Goals Predisposes to Fatness

Duloo AG, and Montani JP. Dieting and cardiometabolic risks. Obesity Reviews. 2015: 16(suppl 1): 1-6.

- The fraction of weight loss as fat-free mass increases
- Feedback signals from depletion of both fat and FFM through effects on energy intake and adaptive thermogenesis
- A faster rate of fat recovery relative to FFM recovery is a feature of body composition autoregulation
  - High rates of dieting and weight loss recidivism raise concerns..
    - Increased risk for eating disorders
    - Low bone density

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Possible Relationship Between Energy Deficits and Disordered Eating

[From: Benardot D & Thompson W. ACSM Health and Fitness Journal 1999; 3(4): 14-18]

1. Exercise occurs without sufficient energy intake.
2. Body adapts to inadequate energy by lowering metabolic rate
3. Weight gain or increase in body fat % occurs because of increased metabolic efficiency
4. The exerciser reduces energy intake further to maintain desired weight and/or body composition
5. Metabolic rate is reduced more, reducing the amount of energy that can be consumed still further.
6. Eventually, an eating disorder may occur from this cycle.

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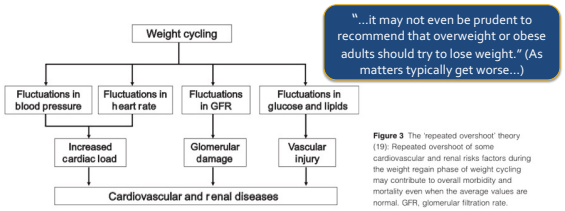
CARDIOVASCULAR AND RENAL DISEASES AND DIET-ASSOCIATED WEIGHT CYCLING



"…it may not even be prudent to recommend that overweight or obese adults should try to lose weight." (As matters typically get worse…)

Figure 3 The 'repeated overshoot' theory (19): Repeated overshoot of some cardiovascular and renal risks factors during the weight regain phase of weight cycling may contribute to overall morbidity and mortality even when the average values are normal. GFR, glomerular filtration rate.

Montani JP, Schutz Y, and Duloo AG. Dieting and weight cycling as risk factors for Cardiometabolic diseases: who is really at risk? *Obesity Reviews*. 2015; 16 (Suppl 1): 7-18.

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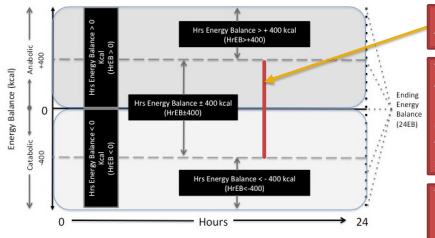
A New Model For Energy Balance Assessment

Benardot D. Energy thermodynamics revisited: Energy intake strategies for optimizing athlete body composition and performance. *Revista de Ciencias del Ejercicio y la Salud (Journal of Exercise Science & Health).* 2013: 11(2): 1-13 (EISSN 1659-4436).



Best to stay within this range

To lose FAT, best to spend 1 to 2 hours more in a catabolic state than in an anabolic state.

To gain MUSCLE, best to spend 1 to 2 hours more in an anabolic state than in a catabolic state, coupled with exercise.

What foods are consumed to achieve the desired goal is critically important.

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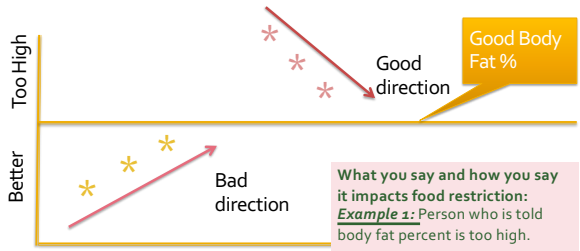
Tracking Invaluable for Developing Appropriate Nutrition Intervention

Single measure vs. Multiple Measures: Delta Score (Change over time)



Analyzing trends is critical to understanding the individual.
Single measures can be misleading and result in poor counseling.

What you say and how you say it impacts food restriction:
Example 1: Person who is told body fat percent is too high.

Example 2: Same person who is told lean mass percent is too low.

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THANK YOU!

Applying Sports Nutrition Research for Enhancing Public Health

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