Orthopedics and Nutrition: moving from strangers to synergy

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Disclosures

We have no relevant relationships with ineligible companies to disclose within the past 24 months. (Note: Ineligible companies are defined as those whose primary business is producing, marketingWe have no relevant relationships with ineligible companies to disclose within the past 24 months. (Note: Ineligible companies are defined as those whose primary business is producing, marketing, selling, re-selling, or distributing healthcare products used by or on patients.)

Outline

- Metabolic health implications for orthopedics
- Epidemiology and costs of malnutrition
- Sports Nutrition
- Uric acid implications
- Perioperative nutrition management
- Future developments in nutrition and orthopedics

Objectives

- Evaluate individual patient nutritional practices and provide research-based and specific opportunities for change.
- Discuss the specific recommendations of each macronutrient in the pre and post-operative periods.
- Describe the importance of metabolic health within the context of the orthopedic patient.
- Discuss the relevance of monitoring uric acid in regards to joint health.
- Highlight current research regarding sports nutrition and the high performance athlete.
- Recommend general dietary recommendations for all patients.
- Discuss future developments in orthopedics and nutrition.

"Food drives both illness and wellness; it's the poison and the antidote."

-Dr. Robert Lustig, *Metabolical*

Let’s bring the nutrition conversation into ALL domains of medicine, including orthopedics!

Currently, only 28% of medical schools have a formal nutrition curriculum.

And 88% of Americans are metabolically ill!

Breaking away from the silo approach

Silos in agriculture function to store and separate. Medical silos allow for depth in a domain, but may prevent collaboration and the flow of information and resources.

A day in the life…

Meet Jim

- 59 years old
- 6’3” and 400 lb - BMI = 50
- Chief complaint: right hip pain
- PMHx: HTN, Insulin Resistance, arthritis
- PSHx: cholecystectomy
- SocHx: - Tob, -EtOH, retired professional boxer
- Meds: HCTZ, Benazepril, Metformin
- Allergies: NKA

What does this conversation look like?

1) Give the diagnosis and be straightforward with barriers to care.
2) Ask about their average day.
    a) What do they do each day? How active are they?
    b) What do they eat? Who cooks their meals? Do they tend to be a snacker or an over eater? What liquids are they drinking?
3) Ask if they've ever successfully lost weight in the past and how they did it.
4) Ask if any medical professional has ever offered to help them lose weight using medications or through nutritional counseling.
5) Make a plan. Give tips and tricks. Suggest phone apps/snacks/ideas - be specific and cater to their individual lifestyle!
6) Schedule follow-up with the expectation of a weight check that day combined with a check up of their orthopedic problem.

Metabolic Health: Insulin Resistance

You can’t out run, out exercise, or medicate away a bad diet.

- Metabolic diseases have a direct systemic effect on joints (impact of weight + obesity-associated inflammation is associated with osteoarthritis severity and may modulate osteoarthritis progression in mouse models)
- Role of metabolic disease inducing / aggravating joint damage via low grade inflammation and oxidative stress
- EVIDENCE: osteoarthritis synovium from type 2 diabetic patients shows insulin-resistant features, which may participate in joint catabolism

Metabolic Health and Uric Acid

- We can assess diet and mitochondrial function by measuring uric acid
- Levels above 5.5– mitochondrial dysfunction and insulin resistance
- High levels found in obesity, insulin resistance/ diabetes, NAFLD, hypertension, CAD, stroke, neurological disorders (including Alzheimer's) and premature death
- From 1960's to 1990's the # of gout patients more than doubled in US (correlates with prevalence of obesity and metabolic syndrome)
- High uric acid associated with **elevated systemic inflammation** (diminishes the anti-inflammatory capacity of cells)
- Hyperuricemia surges parallel the upswing in sugar-sweetened food/ drinks

Metabolic Health and Lipids

- Association between rotator cuff tears and abnormal lipid profiles (increases tendon stiffness)
- Increased inflammation and pain with abnormal lipid profiles
- Correcting lipid profile will not reverse OA, but may delay onset of other joint problems

Metabolic Health & Inflammation

- Patients with metabolic syndrome are in a chronic state of inflammation!
- Systemic inflammation ("obesity- associated inflammation") can affect how we perceive pain
- **ginger**: anti-inflammatory + antioxidant + glucose-regulating properties (by impeding synthesis of pro-inflammatory molecules: prostaglandins and cytokines)
  - may curb sx's of OA (500mg ginger powder capsules daily x 3 mo)
- **turmeric:** rich in phytonutrients; neutralizing free radicals
  - anti-inflammatory + antioxidant
- **omega 3 FA's:** alter gut bacteria and increase the production of anti-inflammatory compounds + enhance insulin sensitivity
  - adults: EPA plus DHA intake greater than 2 g / day seems to be required to elicit anti-inflammatory actions

Best Anti-Inflammatory Diet

- **Eat plenty of fruits and vegetables.**
- **Avoid all added sugars and keep sugar consumption as low as possible.**
- **Avoid foods made with refined grains, such as bread, crackers, cereals, white rice, and cookies.**
- **Rich in omega-3-rich fish such as salmon.**
- **Avoid fried foods.**
- **Drink alcohol in moderation.**

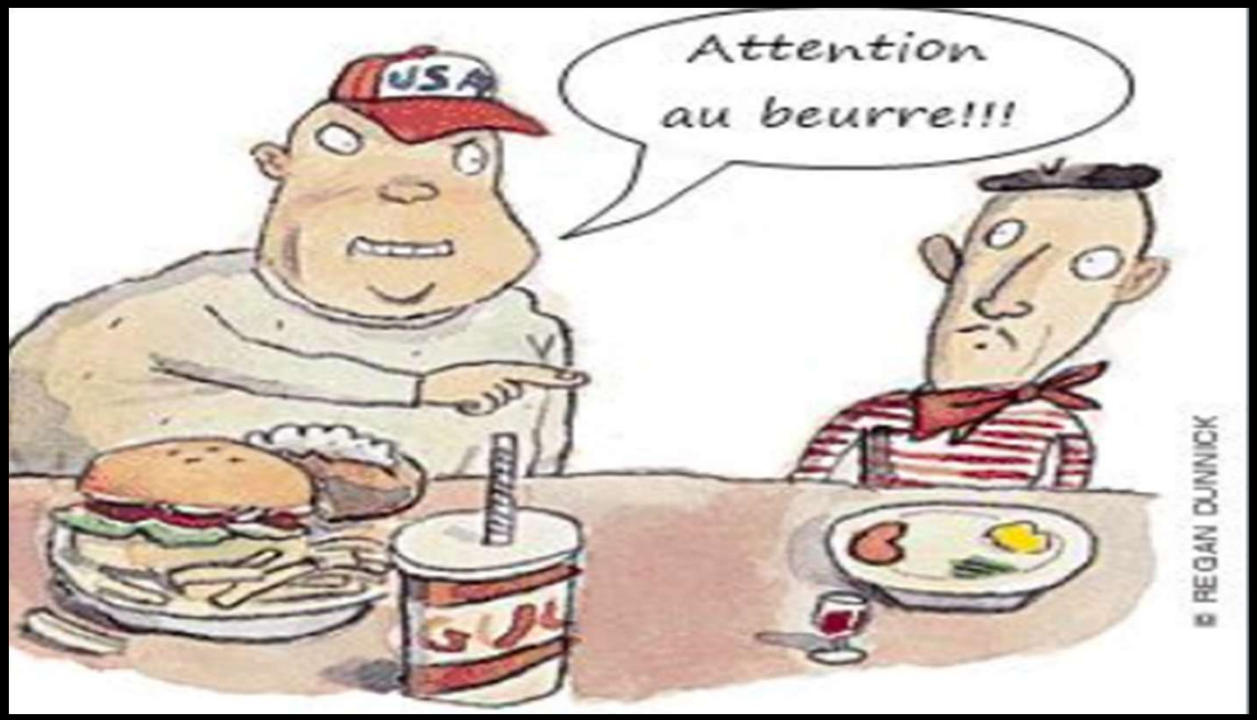
Foods with notable anti-inflammatory effects:

- **Beans and legumes, such as black beans, lentils, and peas**
- **Fish rich in omega-3s, such as salmon and sardines**
- **Nuts and seeds, such as almonds, walnuts, and chia seeds**
- ***Olive oil**
- **Spices, such as turmeric, cinnamon, and ginger**
- **Garlic**
- **Leafy greens, like spinach and collard greens**
- **Green tea**
- **Broccoli**
- **Tomatoes**
- **Berries, such as blueberries, strawberries, and raspberries**

Metabolic Health and Diet

- Almost all chronic diseases have metabolic dysfunction in common (due to DIET)
- BLUF: lower waist circumference, pulse, blood pressure, triglycerides, and glucose= better chance of prolonging onset of chronic disease
- No magic diet: real food, high in vegetables/ fruits/ complex carbs and protein is ideal
- REAL food, cook/prepare meals at home, avoid processed food
- We were not meant to have food available to us 24/7/365 (esp processed food + sugar)
- HEALTHY LIVING: restrict time eating, dietary intake (sugar, fat, carbs, animal food), OR caloric intake
- Attention to PROTEIN

The French Paradox



Metabolic Health and Diet

- Food pairing: avoid “naked carbs”- always accompany with **fat, protein, or fiber** for blood sugar stabilization (glucose response is higher when carbs are eaten first in the meal, before any fat or protein)
- Walk after meals
- FIBER SOURCES- legumes, above-ground vegetables, whole fruits, nuts, seeds (flax, chia, pumpkin, sesame); aim for min **35g fiber/day**

Metabolic health and Diet: Fructose

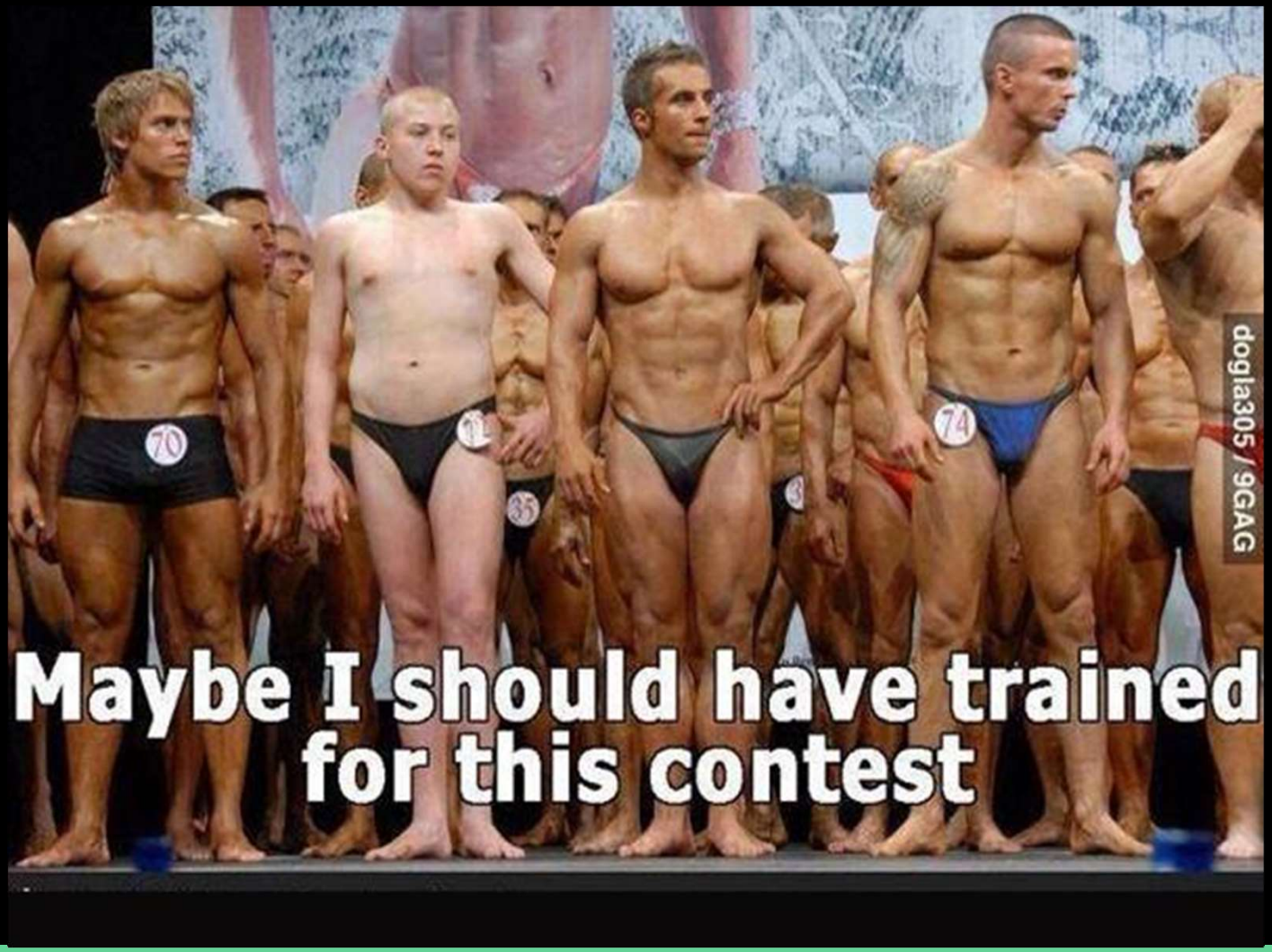
- Mice fed a high fructose diet ate more and moved less and accumulated more fat
- Fructose silences leptin (necessary for satiety)

Metabolic Health Criteria:

- Waist Circumference, < 102/88 cm in men/women
- Systolic Blood Pressure, < 120 mmHG
- Diastolic Blood Pressure, < 80 mmHG
- Fasting Glucose < 100 mg/dL
- HbA1c < 5.7%
- Triglycerides < 150 mg/dL
- HDL-C >= 40/50 mg/dL men/women
- FASTING INSULIN: <15 (if we are only measuring fasting glucose, we are too late!)

BOTTOM LINE:

Encourage our patients to eat **real food** (low sugar + high fiber), the less processed, the better!


Maybe I should have trained for this contest
dogla305 / 9GAG

Sports Nutrition

Patient Identification:

Fitness Goals:

1) Casual gym goer
2) Avid runner
3) Avid weightlifter
4) Elite Athlete

Wellness Goals:

1) none
2) weight loss
3) body composition
4) overall health

Calculating Resting Metabolic Rate (RMR)

What is RMR?

- RMR is an estimate of the caloric expenditure with no physical activity.
- The energy required to keep an animal alive with no activity.

Your metabolic rate = Your RMR + Estimated Energy Consumed by your Daily Activities

Let’s talk MACROS!

What are macronutrients anyway?

Protein

10-35%

Fats

20-35%

Carbohydrates

45-65%

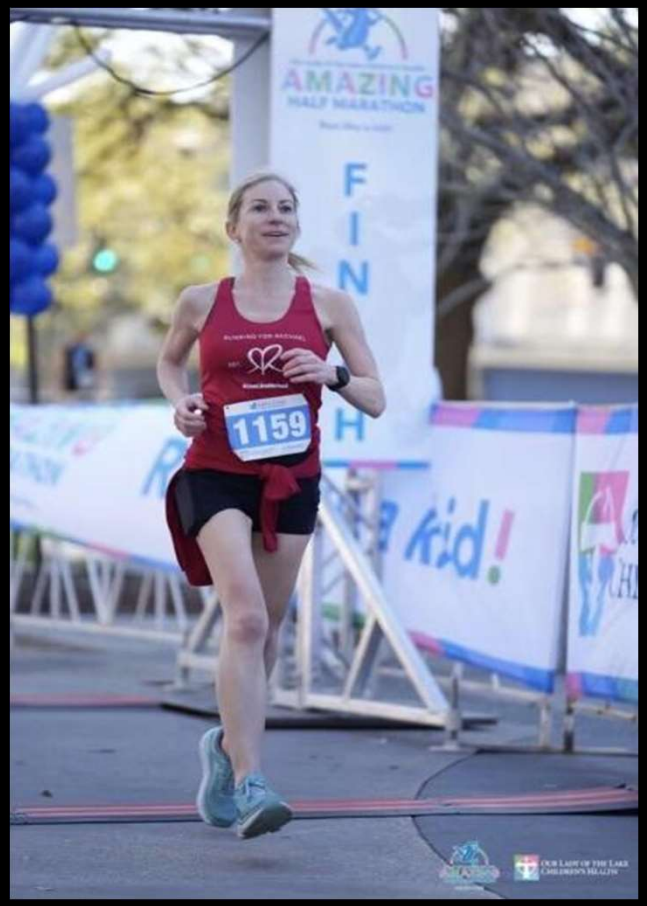
25-30% total protein (1.5-2.0g/kg/day) of calories has been shown to boost metabolism by 80-100 calories per day.

1.2-1.4g/kg/day - endurance training

1.3-1.5g/kg/day - resistance training

1.2 - 2.0g/kg/day - active adults and competitive athletes

Meet Corrie!



Meet Corrie…

- 39 year old female
- Height: 5'5"
- Weight: 126lb
- Corrie runs 6 days/week for an average of 6 miles at a time and she does pilates 1-3 times per week. She likes to run marathons but isn't currently "training."

RMR = 1,326

Estimated Activity Energy Consumption = 700 + 300

Metabolic Rate = 2,326

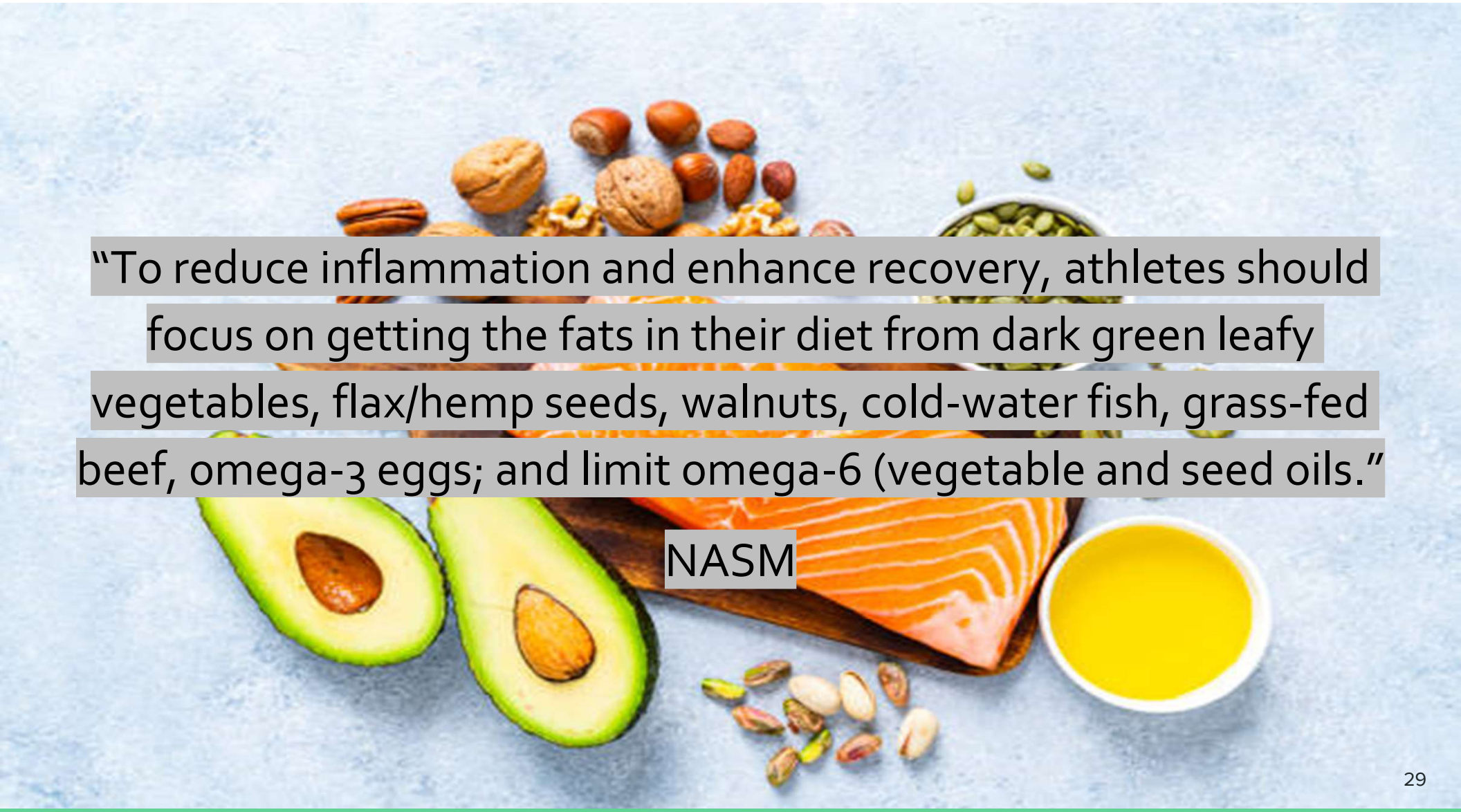
Protein:30% (174g)

Carbs:40% (233g)

Fats:30% (78g)

Recovery Nutrition

- Post exercise carbohydrate combined with a small amount of protein (4:1)
  - positively affects subsequent exercise performance
- Branch Chain Amino Acids - Leucine
  - 3g is optimal to stimulate muscle protein synthesis
- Fats help reduce inflammation and enhance recovery
  - nuts, seeds, oils
- Hydration
  - Aim to hydrate back to pre-race weight



"To reduce inflammation and enhance recovery, athletes should focus on getting the fats in their diet from dark green leafy vegetables, flax/hemp seeds, walnuts, cold-water fish, grass-fed beef, omega-3 eggs; and limit omega-6 (vegetable and seed oils."

NASM


CASEIN
BCAA
100% WHEY
WHEY PROTEIN ISOLATE - PRIMARY SOURCE
HYDRO WHEY
PURE
CREATINE
POWDER

EAT REAL FOOD!!

Supplements

- Creatine monohydrate - increases energy storage in muscle to enhance muscle performance
  - 3g-5g per day
  - 3-4 weeks to build up stores
  - most studied sports nutrition supplement
- Caffeine - improves endurance by sparing carbohydrates
- Omega-3 and Fish Oil - reduce inflammation
- BCAA - reduction in self-reported muscle soreness

Perioperative Nutrition

ERAS PROTOCOL: patient-centered, evidence-based, multidisciplinary team developed pathways for a surgical specialty and facility culture to **reduce the patient's surgical stress response, optimize their physiologic function, and facilitate recovery.** These care pathways form an integrated continuum, as the patient moves from home through the pre-hospital / preadmission, preoperative, intraoperative, and postoperative phases of surgery and home again.

NUTRITIONAL IMPLICATIONS: ERAS PROTOCOL IN ORTHOPEDIC SURGERY

1. **Pre-operative stage:** focus is on optimisation of physical and psychological health (i.e. identification and management of **anemia**, pre-operative education and counseling including **smoking cessation** 4 wks prior to surgery + **alcohol** misuse managed, and preemptive organisation of discharge arrangements).
2. Intra-operatively: atraumatic surgical techniques are used; anaesthesia/ analgesia protocols are standardised, multimodal opioid sparing analgesia regimes; blood loss minimized; normovolemia and normothermia are promoted, and hypoxia prevented.
3. **Post-operatively:** early ambulation with effective analgesia is essential (avoiding opioids where feasible); catheters, drains and drips minimized or removed as soon as possible; **patients encouraged to eat and drink early** + wash/ dress/ socialise as soon as possible. Discharge pts home with clear instructions and support on progressing independently.

THA + THA RESEARCH

- **Pre–operative fasting: Clear fluids until 2 hours before** induction of anesthesia, and a **6-hour fast for solid foods**.
- **<u>Carbohydrate loading</u>**
  - May **reduce insulin resistance** in various surgical procedures including orthopedic surgery.
  - Some small RCTs show positive effects on preoperative hunger and **nausea, and postoperative pain** as well as on **glucose metabolism** and insulin resistance.
- Screening for and multimodal PONV prophylaxis and treatment for patients undergoing hip and knee replacement
- Early return to normal diet is recommended and should be promoted

Surgical Outcomes

With adequate perioperative nutrition:

Reduced morbidity (up to 20% in malnourished GI surg patients)

Reduced mortality

Reduced infections

Adequate post-op nutrition, delivered beginning on the first day of oncologic surgery, independent predictor of increased rates of 5-year survival

Wischmeyer PE, Carli F, Evans DC, et al. American Society for Enhanced Recovery and Perioperative Quality Initiative Joint Consensus Statement on Nutrition Screening and Therapy Within a Surgical Enhanced Recovery Pathway. Anesthesia and analgesia. 2018;126(6):1883-1895.

Epidemiology of Malnutrition

Frequently encountered condition, not always identified

50%-- Estimated number of patients undergoing surgery at nutritional risk

Only 1 in 5 patients receive a pre-op nutrition intervention including nutrition consultation

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Economic Costs of Malnutrition

- Malnutrition comes with significantly greater costs of care
  - Likely driven by **longer hospitalization**, greater likelihood of **readmission**
- Previously estimated that for every 1 dollar spent on nutrition= 52 dollars are saved in hospital expenditure

ASER Evaluation

- Modified malnutrition screening tool proposed by American Society for Enhanced Recovery (ASER) and Perioperative Quality Initiative workgroup
- Pre-op Nutrition Score (PONS)
  - BMI <18.5 or <20 if 65 or older
  - 10% or greater unintentional wt loss in the past 6 months
  - Serum Albumin <3.0
- Nutrient deficiency diseases can bear striking resemblances to nutrient excess diseases!

Physiologic Effects of Surgery

- Similar reaction as other tissue injury:
  - Salt and water retention to maintain plasma volume
  - Increased cardiac output/ oxygen consumption
  - Insulin resistance
  - Increased cytokine production, systemic inflammatory reaction:
    - catabolism of glycogen, fats, and protein (sarcopenia!) to aid in healing and the immune response

- **PROTEIN** is our main target of pre- and post-op nutrition therapy!

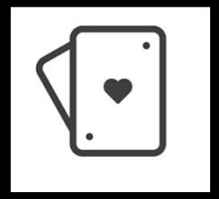
Gillis C, Wischmeyer PE. Pre-operative nutrition and the elective surgical patient: why, how and what?. *Anaesthesia*. 2019;74 Suppl 1:27–35. doi:10.1111/anae.14506

Protein recommendations

Perioperative focus should be placed on protein consumption

- RDA for healthy adults – 0.8g/kg/d of protein
- Those undergoing surgery – 1.2 – 2.0g/kg/d of protein
- Calculate for each pre-op appointment: make it personal!

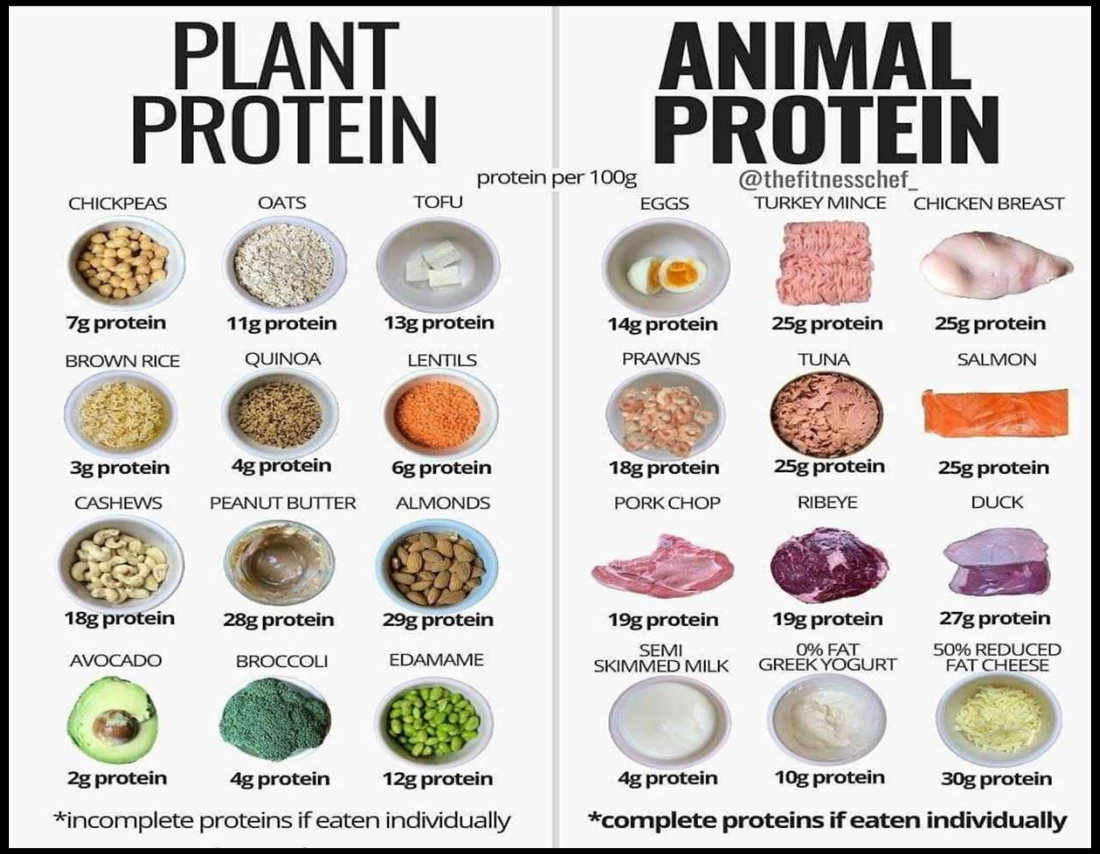
Estimating Protein



- 1 deck of cards or palm of hand = 3 to 4 oz of meat
- 4 stacked dice = 1 oz of cheese

- 8oz of milk (1 cup) = 8g
- So pt reports portions slightly bigger than a deck of cards – estimate about 4-5oz.
- EXAMPLE
  - If a 70kg patient eats 2 eggs in the morning, 3 oz of meat at lunch, and 5 oz at dinner = 70 grams of protein from animal sources per day OR about 1g/kg/d

Practical examples of daily protein goal



25 GRAMS OF PROTEIN

@MARCINEVIN

1 Cup
Cottage Cheese

1 - 1 1/4 Cup
Greek Yogurt

1 Scoop
Protein Powder

4
Large Eggs

1 Cup
Liquid Egg Whites

3 oz
Cooked
Chicken Breast

3.5 oz
Deli Turkey

3 oz
Cooked 99% Lean
Ground Turkey

3 oz
Cooked 95% Lean
Ground Beef

3.5 oz
Roasted
Pork Tenderloin

4 oz
Grilled Salmon

4 oz
Canned Fish

Patient handout ideas

PROTEIN CONTENT OF COMMON FOODS

	Portion Size	Grams of Protein
Meats, Poultry, and Fish		
Beef/Turkey Jerky	1 oz dried	10-15
Beef, Chicken, Turkey, Pork, Lamb	1 oz	7
Fish, Tuna Fish	1 oz	7
Imitation Crab Meat	1 oz	3
Seafood (Crabmeat, Shrimp, Lobster)	1 oz	6
Egg	1	6
Soy and Vegetable Protein		
Soy milk	8 oz	7
Edamame, fresh or frozen	½ cup	8
Edamame, dry roasted	1 oz	13
Tofu	1 oz	3
Legumes and Nuts		
Lentils	½ cup	9
Lima beans	½ cup	7
Kidney, Black, Navy, Cannellini beans	½ cup	8
Refried beans	½ cup	6
Hummus	⅓ cup	7
Chili with beans, drained	½ cup	10
Peanut butter	2 Tbsp	7
Nuts	1 oz (¼ cup)	4-6
Sunflower seeds	1 oz	5
Almond milk	8 oz	1

Milk and Dairy		
Milk, skim or 1%	8 oz	8
High protein ultra-filtered milk, fat free or 1%	8 oz	13
Yogurt, fat free, light	6 oz	5
Greek yogurt, plain, nonfat, light	5 oz	12-18
Cheese, hard (low fat)	1 oz	7
American cheese (low fat)	1 slice (0.7oz)	5
Cottage cheese, Ricotta (part skim)	½ cup	14
Sugar free pudding, made with milk	½ cup	4

Grains		
Bread	1 oz slice	3
Cereal	½ cup hot ¾ cup cold	3
High protein cereals	¾-1⅓ cup	7-15
Rice, Pasta	⅓ cup	3
Quinoa	⅓ cup	6
Vegetables		
Fresh, frozen, canned	½ cup, 1 cup raw leafy greens	2
Fruit		
Fresh or canned fruit in 100% juice	1 small, ½ cup	0

Dietary Sources

Protein:

- Eggs
- Chicken
- Lean beef
- Cottage cheese
- Greek yogurt
- Tuna
- Turkey
- Fish/ shrimp

Plant-based protein:

- Buckwheat
- Hummus
- Soy: tofu, tempeh, edamame
- Peanut butter
- Beans + rice
- Quinoa
- Hemp seeds
- Chia seeds
- Spirulina

Pre-op Nutrition Management – Well Nourished

- Encourage high-quality protein diet consumption
  - Aim for 1.2 - 2.0 grams of protein per kilogram body weight
  - Eggs, poultry, beef, fish, pork, milk, soy (particularly if vegetarian)
  - Starting at least 7 days prior to surgery
  - Consider oral nutrition supplements
- Adequate calorie consumption for surgery – needs typically 25 calories/kg/d
- Night prior and the morning of surgery up to 2 hours before – oral clear liquid carbohydrate solutions
  - 50g of carbohydrate 2 hours prior to surgery, and 100g the night before
- Consider participation in resistance training as part of a prehab program

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Pre-op Nutritional Management – Malnourished

- Similar to well-nourished but more aggressive!
- High protein diet 1.2 - 2.0g/kg/d
  - Begin 14 days prior to surgery
  - Encourage highly bioavailable protein sources
  - Start oral nutrition supplements – 18g of protein per serving or greater
  - Consider immunonutrition therapy
- Minimize perioperative fasting
  - Carbohydrate feedings 2 hours prior to surgical procedure, and the night prior
  - Feed either within hours of surgery with clears OR within the same day of surgical procedure with high protein diet

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Post-op Management – Well Nourished

- Resume oral feeding with clear liquids within HOURS after feeding – ESPN rec
- Resume oral feedings with high protein diet on day of surgery – ASER rec
  - Make sure to include adequate carbohydrates
- Continue high protein diet 4-8 weeks post surgery
- Exceptions: bowel not in continuity, bowel ischemia, persistent bowel obstruction

Post-op Management – Malnourished

- **Similar for well-nourished patient**
  - Resume high protein diet on same day of surgery – ASER
  - Clears within the first HOURS after surgery
  - Continue high protein diet for 3 - 6 months post surgery!

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Weimann A, Braga M, Carli F, et al. ESPEN guideline: Clinical nutrition in surgery. *Clin Nutr.* 2017;36(3):623–650. doi:10.1016/j.clnu.2017.02.013

Oral Supplement Options

- **High protein supplements – wide variety**
  - Excellent bioavailability of milk proteins – whey and casein – may recommend preoperatively
- **Immunonutrition supplements – combination product**
  - Arginine
  - Omega-3-fatty acids
  - Antioxidants
  - Generally given 5 days prior to surgery and up to 7 days after
  - Studies have demonstrated reduced surgical complications and length of stay
  - Particularly beneficial for wound healing

Dietary Sources: Immunonutrition

Arginine:

- Turkey
- Pork
- Chicken
- Pumpkin seeds
- Soybeans
- Peanuts
- Spirulina
- Chickpeas
- Lentils

Omega 3 fatty acids:

- Salmon
- Herring
- Anchovies
- Sardines
- Trout

  Fish oil supplements with EPA & DHA

Dietary sources

Glutamine (for wound healing):

- eggs
- beef
- firm tofu

ALSO for wound healing:

- B Vitamins
- Zinc
- Vit C

Macronutrient Role in Recovery

- **Protein – improve, promote building of lean body mass**
  - Maximize protein stores prior to acute phase of injury following surgery
  - Reduced morbidity and mortality
  - High protein diet activates mTOR (Mammalian Target of Rapamycin)-promoting cell division, *development of lean body mass, insulin sensitivity, bone/cardiovascular health.
- **Carbohydrates – promote maximal glycogen storage**
  - Improves insulin resistance following surgery
  - Improves psychological well-being after surgery
  - Evidence demonstrating improved post-op nausea and vomiting
  - Evidence demonstrating reduced length of hospital stay
  - Caution in poorly controlled diabetics
- **Fats – Some antioxidant properties**
  - Healthiest sources: EVOO, almonds, walnuts, avocados, fish, flax

Nutrient Timing

Concepts from sports nutrition

- **1.2 - 2.0 g/kg/d of protein –** same range we feed collegiate and professional athletes throughout the spectrum of their season
- **Carb loading –** 50 and 100g glucose load the night and morning of surgery
  - Similar concept as promotion of optimal glycogen concentrations prior to endurance events
- **Optimal protein timing?** Muscle protein synthesis best maximized by 25-35g protein load at meals
  - Similar to recover recommend s/p resistance and endurance training workout
  - May stimulate protein synthesis best pre-op and post-operatively if protein spread throughout the day

GOALS of pre-operative nutrition counseling:

- provide caloric and nitrogenous support for wound healing
- avoid excessive loss of lean body mass
- modulate inflammation and the immune response
- attenuate the hypermetabolic response to surgery
- provide micro- and macronutrients to optimize healing and recovery

Future Developments/ areas of ongoing research:

- Time restricted eating?
- CGM?

Recommended resources:

- Drop Acid, David Perlmutter, MD
- Metabolical, Robert Lustig, MD
- PODCASTS:
  - Levels: A Whole New Level
  - Levels- Metabolic Insights
  - The Drive, Peter Attia MD
- Blog: Dr. Howard Luks (Orthopedic surgeon)
- Levelshealth.com
- https://erassociety.org/specialty/orthopaedics/

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Any Questions?

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