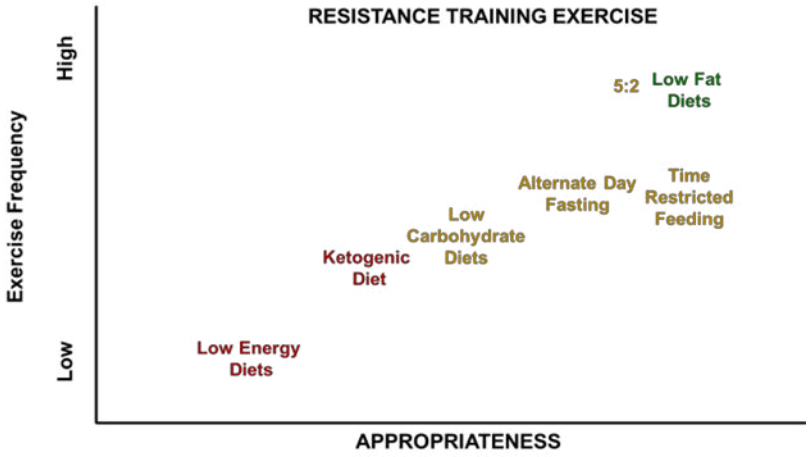
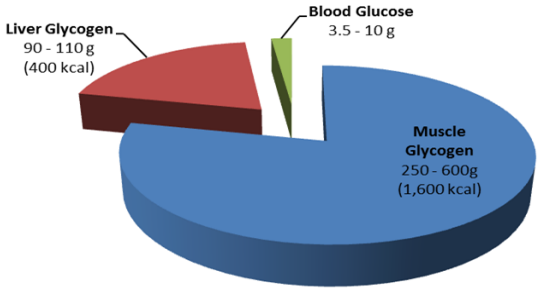
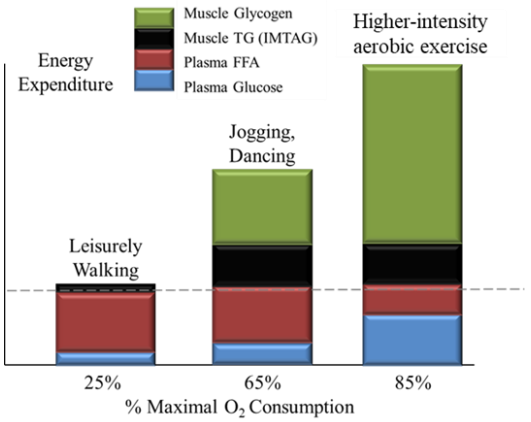
Aligning Diet and Exercise

Ideas to Maximize Results







Developed by:

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NASM CPT, CES, PES, CNC, CSNC & CWC; ACE CPT & HC; ACSM EP-C; CSCS; CISSN

Engage.. Ignite.. Empower..©

Agenda …

110-minutes:

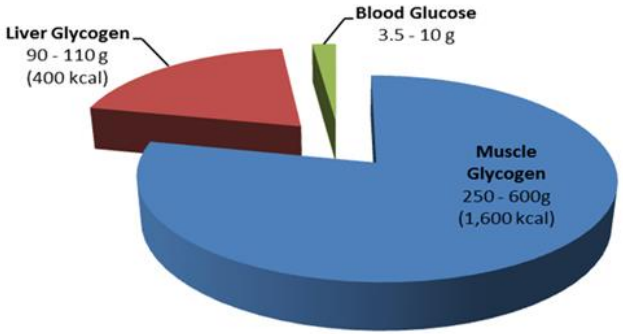
1. Carbohydrate Concepts in Exercise Science:
   - Carbohydrate storage in the body
   - Carbohydrate and fat utilization during exercise
   - Carbohydrate depletion
   - Fasted cardio
   - Carbohydrate needs of the body
2. Protein Concepts in Exercise Science:
   - RDA versus exercising needs
   - Protein needs and weight loss – body composition changes
3. Diets, Macronutrient Composition and Exercise.
   - Low carbohydrate and low-fat diets
   - Low energy diets
   - Fasting-type diets.

Carbohydrates …

Carbohydrate Roles in the Body

Carbohydrate Source → Ingestion → Digestion and Absorption → **Monosaccharides** → Entry into blood to liver (portal vein)

Glucose | **Fructose** | Galactose insignificant



35-to-45% oxidized

Priority #1: Fuel for Immediate Use*

40-to-50% converted to glucose

Priority #2: Replenish Depleted Glycogen in Cells

Priority #3: Some Conversion to Fat
(capped glycogen stores)

Glucose → Conversion to TGs can happen directly within muscle and fat cells

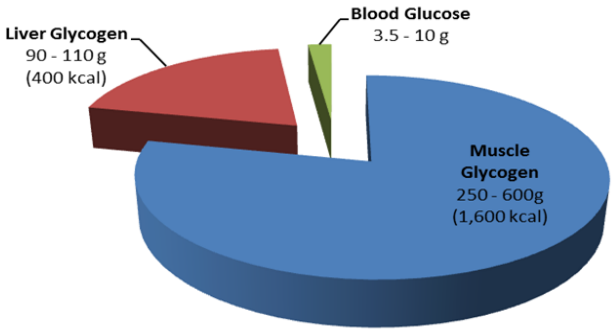
Fructose → Conversion to TGs in liver

* Use of carbohydrates as fuel or helping completely metabolize fats as fuel.

Reference: Sun SZ, and Empie MW, (2012). Fructose metabolism in humans – what isotopic tracer studies tell us. *Nutrition and Metabolism*, 9:89. https://doi.org/10.1186/1743-7075-9-89.

Carbohydrates …

Carbohydrate Storage in the Body



Muscle Mass

~40-to-45% (to 55%) of mass (males).

~30-to-35% of mass (females).

Muscle:

- Normal storage = 15g/Kg (6.8 g/lb.) of muscle tissue*.
- Equals ~250-to-600g (1,000-to-2,400 kcal).

*Increased with carb-loading protocols (~5 days) or through endurance training.

Liver:

- Normal storage = 50g/Kg (22.7g/lb.) of tissue.*
- Liver is between 1.5-and-2.5 Kg = ~75-to-125 grams (300-to-500 kcal).

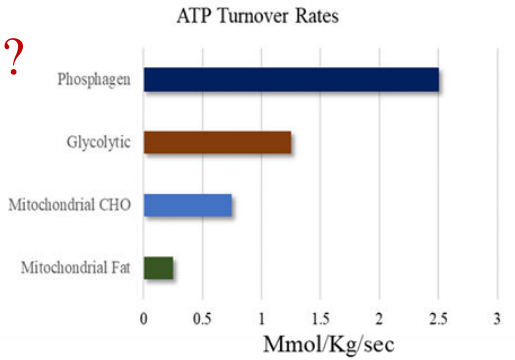
Roles of carbs in muscle v. liver**

**Liver stores can deplete within 12-to-18 hours

Reference: Janssen I, Heymsfield SB, Wang Z, and Ross R, (2000). Skeletal muscle mass and distribution in 468 men and women aged 18–88 years. *Journal of Applied Physiology,* 89(1):81-88.

Carbohydrates …

Carbohydrate Utilization v. Intensity



Why do we rely more upon carbohydrates at higher intensities?

- Key reasons include:
  - Faster rate of ATP production per unit of time v. fats.
  - Carbohydrates are more efficient – produce more ATP per O_2 molecule v. fatty acids
    - Glucose = 6.0 ATP per O_2 molecule
    - Palmitic acid = 5.6 ATP per O_2 molecule.
  - Greater reliance upon type 2 muscle fibers – more anaerobic (i.e., glucose dependent).
  - Greater circulating levels of epinephrine at higher intensities = faster glycogenolysis rates in liver = more glucose release to the blood.
    - Epinephrine stimulates glycolysis in muscle tissue.

Carbohydrates …

Carbohydrate Utilization v. Intensity

Why do we rely more upon carbohydrates at higher intensities? (cont.)

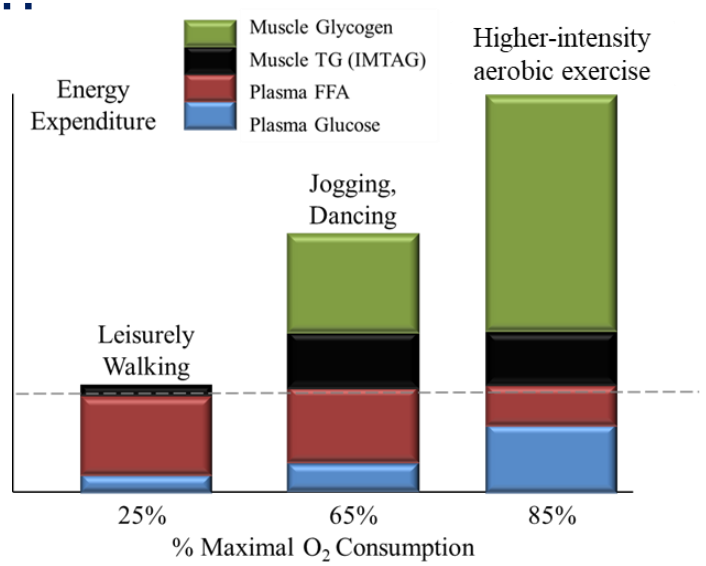
- Greater glucose uptake into muscle cells v. rest due to uptake pathway:
  - NIMGU when insulin is suppressed under SNS activation.
  - Muscle contraction moves glucose receptors to the outer cell wall to increase glucose uptake rates independent of insulin.
- Increased ATP breakdown increases H^+ concentration
  - Changes cell ph.
  - Inhibits carnitine acyltransferase (CPT1) – slows free fatty acids (FFA) transport to mitochondria.

References:

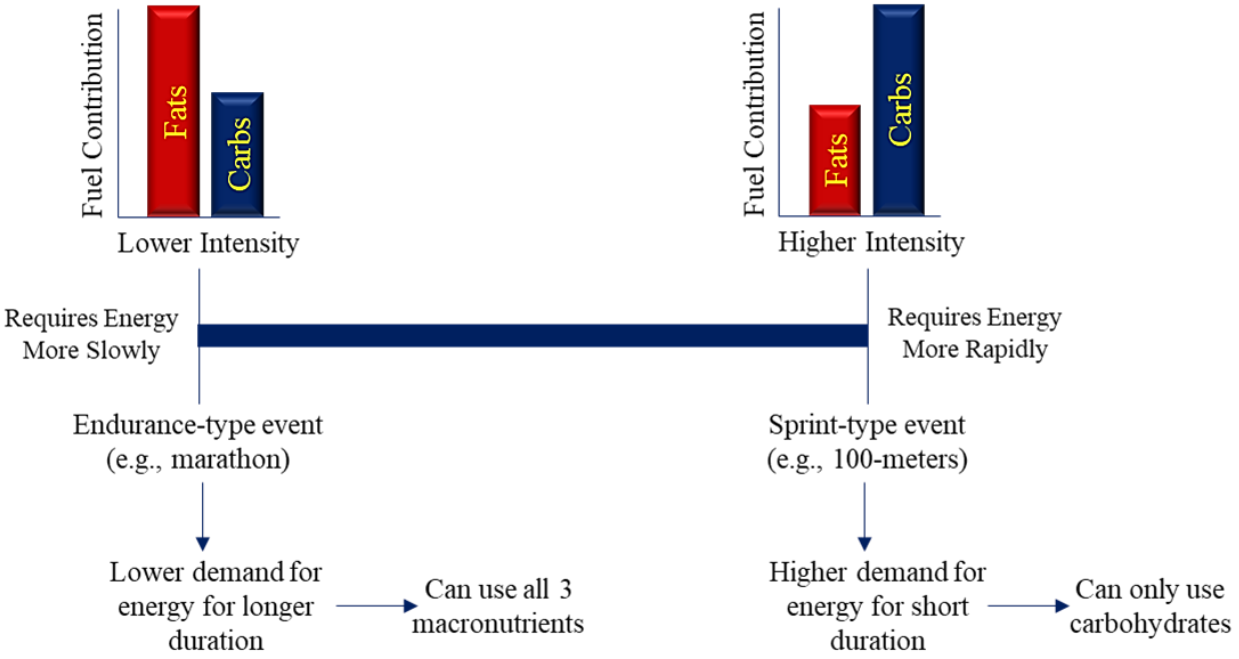
1. Pocari J, Bryant, CX, and Comana, F (2015). *Exercise Physiology*. Philadelphia, PA. The FA Davis Company.
2. McArdle WD, Katch FI, and Katch VL, (2015). *Essentials of Exercise Physiology (5th edition).* Philadelphia, PA. Wolters Kluwer.
3. Kenney WH, Wilmore JH, and Costill DL, (2021). *Physiology of Sport and Exercise (8th edition).* Champaign, IL. Human Kinetics.
4. Haff GG, and Triplett NT, (2016*). Essentials of Strength Training and Conditioning (4th edition)*. Champaign, IL., Human Kinetics.

Fuel Use During Exercise …

Fuel Use – Intensity:



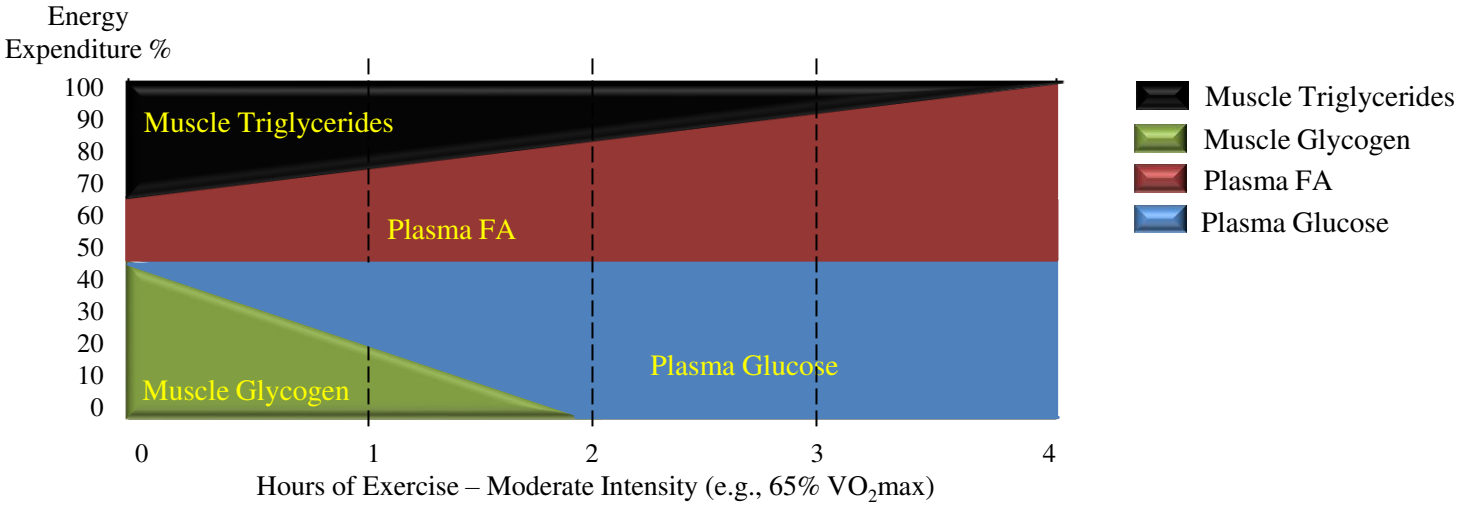
- General takeaway:



Reference: Romijn JA, Coyle EF, and Sidossis LS, (1993). Regulation of endogenous fat and carbohydrate metabolism in relation to exercise intensity and duration. *American Journal of Physiology, Endocrinology and Metabolism.* 265(3):E380-391.

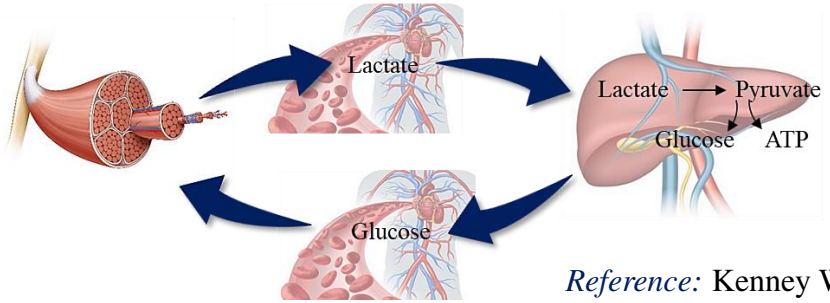
Fuel Use During Exercise …

Fuel Use – Duration (moderate-intensity exercise)



Average Adult:

- Estimated burn rate = ~100 kcal/mile = total glycogen = ~20 miles.
- Muscle glycogen capacity = 90-to-120-minutes.
- Anaerobic Work:
  - Glycogen depletion = ~40% over 60-to-90-min of work ONLY!



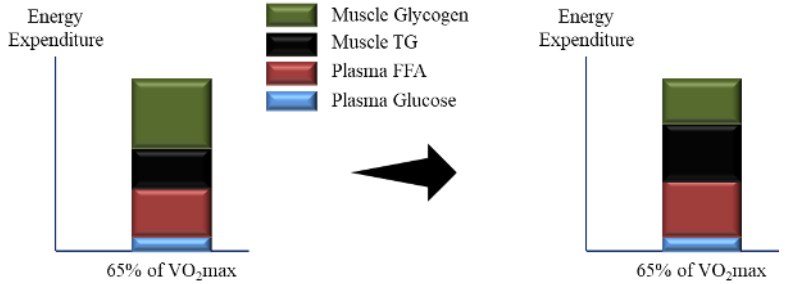
Can account for ~50% of carbohydrates used by muscles during intense exercise when lactate is produced.

Reference: Kenney WH, Wilmore JH, and Costill DL, (2021). *Physiology of Sport and Exercise (8th edition).* Champaign, IL. Human Kinetics.

Fuel Use During Exercise …

Can I Increase Fat Utilization Rates?

1. Macronutrient Composition:
   - Low-carb/high-fat diets change resting fat utilization rates.
   - Low-carb/high-fat diets change sub-maximal exercise fat utilization rates – applicable to low-to-moderate intensity exercise.
2. Training Effect:
   - HIIT or SIT-type training = improvements in oxidative efficiency and fat utilization rates, but larger effects expected with longer (endurance-type) training regimens.
   - Concept of Quantity.



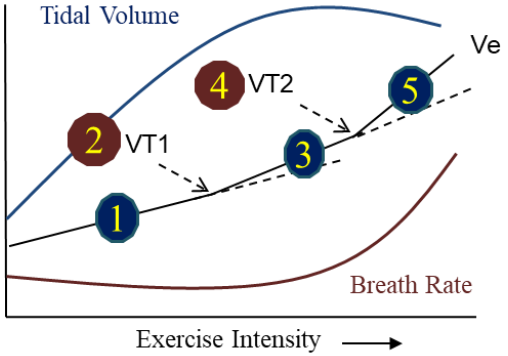
References:

1. Atakan MA, Guzel Y, Shrestha N, et al., (2022). Effects of high-intensity interval training (HIIT) and sprint interval training (SIT) on fat oxidation during exercise: a systematic review and meta-analysis. *British Journal of Sports Medicine*, 56(17): 20:bjsports-2021-105181
2. Zajac A, Poprzecki S, et al., (2014). The Effects of a Ketogenic Diet on Exercise Metabolism and Physical Performance in Off-Road Cyclists. *Nutrients*, 6(7):2493-2508.
3. Burke LM, Whitfield J, Heikura IA, et al., (2021). Adaptation to a low carbohydrate high fat diet is rapid but impairs endurance exercise metabolism and performance despite enhanced glycogen availability. *Journal of Physiology*, 599(3):771-790.

Fuel Use During Exercise …

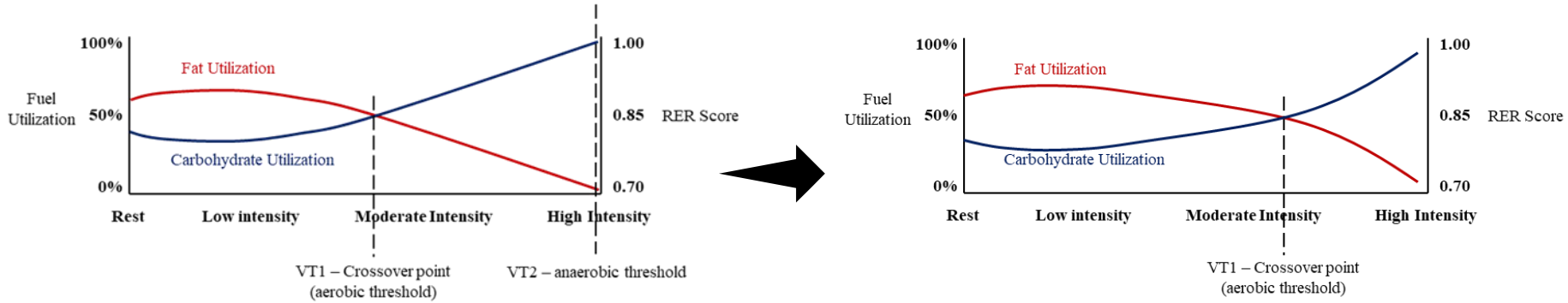
Can I Increase Fat Utilization During Exercise?

2. Training Effect (cont.):
   - VT1 Training
   - Concept of Quality.



1. Continuous talking is easy.
2. Continuous talking is now challenging (VT1 or LT) – true lactate threshold (> 2 mmol).
3. Continuous talking is becoming very uncomfortable.
4. Continuous talking is very difficult (VT2 or RCP).
5. Any talking is essentially impossible. Above VT2, we experience respiratory compensation = sharp increase in Ve.

VT1 = a shift to glucose as the primary fuel; intensity = 5-to-7 out of 10; also known as marker of 'caloric quality' or 'aerobic threshold.'



References:

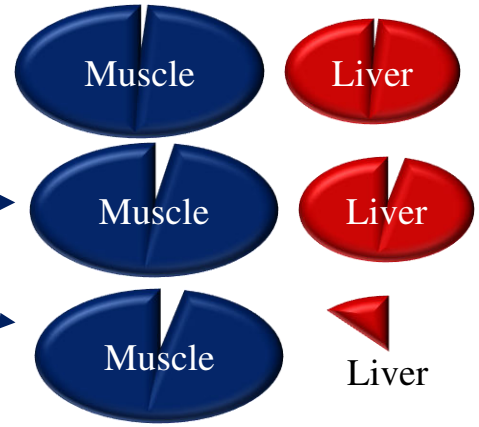
1. Atakan MA, Guzel Y, Shrestha N, et al., (2022). Effects of high-intensity interval training (HIIT) and sprint interval training (SIT) on fat oxidation during exercise: a systematic review and meta-analysis. *British Journal of Sports Medicine*, 56(17): 20:bjsports-2021-105181
2. Helge J, (2002). Long term fat diet adaptation effects on performance, training capacity, and fat utilization. *Medicine and Science in Sports and Exercise*, 34:1499-1504.
3. Spriet L, and Watt M, (2003). Regulatory mechanisms in the interaction between carbohydrate and lipid oxidation during exercise. *Acta Physiol. Scand.*, 178:443-452.

Fuel Use During Exercise …

Can I Increase Fat Utilization During Exercise – Fasted Cardio?

Dinner – Carbohydrates

- Muscle and liver glycogen filled.
- Evening activities – bedtime.
- Overnight fast – bodily functions:
  - Muscle v. liver roles.

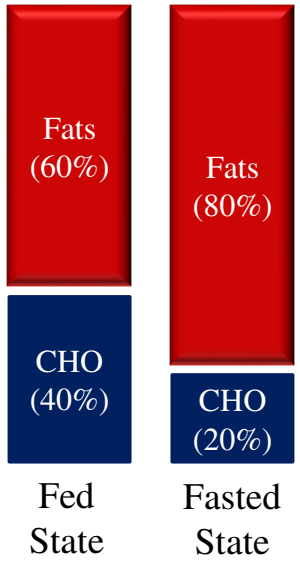


Practice of Fasted Cardio – burn more fat.

- *Example:* 300 kcal per session
  - Fed State: 60% = 180 kcal v. Fasted State: 80% = 240 kcal
  - 3,500 kcal = 1 lb. fat (requires 58 sessions).

But at what cost???

- Elevated cortisol:
  - Promotes lipolysis.
  - Increased gluconeogenesis from protein.
  - Suppressed metabolism (up to 20%).
  - Elevated ketones – can decrease serotonin and dopamine levels.



Macronutrient Needs of the Body …

Exercise	Daily Intake	Exercise	Daily Intake
General adult	3-to-5 grams / Kg BW	Endurance Training (1-to-3 hours/session)	6-to-10 grams / Kg BW
Moderate Exercise (60-to-90 min/session)	5-to-7 grams / Kg BW	Extreme Endurance (> 4-to-5 hours/session	8-to-12 grams / Kg BW

Reference: Burke LM, Hawley JA, Wong SHS, and Jeukendrup AE, (2011). Carbohydrates for training and competition. *Journal of Sport Sciences*, 29(Supp 1):S25-27.

Position Statements – Quantity (Complied from AND, JDC, ACSM, NSCA, ISSN):

Activity Level	Type of Exercise	Protein Needs (g/kg BW)	Protein Needs (g/lb. BW)
None	N/A	RDA (0.8g/kg)	RDA (0.36g/lb.)
Light-to-moderate	Cardiopulmonary Training	1.2-to-1.4g/Kg	0.55-to-0.64g/lb.
Light-to-moderate	Resistance Training	1.5-to-2.0g/Kg	0.68-to-0.91g/lb.
Moderate-to-vigorous	Endurance Training*	1.5-to-2.0g/Kg	0.68-to-0.91g/lb.
Moderate-to-vigorous	Resistance Training	1.7-to-2.2g/Kg	0.77-to-1.00g/lb.

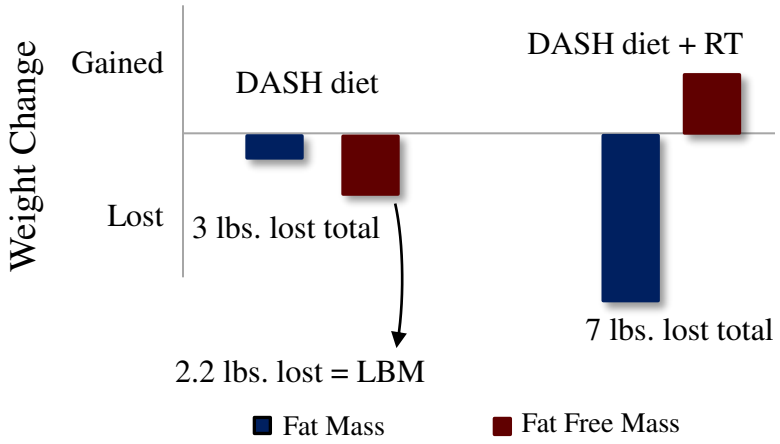
* Sport-specific training or > 10 hours of vigorous weekly exercise.

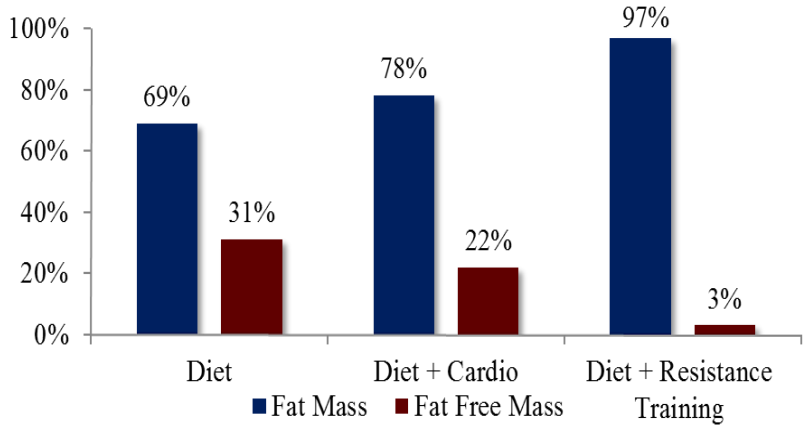
Reference: Pencharz PB, Elango R, and Wolfe RR, (2016). Recent developments in understanding protein needs - How much and what kind should we eat? *Applied Physiology, Nutrition, and Metabolism*, 41(5):577-580. doi:10.1139/apnm-2015-0549.

Weight Loss and Body Composition Change …

Diet (alone) v. Diet + Resistance Training

- Dash diet v. DASH + moderate intensity resistance training
  - 10-weeks, 40-min x 3 (non-consecutive) days/week.
  - Machine-based with 6 UE-LE exercises – 1-sec concentric; 2-to-3-sec eccentric phase.





References:

1. Avila JJ, Gutierres JA., Sheehy ME, et al., (2010). Effect of moderate intensity resistance training during weight loss on body composition and physical performance in overweight older adults. *European Journal of Applied Physiology*, 109(3):517–525.
2. Stiegler, P., Cunliffe, A. (2006). The Role of diet and exercise for the maintenance of fat-free mass and resting metabolic rate during weight loss. *Sports Medicine*, 36(3):239-263.

Weight Loss and Body Composition Change …

Low Energy Availability In Athletes

Energy availability (EA): Amount of dietary energy available to sustain physiological function after subtracting the energy cost of exercise.

- Insufficient EA, often attributed to increased exercise, reduced energy intake, or some combination = physiological disruptions
- Often evident in female athlete triad and RED-S.

$$\frac{\text{Total Energy Intake} - \text{Exercise Energy Expenditure}}{\text{Fat-free Mass (kg)}}$$

Score	Male	Female	Notes
High	> 40	> 45	Maintenance or weight gain
Optimal	40	45	Maintenance and normal physiological function
Sub-optimal	30-to-40	30-to-45	Suggested for short-term weight loss
Clinical	< 30	< 30	Unhealthy – potential physiological impairments

References:

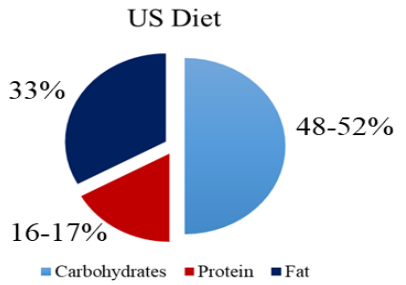
- Logue D, Madigan SM, Delahunt E, et al., (2018). Low energy availability in athletes: A review of prevalence, dietary patterns, physiological health, and sports performance. *Sports Medicine*, 48(1):73-96.
- Areta JL, Taylor HL, and Koehler K, (2021). Low energy availability: history, definition and evidence of its endocrine, metabolic and physiological effects in prospective studies in females and males. *European Journal of Applied Physiology*, 121(1):1-21.

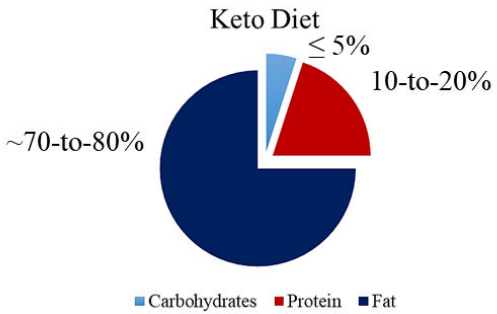

Exercise and
Diet
Archetypes

Aligning Diet and Exercise …

Various Diet Categories

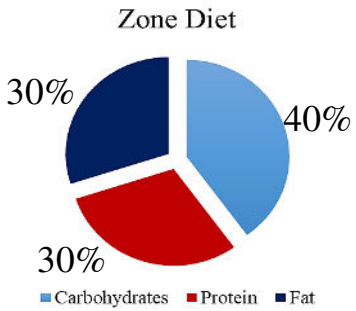
- Ketogenic or very low-carbohydrate diet (VLCD)
- Low-to-moderate carbohydrate diets
- Low energy / high protein – aka protein-sparing
- Low fat diets
- Fasting-type schedules (e.g., 5:2 schedule)
- Time-restricted feeding schedules

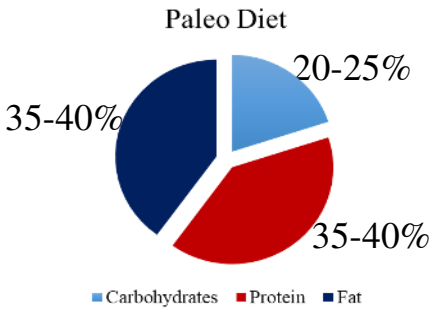


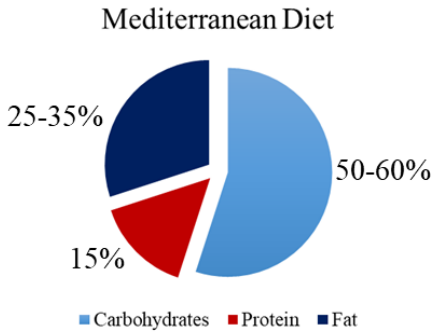


Selection Criteria:

- Popularity
- Available scientific literature







Aligning Diet and Exercise …

Exercise Definitions

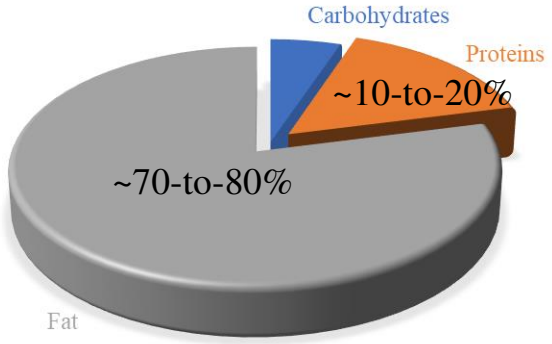
Exercise	Low Intensity (e.g., SS)	Moderate Intensity (e.g., MICT)	High Intensity (e.g., HIIT, SIT)
Cardio	< 45% VO_2max or < 65% MHR or < 11 RPE	Up to 64% VO_2max or Up to 75% MHR or 12-13 (RPE)	≥ 65% VO_2max or Up to 95% MHR or 16-17 (RPE)

Exercise	Low Intensity	Moderate Intensity	High Intensity
Resistance Training	< 50% 1RM (21-to-25 reps to POF)	50-to-70% 1RM (12-to-20 to POF)	to 85% 1RM (5-to-11 to POF)

Reference: Liguori G, and American College of Sports Medicine (2021) *ACSM's Guidelines for Exercise Testing and Prescription (11th ed.).* Philadelphia, PA. Wolters Kluwer

Aligning Diet and Exercise …

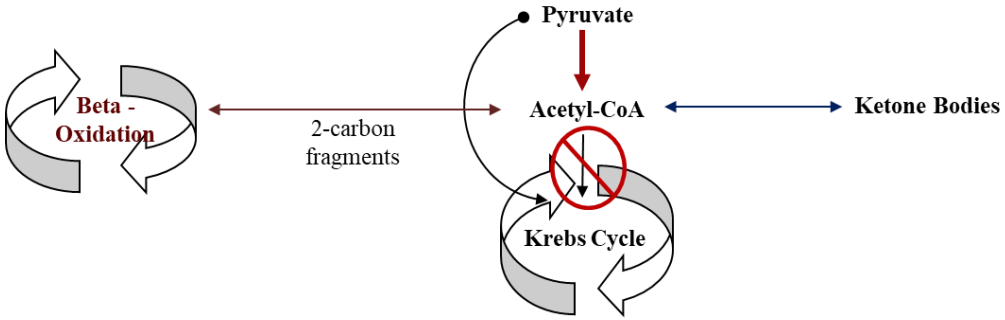
Ketogenic Diet (Very Low Carbohydrate Diet)



Diet:

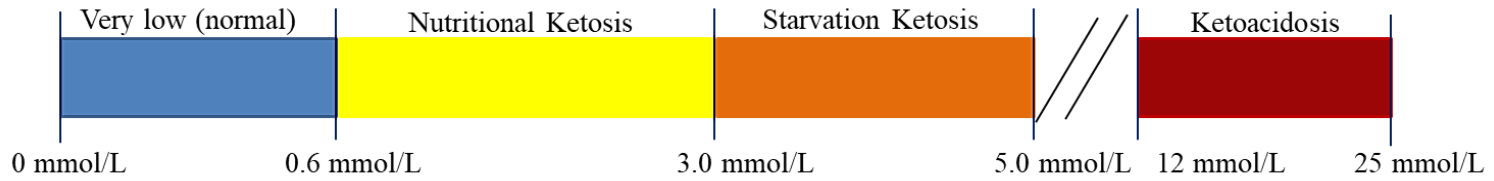
- Traditional Keto diet:
  - ≤ 5% carbohydrates (≤ 50g).*
  - Current adult RDA for carbohydrates = 130g
- What are Ketones:
  - Incompletely metabolized fat fragments formed in liver.
  - 150g+ produced daily (2-to-6% of TEE).

*10-to-15% or up to 100g = LCD



Key Events:

- Extreme fasting or starvation.
- Low carbohydrate diets.
- Carbohydrate restriction
- Glycogen depletion.
- Uncontrolled diabetes.



Aligning Diet and Exercise …

Ketogenic Diet (Very Low Carbohydrate Diet)

Concerns/Comments:

- Weight loss attributed to reduced kcal intake (300-to-600 kcal less).
- Adherence.
- Keto flu (1st 1-to-2 weeks to 1-month)
- Muscle loss (long-term)

Exercise:

Exercise Type	Low	Moderate	High
Cardiovascular	★★★★	★★	Not Rx
Resistance Training	★★★★★	★★★	★

- Some glycogen-sparing for low-to-moderate intensities (< 60%VO_2max).
- RT performance not impacted to same degree given anaerobic nature.

References:

1. Brinkworth GD, Noakes M, Buckley JD, et al., (2009). Long-term effects of a very-low-carbohydrate weight loss diet compared with an isocaloric low-fat diet after 12 mo. *American Journal of Clinical Nutrition,* 90(1):23-32.
2. Foster GD, Wyatt HR, and Hill JO, (2010). Weight and metabolic outcomes after 2 years on a low-carbohydrate versus low-fat diet: A randomized trial. *Annals of Internal Medicine*, 153(3):147-157.

Aligning Diet and Exercise …

Ketogenic Diet (Very Low Carbohydrate Diet)

Exercise (Cont.):

- Rx:
  - Reduce overall training intensity.
  - Reduce total training volume (over time, not per session).
  - Longer recovery periods needed for moderate-to-vigorous intensities:
    - Between sets (phosphagen recovery).
    - Between workouts.

References:

1. Burke LM, Ross ML, and Garvican-Lewis LA, (2017). Low carbohydrate, high fat diet impairs exercise economy and negates the performance benefit from intensified training in elite race walkers. *The Journal of Physiology*, 595(9):2785-2807.
2. Vargas-Molina S, Petro JL, Romance R, et al., (2020). Effects of a ketogenic diet on body composition and strength in trained women. *Journal of the International Society of Sports Nutrition*, 17: 19. https://doi.org/10.1186/s12970-020-00348-7

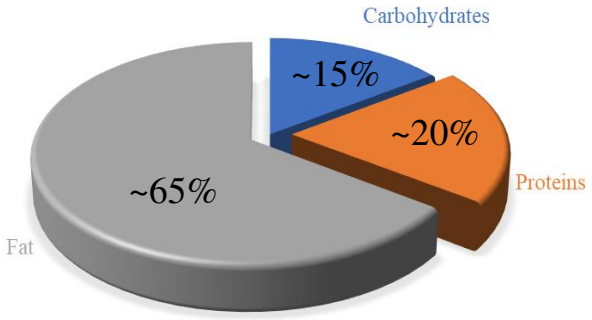
Aligning Diet and Exercise …

Modified Ketogenic Diet (Moderate Ketogenic or Low Carbohydrate Diet)

Diet:

- Increased carbohydrate intake to >100g.

Exercise:



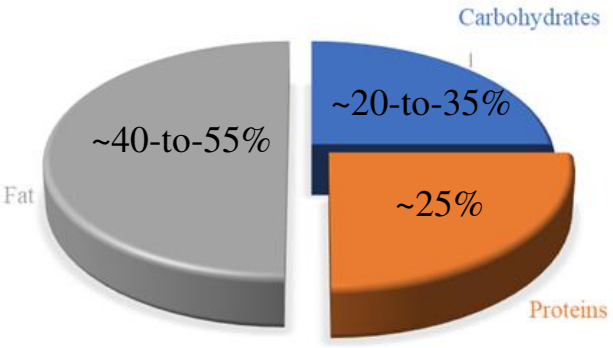
Exercise Type	Low	Moderate	High
Cardiovascular	★★★★	★★★	Not Rx
Resistance Training	★★★★★	★★★★	★★

References:

1. Brinkworth GD, Noakes M, Buckley JD, et al., (2009). Long-term effects of a very-low-carbohydrate weight loss diet compared with an isocaloric low-fat diet after 12 mo. *American Journal of Clinical Nutrition,* 90(1):23-32.

Aligning Diet and Exercise …

Low-to-Moderate Carbohydrate Diets



Diet:

- Carbohydrates = 20-to-35%

Concerns/Comments:

- Effective for weight loss = reduced kcal intake.
- Reduced side effects associated with keto-type diets.
- Positive impact on insulin sensitivity and HbA1C levels.
- Possible long-term adherence issues with lower carbohydrate intakes.

Exercise:

- Carbohydrate intake sustainable for most exercise enthusiasts < 90-min.
- Insufficient for longer-duration or higher-intensity cardio or for multiple sessions (2-a-days).

References:

1. Cook C, and Haub MD, (2007). Low-carbohydrate diets and performance. *Current Sports Medicine Reports*, 6(40):225-229.
2. Skein M, Duffield R, Kelly BT, and Marino FE, (2012). The effects of carbohydrate intake and muscle glycogen content on self-paced intermittent-sprint exercise despite no knowledge of carbohydrate manipulation. *European Journal of Applied Physiology*, 112(8):2859-2870.
3. Wang LL, Wang Q, Hong Y, et al., (2018). The effect of low-carbohydrate diet on glycemic control in patients with type 2 diabetes mellitus. *Nutrients*, 10(6):661

Aligning Diet and Exercise …

Low-to-Moderate Carbohydrate Diets

Exercise (Cont.):

- Monitor high-volume and high-intensity RT.
- Select alternate training days – allow adequate recovery between sessions.
- *Example:*
  - 25% CHO intake on 2,400 kcal = 600 kcal or 150g (carbohydrate RDA = 130g)
  - Almost aligns with current USDA 2018 Physical Activity Guidelines:
    - Perform muscle-strengthening activities involving all major muscle groups ≥ 2 days/week.

Exercise Type	Low	Moderate	High
Cardiovascular	★★★★	★★★	★
Resistance Training	★★★★★	★★★★	★★

	Traditional Keto (5% CHO)	Modified Keto (10-to-15% CHO)	Low-to-Moderate CHO (20-to-35% CHO)
Cardio:	Moderate: ★★	Moderate: ★★★	Moderate: ★★★
RT:	Moderate: ★★★	Moderate: ★★★★	Moderate: ★★★★

Aligning Diet and Exercise …

Low-energy Diets (High Protein – Protein Sparing)

Diet:

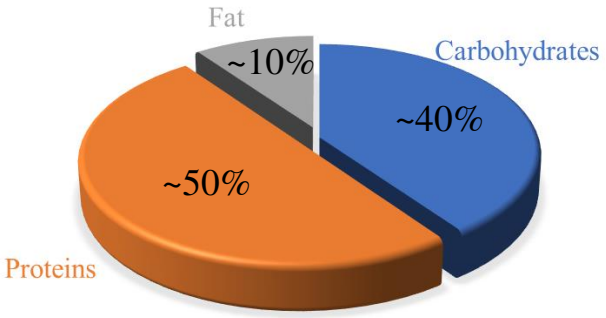
- Approx 800-to-1,200 kcal (VLCD = 400-to-800 kcal) – below 1,200 / 1,500 kcal Rx thresholds.
- Macronutrients:
  - 70-to-100g protein.
  - < 100g CHO.*

*Current adult RDA for carbohydrates – 130g

- Accelerated weight loss (short-term only – 8-to-12 weeks) – sustained use = metabolic suppression.

Concerns/Comments:

- LEA and metabolic suppression.
- Muscle loss – reduced when paired with RT.



References:

1. Brown A, and Leeds AR, (2019). Very low-energy and low-energy formula diets: Effects on weight loss, obesity co-morbidities and type 2 diabetes remission – an update on the evidence for their use in clinical practice. *Nutrition Bulletin*, 44(1):7-24.
2. Seimon RV, Wild-Taylor AL, Keating SE, et al., (2019). Effect of weight loss via severe vs moderate energy restriction on lean mass and body composition among postmenopausal women with obesity: The TEMPO diet randomized clinical trial. *Journal of the American Medical Association Network Open,* 2(10):e1913733. doi:10.1001/jamanetworkopen.2019.13733

Aligning Diet and Exercise …

Low-energy Diets (High Protein – Protein Sparing)

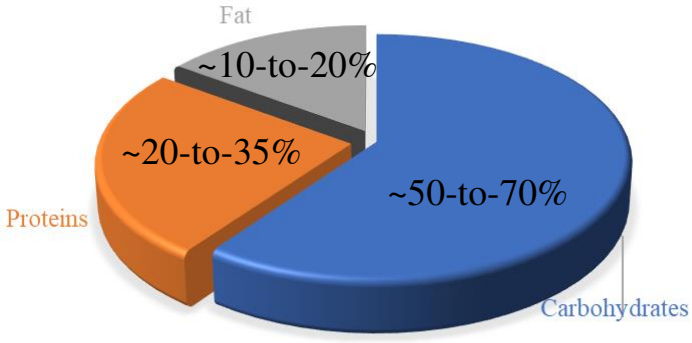
Exercise:

Exercise Type	Low	Moderate	High
Cardiovascular	★★	Not Rx	Not Rx
Resistance Training	★★	Not Rx	Not Rx

- Exercise and intensity and duration = significant negative impact.
- Exercise frequency / volume:
  - 10-to-20% kcal deficit, reduce weekly exercise volume ~10-to-15%.
  - 20-to-30% kcal deficit, reduce weekly exercise volume 16-to-25%.
  - 30-to-40% kcal deficit, reduce weekly exercise volume 25-to-40%.
  - 40%+ kcal deficit, reduce weekly exercise volume 50-to-60% (medically supervised).
- Gauge volume reduction off recovery (e.g., RHR, HRV).

Aligning Diet and Exercise …

Low Fat Diets



Diet:

- Focus on healthy carbohydrates.

Concerns/Comments:

- Can improve many health metrics.
- Emphasis on vegetable sources may compromise protein quality and quantity.
- Concern over fat soluble vitamin intake and steroid hormone production.

Exercise:

- No real limitations – possible exception = impaired muscle protein synthesis.

Exercise Type	Low	Moderate	High
Cardiovascular	★★★★★	★★★★★	★★★★★
Resistance Training	★★★★★	★★★★★	★★★★

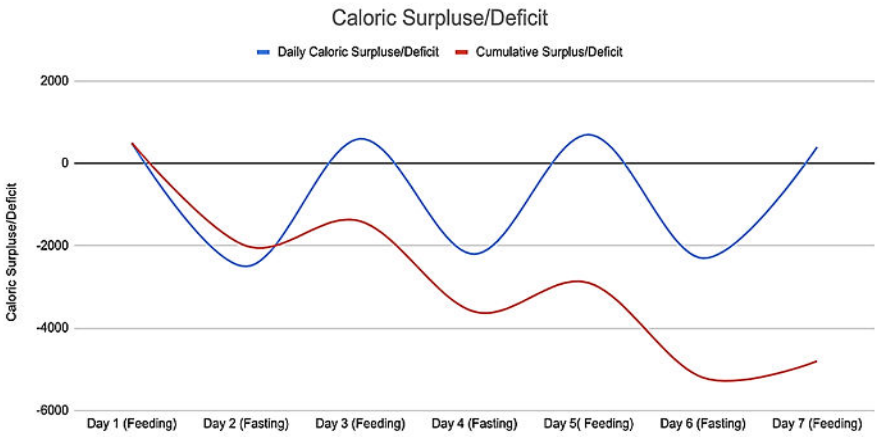
Aligning Diet and Exercise …

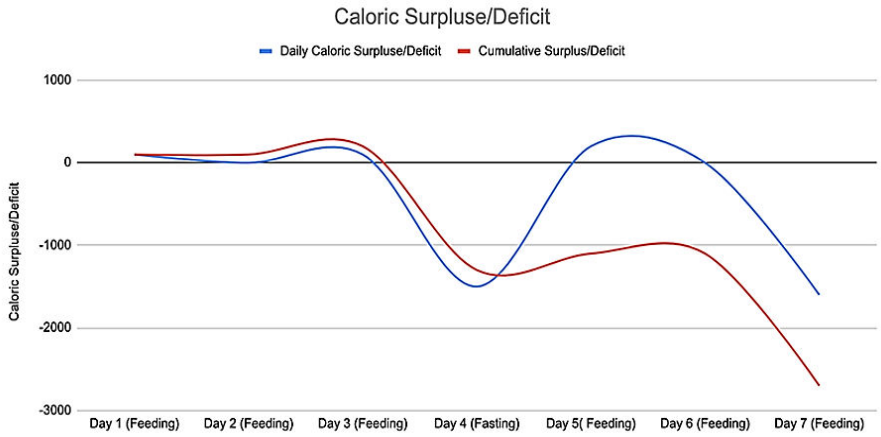
Fasting-Type Schedules: ADF and 5:2

Diet:

- Many variations – emphasis on timing, not food choices.

Type	Characteristics
Traditional Alternate Day Fasting (ADF)	24-hour cycles of feeding-fasting with no compensatory /binge eating
5:2 Fasting Schedule (Michael Mosely, Kate Harrison)	2 non-consecutive partially fasted days. Kcal reduced to 20-to-25% of normal = 500-to-600 kcal over 3-to-4 meals (can be any kcal)





Aligning Diet and Exercise …

Genesis Wellness Group

Fasting-Type Schedules: ADF and 5:2

ADF Diet:

- Effective weight loss plan – comparable results to 25% daily caloric restriction.
- Health promoting effects (e.g., insulin sensitivity).
- ADF advantage (v. starvation-type diets) = greater hormonal stability:
  - Short term kcal undulation = smaller effect on chronic elevation of cortisol.
  - Cortisol suppresses TSH and metabolism.

ADF Concerns:

- Muscle protein degradation (MPD):
  - Body requires continual protein feeding every 3-to-4 hours = (4 feedings per day).
  - *Dosage:* 0.25-to-0.4 g/Kg (0.11-to-0.18g/lb.) per feeding = 20-to-40g.
- Diet not ideal for athlete / individuals seeking muscular development.

References:

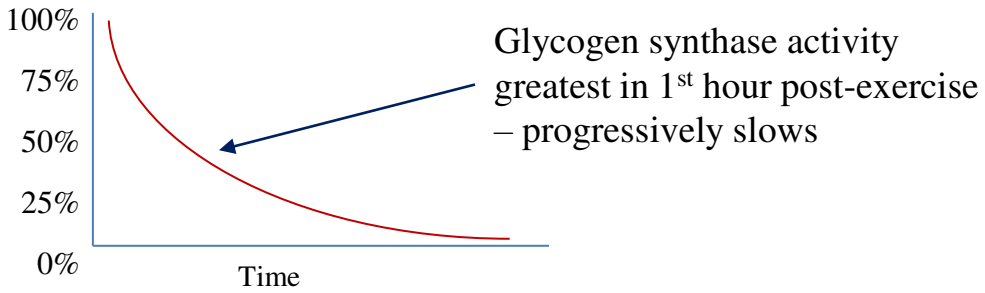
1. Akasheh RT, Kroeger CM, and Trepanowski JF, (2020). Weight loss efficacy of alternate day fasting versus daily calorie restriction in subjects with subclinical hypothyroidism: a secondary analysis. *Applied Physiology Nutrition Metabolism*, 45(3):340-343.
2. Aragon A, and Schoenfeld BJ, (2020). How much protein can the body use in a single meal for muscle building? Implications for total protein distribution. *Journal of the International Society of Sports Nutrition*, 15(1).
3. Kerksick CM, Arent S, Schoenfeld BJ, et al., (2017). International Society of Sports Nutrition position stand: nutrient timing. *Journal of the International Society of Sports Nutrition,* 14:33.

Aligning Diet and Exercise …

Fasting-Type Schedules: ADF and 5:2

ADF and Exercise:

- Synchronize with diet:
  - Moderate cardio and RT on eating days, offload on fasting days.
  - Long-duration cardio ONLY following eating days (need minimum 4-to-6 hours post-training for glycogen resynthesis).
  - Offload or restorative days with fasting.
  - Synchronizing ADF with endurance training shows improvements – CHO undulation increases muscle/live glycogen storage capacity.
- Issue: Limited to 3-to-4 training sessions/week.
- Issue: Slower recovery.



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1. Jager R, Kerksick CM, Campbell BI, et al., (2017). International Society of Sports Nutrition Position Stand: protein and exercise. *Journal of the International Society of Sports Nutrition*, 4, 20. https://doi.org/10.1186/s12970-017-0177-8.
2. Aird TP, Davies RW, and Carson BP, (2018). Effects of fasted vs fed-state exercise on performance and post-exercise metabolism: A systematic review and meta-analysis. *Scandinavian Journal of Medicine and Science in Sports*, 28(5):1476-1493.

Aligning Diet and Exercise …

Fasting-Type Schedules: ADF and 5:2

ADF and Exercise (Cont.):

Exercise Type	Low	Moderate	High
Cardiovascular	★★★★★	★★★	Not Rx with fasting
Resistance Training	★★★★★	★★★	Not Rx with fasting

5:2 Diet:

- Original: 2 non-consecutive partially fasted days with 20-to-25% kcal reduction over 3-to-4 meals.
- Modified: 1-to-2 non-consecutive partially fasted days with 20-to-50% kcal reduction over 3-to-4 meals – *progressive approach.*
- Comparable (slightly less) results to ADF and 25% daily caloric restriction.
- Greater adherence and flexibility.
- Health promoting effects (e.g., insulin sensitivity).

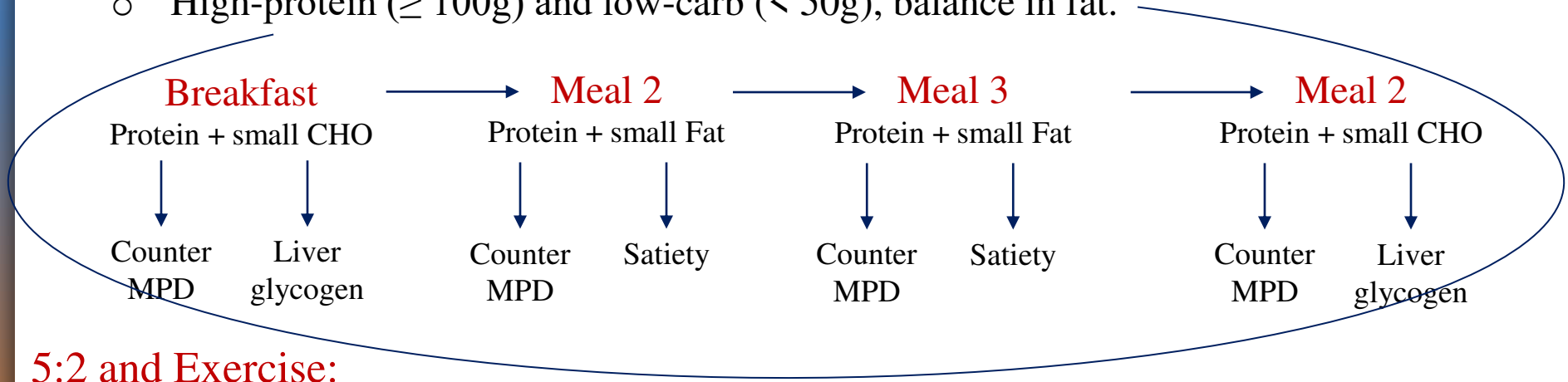
Reference: Hajek P, Przulj D, Pesola F, et al., (2021). A randomised controlled trial of the 5:2 diet. *PLoS One,* 16(11):e0258853.

Aligning Diet and Exercise …

Fasting-Type Schedules: ADF and 5:2

ADF Concerns:

- Muscle protein degradation (MPD):
  - Strategic protein feeding on 1-to-2 fasting days can minimize MPD.
- Strategy:
  - Progress from 50% down to 20-to-25%, 1-day to 2-days.
  - High-protein (≥ 100g) and low-carb (< 50g), balance in fat.

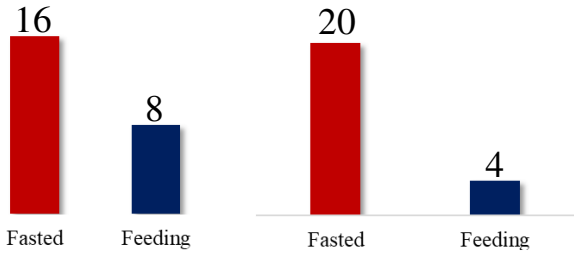


5:2 and Exercise:

Exercise Type	Low	Moderate	High
Cardiovascular	★★★★★	★★★★	Not Rx with fasting
Resistance Training	★★★★★	★★★★	Not Rx with fasting

Aligning Diet and Exercise …

Fasting-Type Schedules: TRF



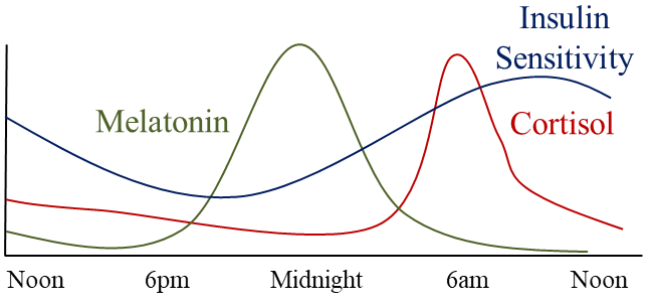
TRF Diet:

- Popularized in fitness – 16:8-to-22-2.
- Most derived off *'fasted cardio'* concept.

Concerns/Comments:

- TRF in general = many health benefits, but time of day???
- Circadian Rhythm – Early-fed TRF v. early fast TRF:

Early-fed TRF (e.g., 7am – 3pm)	Early-fast TRF (e.g., 12pm – 8pm)
• Aligns with natural circadian rhythms = better appetite control throughout day + reduced caloric intake. • Improved fat oxidation throughout day. • Lower insulin levels • Improved insulin sensitivity. • Lowered blood pressure.	• Higher ghrelin levels throughout day. • Elevated postprandial (lunch) glucose and insulin levels – insulin inhibits fat metabolism. • Reduced muscle protein synthesis (MPS) rates throughout the day.

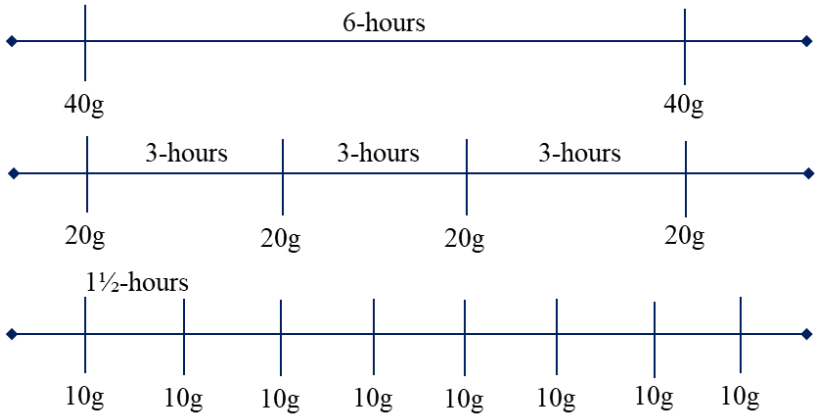


Aligning Diet and Exercise …

Nutrient Timing: Protein

Compare muscle protein rates over a 12-hour period with whey protein:

- 4x20g servings was superior v. 2x40g or 8x10g spread evenly over day.
  - Results:
    - 10g servings failed to reach LT (threshold) – did not stimulate MPS optimally.
    - 20g and 40g reached threshold, but 4-servings did so more frequently (i.e., every 3 hours v. every 6 hours).



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3. Mamerow MM, Mettler JA, English KL, et al., (2014). Dietary protein distribution positively influences 24-h muscle protein synthesis in healthy adults. *Journal of Nutrition*, 144(6): 876-880.

Aligning Diet and Exercise …

Fasting-Type Schedules: TRF

TRF and Exercise:

Exercise Type	Low Intensity	Moderate Intensity	High Intensity (8-hour)	High Intensity (4-hour) *	High Intensity (2-hour) **
Cardiovascular	★★★★★	★★★★	★★★	★★★	★
Resistance Training	★★★★★	★★★★	★★★	★★	★

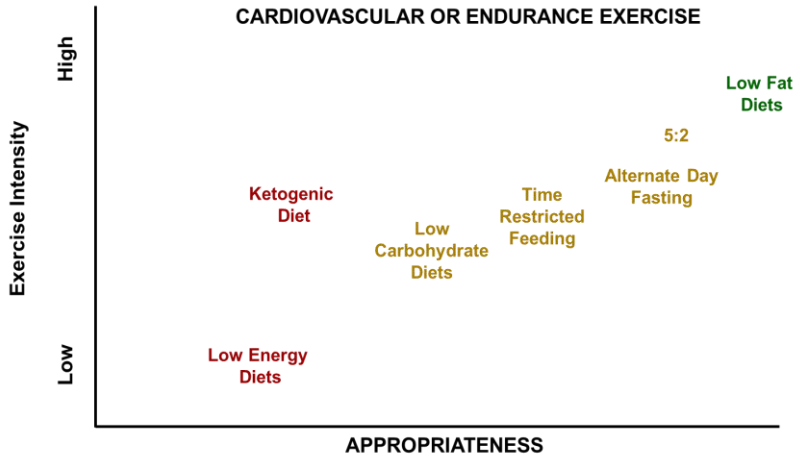
* Reduce volume
** Greatly reduce volume

References:

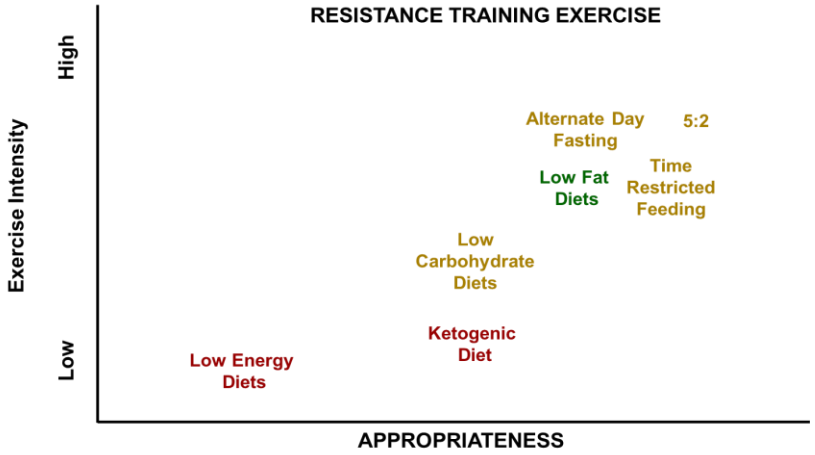
1. Queiroz JDN, Macedo RCO, Tinsley GM, and Reischak-Oliveira A, (2021). Time-restricted eating and circadian rhythms: the biological clock is ticking. *Critical Reviews in Food Science and Nutrition*, 61(17):2863-2875.
2. Adafer R, Messaadi W, Meddahi M, et al., (2020). Food Timing, Circadian Rhythm and Chrononutrition: A Systematic Review of Time-Restricted Eating's Effects on Human Health. *Nutrients,* 12(12):3770.
3. Sutton EF, Beyl R, Early KS, et al., (2018). Early time-restricted feeding improves insulin sensitivity, blood pressure, and oxidative stress even without weight loss in men with prediabetes. *Cell Metabolism*, 27(6):1212-1221.

Summarizing – Takeaways …

	Higher Intensity	Longer Duration	Greater Frequency
Cardiovascular Endurance	Low Fat Diets 5-2 Alternate Day Fasting	Low Fat Diets 5-2 Alternate Day Fasting	Low Fat Diets 5-2 Time Restricted Feeding
Resistance Exercise	5:2 Alternate Day Fasting Time Restricted Feeding	Low Fat Diets 5:2 Time Restricted Feeding	Low Fat Diet 5-2 Time Restricted Feeding



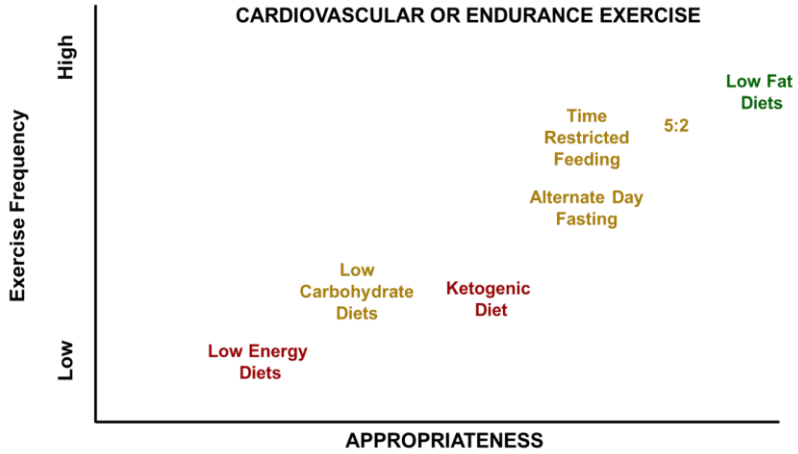
Summary: Diets/schedules and impact upon intensity of cardiovascular exercise



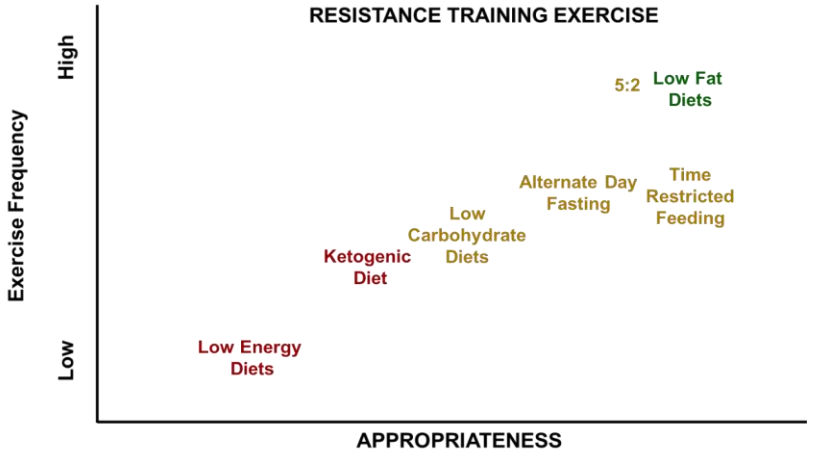
Summary: Diets/schedules and impact upon intensity of resistance training

Green – high carbohydrates
Red – restricted carbohydrates/energy

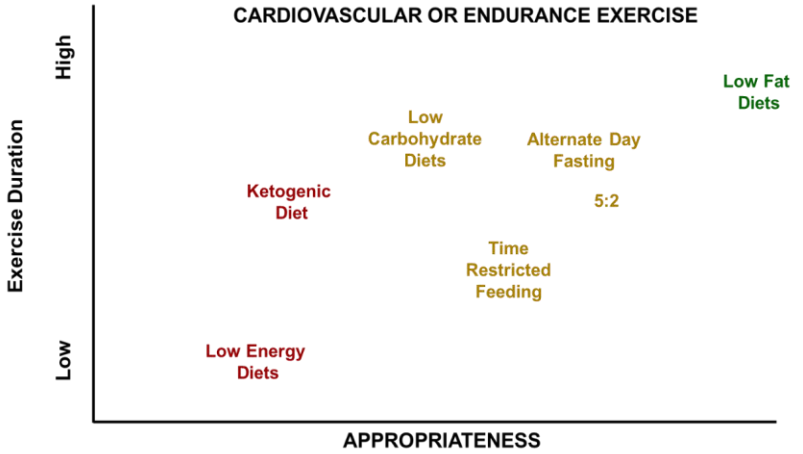
Summarizing – Takeaways …



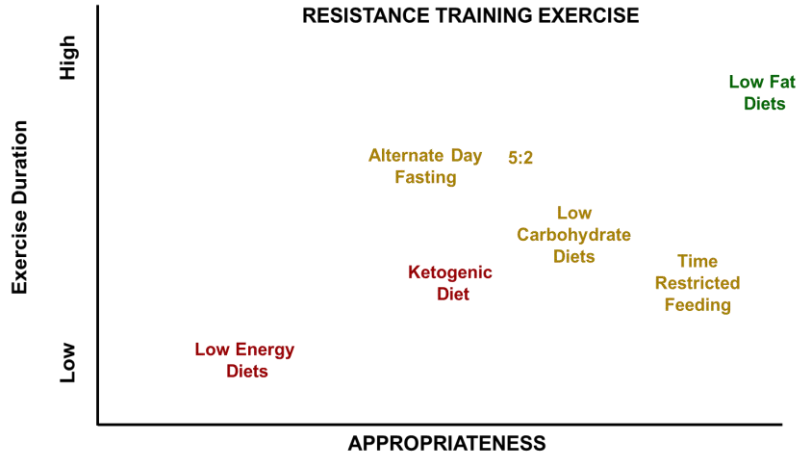
Summary: Diets/schedules and impact upon <u>frequency</u> of cardiovascular exercise



Summary: Diets/schedules and impact upon <u>frequency</u> of resistance training



Summary: Diets/schedules and impact upon <u>duration</u> of cardiovascular exercise



Summary: Diets/schedules and impact upon <u>duration</u> of resistance training

Thank You..!!

For Your Commitment to Excellence

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