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GLP -1 Agonists: Diet Strategies to Optimize Results

Laura LaValle, RDN, LD

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Objectives

Be able to recommend:

- Dietary measures for optimized lean body mass retention during GLP-1 use.
- Dietary measures to control blood glucose during GLP-1 use.
- Strategies for eating a nutrient dense diet during and after GLP-1 use.
- Low allergen diet strategies as appropriate for patients' clinical picture

Understand:

- Impact of special diets such as Vegetarian and Vegan diets and conventionally raised foods vs organic foods.

Disclosures: I have no financial interests in any of the products discussed in this presentation.

GLP-1 Primary Mechanisms of Action

- Trigger insulin release from the pancreas
- Block glucagon secretion
- Slows stomach emptying
- Affects feedback to brain, promotes hunger and satiety signaling

Postgrad Med. 2015;127(8):818-26.
doi: 10.1080/00325481.2015.1090295. Epub 2015 Sep 15.

GLP-1 Agonist Issues

- Decreased appetite – hard to eat much food
- With low calorie intake, loss of lean mass along with fat loss
- Prevention of low blood sugar
- Maintenance of weight loss after D/C

Nutrient Density

- Nutrient density = the amount of nutrients/1000 calories

- Avoid low nutrient density foods. With down-regulation of appetite, there is NO room for empty calories.

- All foods eaten should be nutrient dense foods.

Low Nutrient Density Foods

- Ultra processed = white flour, refined sugar, high fructose corn syrup, extruded flours (corn for Cheetos, breakfast cereals). Typically, also have additives, preservatives, stabilizers, artificial colors and flavors.

- Enriched flour foods=white bread/buns/crackers, frozen meals, fast food, soft drinks, packaged cookies/cakes, hot dogs, salty snacks.

Nutrient Density: Calculated

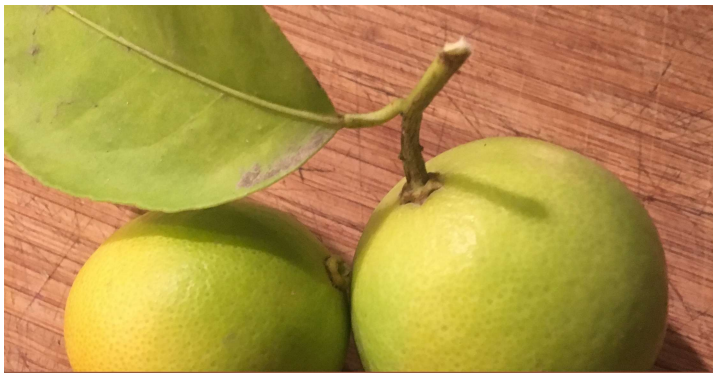
- Nutrient density = the amount of nutrients/1000 calories
- Apple 95 kcal – vit c 9.2/75 mg = .122 x 1000 = 122
  Calcium – 12, K – 30, Fiber 120. **ND = 254**
- Doughnut 200 kcal – vit C -0, Calcium 52, K – 8.5,
  Fiber – 1.6 **ND = 62.1**
- Baked potato (med) 160 kcal – vit C 192, Ca 31, K 272, Fiber 160
  ND = 655

Nutrient Dense Foods







Preserving Lean Mass

Low Calorie/Low Protein: What was lost?

- 1500 kcal Zone diet (40/30/30) vs. AHA Step I (60/15/25) – 29 overweight men and women, 6 wks.
- Zone group lost 6.2 lb. and .5% body fat
- AHA group lost 2.6 lb. and no body fat.
- Profile of Mood Analysis (POMS): the Zone 44% fatigue reduction and incr 15.7% vigor vs. no change in AHA group

Kalman D, et al. A Comparitive Study of A 1500 Calorie 40/30/30 Diet VS. 1500 Calorie Step 1 Diet on Body Composition and Blood Parameters in Overweight Adults. JADA 1998;98(9):s1,a43

Low Calorie Diet = Loss of Lean Mass

Energy restricted diets – up to 1/3 of weight loss can be from lean mass (muscle and bone)

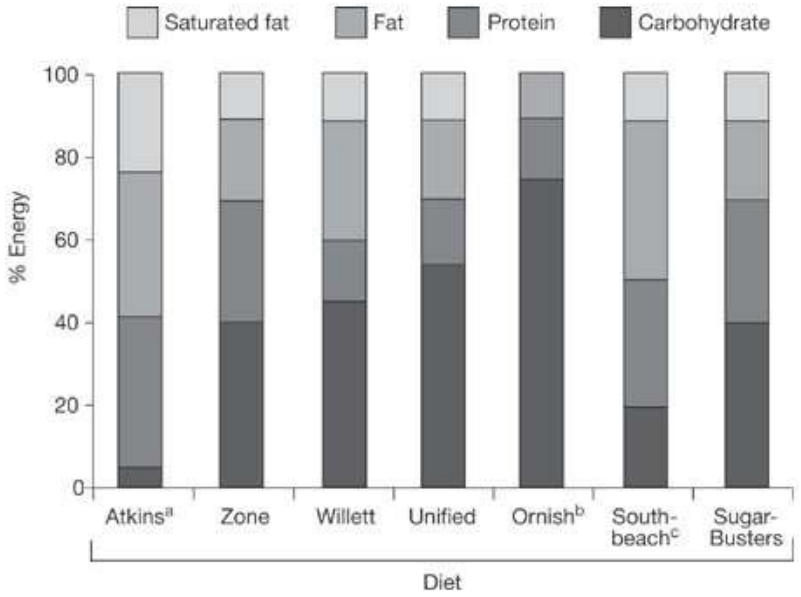
LE Gill, SJ Bartels, JA Batsis. Weight management in older adults, Curr Obes Rep, 4 (2015), pp. 379-388

- During energy deficit, muscle synthesis is down regulated, and muscle proteolysis and nitrogen excretion increase.
- During energy balance – increased protein intake enhances nitrogen retention for muscle gain.

Low Success Rates/High Recidivism

- 5% keep weight off for 2 years
- RDN perspective – “frequent flyers”, low kcal needed when eating all foods, hunger = drop out

Figure 1 A comparison of popular weight-loss diets by percent macronutrient and saturated fat



Malik VS and Hu FB (2007) Popular weight-loss diets: from evidence to practice
Nat Clin Pract Cardiovasc Med **4:** 34–41 doi:10.1038/ncpcardio0726

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Lean Mass Loss

- Consider Baseline - Persons with obesity have more total fat-free and muscle mass (20% more muscle mass) than those with normal weight, but more fat in muscle fibers (2 x more) leading to reduced muscle function (CL, LaFortuna, et al. Clin Physiol Funct Imaging, 34 (2014), pp. 47-55)
- Wt Cycling

- Wt Loss in nl wt – calorie reduction leads to 35% loss of lean mass and wt regain favors fat in nl wt with severe wt loss .
- Wt Loss in Obese – 20-30% of wt lost is lean mass, wt regain is both lean and fat. Overall fat free mass to fat mass ratio is more favorable after wt loss, so "current evidence does not support an adverse effect of wt cycling on body composition." Review Curr Opin Clin Nutr Metab Care 2014 Sep;17(5):396-400.

How to Mitigate Loss of Lean Mass

- **Weight Bearing Exercise** - can slow loss of muscle during energy restriction
- **Increase protein intake** - RDA pro .8g /kg (18% pro) vs 1.3 to 3.1 g/kg (30% pro) Higher pro intake not only prevents loss of lean mass, but improves satiety (After wt loss, when in maintenance.)
- Note: no evidence for higher pro leading to renal failure

Phillips SM 2014. A brief review of higher dietary protein diets in weight loss: A focus on athletes, 44 (suppl 2): 149- 153.

Leidy HJ, Carnell NS, Mattes RD, and Campbell WW. *Obesity* (2007) **15**, 421–429; doi:10.1038/oby.2007.531

Devries, MC et al, Changes in Kidney Function Do Not Differ between Healthy Adults Consuming Higher- Compared with Lower- or Normal-Protein Diets: A Systematic Review and Meta-Analysis, *The Journal of Nutrition* (2018).

Preserving Lean Mass During Wt. Loss

- Higher protein intake: 1.25–1.5 times the RDA for sedentary persons and >1.5 times the RDA for those who exercise (Bray GA, et al Am J Clin Nutr, 101 (2015), pp. 496-505) Distribute protein intake evenly throughout day(* Advances in Nutr May 2017, Pages 511-519)
- Regular exercise especially resistance training. (Cava E, et al Preserving healthy muscle during weight loss, Advances in Nutr May 2017, Pages 511-519)
- Diet induced weight loss reduces muscle lipid content and therefore improves muscle function. Studies show muscle strength is mostly maintained (sl leg muscle weakness seen in some studies. (Advances in Nutr May 2017, Pages 511-519)

Low Carb and REE

2 calorie restricted diets, either low fat or low GL (low total carb and low GI)

Bl glu, trig, CRP and BP all improved more in low GL group

REE reduced less in the low GL group

Low GL group also had less hunger

Pereira, MA, et al. JAMA 2004.292 (20):2482-2490

Importance of Potassium/Minerals for Muscle

- Potassium and other minerals – prevent metabolic acidosis, which is associated with muscle wasting
- Electrical cell signaling - intracellular potassium/extracellular sodium is needed for good muscle contraction
- Potassium: dried fruit, beans/legumes, squash, baked potato, OJ/banana,

  veg's, cashews https://ods.od.nih.gov/factsheets/Potassium-HealthProfessional/
- Magnesium – pumpkin seeds, chia seeds, almonds, spinach, cashews, peanuts, soymilk, black beans, edamame, baked potato, brown rice
- Calcium – sardines, salmon, spinach, turnip greens, kale, chia seeds, bok choy, pinto beans
- Nuts and seeds - not only high in potassium, calcium and magnesium – are also high in trace minerals

Lee, YJ., Lee, M., Wi, Y.M. *et al.* Potassium intake, skeletal muscle mass, and effect modification by sex: data from the 2008–2011 KNHANES. *Nutr J* **19**, 93 (2020). https://doi.org/10.1186/s12937-020-00614-z

Low Vegetable Intake Impacts pH

Solution:
Replace: Refined sugar/flour with vegetables, nuts/seeds.
Moderate intake of grains.
Keep lean proteins.

Western diet - high refined carbs, low non-starchy vegetable intake, high calorie leads to increased net acid load Sebastian et al. AJCN 76 (6): 1308-16.

Caloric intake – drives production of metabolic acids, increases need for adequate bicarbonate buffering, drives oxidative stress

Insulin resistance – low uptake of glucose into cell drives anerobic respiration (increases lactic acid)

Low mineral intake – especially potassium and magnesium. Best sources non starchy veg's, nuts/seeds.

Other Measures for Lean Mass Retention

- Creatine Monohydrate – found to be more effective in younger active populations than older adults. Resistance training needed. 2022 https://pmc.ncbi.nlm.nih.gov/articles/PMC8949037/

  Has other benefits – improved lipids, cognition, skin elasticity, speeds recovery from exercise

- HMB – hydroxy methyl butyrate (metabolite of leucine) with vit D in adults age 60 and up. (Dosage 3000 mg HMB + 2000 IU Vit D in divided doses)

  Effective for muscle growth and retention even without exercise 2020 https://doi.org/10.1093/gerona/glaa218

Glucose Management

Carb Management

Carb Intake During GLP-1 Use

- Must eat some high carb carb foods (fruit, starches) to prevent hypoglycemia – 2 moderate servings per day/ women, 4 moderate svg/day men (1 svg = 15 g carb. ½ cup potato, ½ cup pasta, ½ cup beans/legumes, 1/3 c rice, 1 slice whole grain bread, whole grain crackers per label)
- Strategies: Have people try it both ways to see what works better for them.

  Eat protein first, then carbs (potatoes/sw potatoes, rice, whole grains)

  OR Eat carbs first, then protein.
- General Rule on fruit: Eat 3 veg servings: 1 Fruit svg

What's Making People Sick and Fat?

- The **highly processed, calorie-dense, nutrient-depleted diet** in the U.S. leads to exaggerated supraphysiological **post-prandial spikes in blood glucose and lipids.**
- Post-prandial dysmetabolism, **induces immediate oxidant stress**, which increases in direct proportion to the amt of bl glucose and triglycerides after a meal.
- The transient increase in free radicals acutely triggers atherogenic changes including inflammation, endothelial dysfunction, hypercoagulability, and sympathetic hyperactivity.

Post-prandial dysmetabolism is an independent predictor of future cardiovascular events even in nondiabetic individuals.

O'Keefe JH et al. Dietary strategies for improving post prandial glucose. J Am Coll Cardiol, 2008; 51:249-255.

Job #1: Lowering After-meal Blood Sugar Spikes

- Choose high-fiber carbohydrates with low glycemic index - vegetables, fruits, whole grains, and legumes.
- Avoiding highly processed foods and beverages, particularly those containing sugar, high-fructose corn syrup, white flour, or *trans* fats.
- At all 3 meals, consume lean protein, (specifically mentioned high biologic value, animal protein)
- Eat approximately 1 handful of nuts daily (using a closed fist), consumed with a meal.
- Eat salad daily, consisting of leafy greens with dressing of vinegar and virgin olive oil. (leafy green = good source of nitrate = incr nitric oxide)
- Limit portion sizes to modest quantities.
- Other things that positively impact post-prandial dysmetabolism: vinegar, fish oil, tea, cinnamon

Sugar and Starch Lesson

- Sugars – glucose, fructose, lactose
- Sugar containing foods – refined sugar from beets or cane (contains 50% glucose/50% fructose) 1 tsp = 4 g sugar. Fruit – contains blend of glucose and fructose with somewhat more fructose (widely varying svg size – 2 tbs raisins – 15 g carb, 1 cup blueberries = 15 g carb) Honey – 40% fructose, 30% glucose, 17% water, plus sm amt minerals/trace minerals. 1 tsp = 6 g sugar +
- High fructose corn syrup – 40 - 70% fructose 1 tsp – 5-7 g sugars
- Fructose **does not** stimulate insulin like glucose (no leptin). Routes to liver and gets converted to triglycerides. Drives uric acid production (Nutrients 2017 Apr;9 (4):395.

Basciano H, et al. Fructose, insulin resistance, and metabolic dysipidemia (Nutr Metab (Lond) Feb 21 2005;2:5

- Starch – branched structure of glucose molecules. Stimulates insulin and leptin production. So you have a signal to carry glucose to cell and provide a satiety signal.

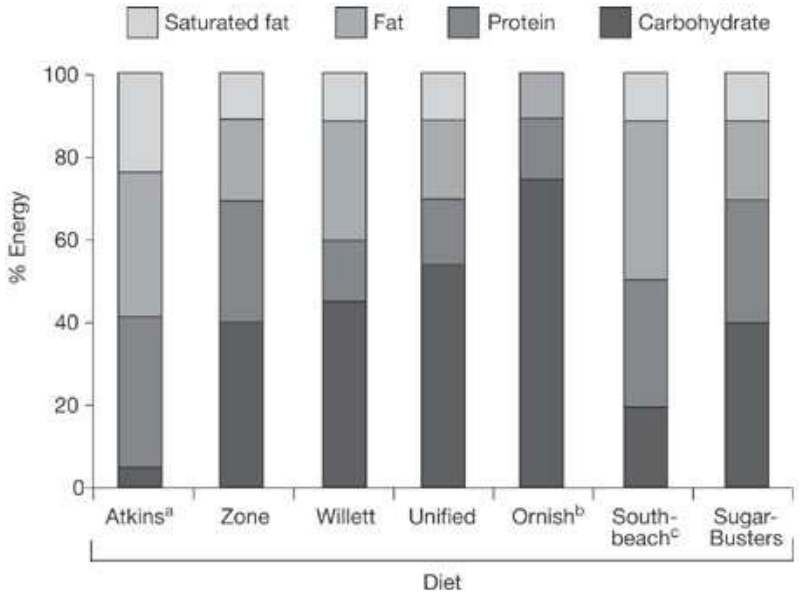
Mediterranean Diet Meta Analysis

- From 8 meta-analysis, 5 RCT, a new meta-anal of 3 studies > 6 mo, showed Mediterranean diet outperformed low fat diets for CVD and diabetes
- Meta-anal of 2 RCT - 49% of remission from metS
- 5 meta-anal's - favorable results compared to other diets for body weight, total chol and HDL
- 2 meta-anal - with greater adherence, Med diet reduced risk of future diab by about 20%.

Esposito K, et al. BMJ Open 2015 Aug 10;5(8):e008222

*Foods Eaten: Vegetables, fruits, nuts, seeds, legumes, potatoes, whole grains, breads, herbs, spices, fish, seafood and extra virgin olive oil.
In moderation: Poultry, eggs, cheese and yogurt.
Red meat – some say eat it only rarely, some say no more than once/wk.

Figure 1 A comparison of popular weight-loss diets by percent macronutrient and saturated fat



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Comparison of 3 Diets

Subjects followed diet for 2 yr:

- AHA low fat calorie controlled (30% fat) – lost 3.3 kg. Chol/HDL reduced 12%
- Mediterranean Diet (35% fat, calorie controlled) – lost 4.6 kg had highest intake of fiber, More favorable glu and insulin than low fat diet in diabetes. Chol/HDL reduced 16%.
- Low Carb Diet not calorie controlled – 20 g carb induction – 120 g max, lost 5.5 kg. Greatest drop in triglycerides. Chol/HDL down 20%

Stempfer MJ, et al. NEJM 359 (3), July 17 2008

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Low Carb Diet Meta Analysis

17 randomized controlled diets of low carb diets compared to low fat, higher carb diets

Low carb diet is best for both weight loss and cardiovascular risk compared to low fat, higher carb diets.

Sackner-Bernstein J, et al, Dietary Intervention for Overweight and Obese Adults: Comparison of Low-Carbohydrate and Low-Fat Diets. A Meta-Analysis. PLoS One. 2015; 10(10): e0139817

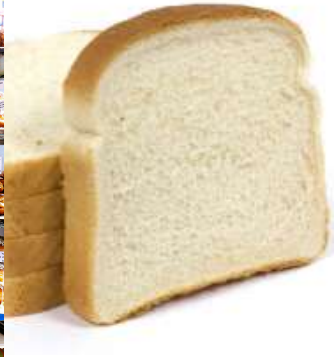
Impact of Glycemic Index and Glycemic Load

- 120 young adults - comparing 2 low vs. 2 high GL (all diets were low fat, reduced kcal)
- All groups lost wt. and waist circum
- High carb groups - one had lower GI, this group nearly doubled fat loss compared to high carb, high GI
- GI and GL influenced results even within a low kcal diet.
- Reducing GL increased rate of fat loss esp. in women

Arch Int Med, July 24, 2006

High Carb Foods: High GI and Load vs Lower




Glycemic Index and Glycemic Load of Foods

- **Glycemic Index:** the measurement of how high and quickly blood sugar elevates after eating a food compared to sucrose (table sugar).

  White potatoes 78, Boiled Yam 44, Baked Yam 94,

  Cooked Carrots 71, Navy Beans, 31

- **Glycemic Load:** considers the total amount of carbohydrate the food contains per serving, but also factors in Glycemic Index.

  White potato – 33, Boiled Yam 11, Baked Yam 42, Navy Beans 9, Cooked Carrots 6

- Atkinson FS, Foster-Powell K, Brand-Miller JC. International tables of glycemic index and glycemic load values: 2008. Diabetes Care 2008;31:2281-2283.

Lowest Glycemic Foods

Protein and Fats – because they contain no sugar or starch, unless added to it

Non-starchy Vegetables – celery, cucumbers, tomatoes, broccoli, cauliflower, lettuce, leafy greens, etc

Contain – small amounts of glucose and fructose, but a lot of fiber and water, vit/min's, and phytonutrients

Ex: ½ cup green beans has 5 g carb (2 g fiber)

Non-starchy veg's have GI 20 and GL 1.5 on avg

Low Glycemic Foods – Non-starchy veg's, healthy fats and proteins









Low Carb Diets and Lipids

- Effects of low-carbohydrate diets v. low-fat diets on body weight and cardiovascular risk factors: a meta-analysis of randomised controlled trials.
- LC diets had more wt loss (WMD -2.17 kg; 95% CI -3.36, -0.99) and decr TAG (WMD -0·26 mmol/l; 95% CI -0·37, -0·15), bigger increase in HDL-cholesterol (WMD 0.14 mmol/l; 95% CI 0·09, 0·19) and LDL-cholesterol (WMD 0.16 mmol/l; 95% CI 0.003, 0.33).
- Our findings suggest that the beneficial changes of LC diets must be weighed against the possible detrimental effects of increased LDL-cholesterol. Mansoor N, et al. Br J Nutr 2016 Feb 14;115(3):466-79. doi: 10.1017/S0007114515004699.

2015 - Both LC and HC diets achieved weight loss, reduced HbA1c and fasting glucose. The LC diet was high in unsat fat and low in sat fat, and achieved greater improvements in the lipid profile, blood glucose stability, and reductions in diabetes medication
Tay J, et al. J Clin Nutr. 2015 Oct;102(4):780-90.

Ketogenic Diets

- Medical diet - developed for epilepsy/seizure disorders originally.
- Now used for cancer, Alzheimers
- 70% fat (try to have majority from long chain triglycerides), 20% pro, 10% carb (3 to 1 fat: pro + carb adults, 4 to 1 ratio in kids)
- Based on calorie needs for ht, wt. age, sex

Ketogenic Diets

- Not appropriate for use with GLP- 1 agonists
- Patients will be prone for hypglycemia
- Fats – slow gastric emptying – and we already have that effect from the GLP-1 agonist, so high fat intake would tend to create more GI discomfort.

Evaluation of Ketosis

- Two low carb diets compared over 6 wks: Ketogenic (KLC) 5% carb vs Non ketogenic (NLC) 40% carb diet
- KLC lost 6.3 vs 7.2 kg in NLC. Fat loss 3.4 vs 5.5 kg. REE and insulin sensitivity incr in both.
- Beta hydroxybutyrate was 3.6 x higher in KLC and was directly correlated with LDL.
- KLC: LDL incr in 5, decr in 4. NLC: LDL Incr in 2/Decr in 8
- KLC had incr. Arachidonic acid:eicosapentaenoic acid ratios in plasma phospholipids (increased inflammation)
- Vigor, happiness, energy rated much higher in NLC.
- Summary: 5% carb ketogenic diet led to increased blood ketones, increased LDL in > 50%, increased inflammation, and decreased profile of mood analysis and energy

Johnston et al. AJCN May 2006 83 (5):1055-61

Ketogenic Diet and Type 2 Diabetes

Type 1

- LC and Keto diets perform well for wt and blood glu mgmt. (HbA1c and insulin dosages). Works well in children, but KD leads to dyslipidemia and can cause low bl glu events. Growth issues in children, and poor lipid profiles.
- Gut health effects – high fat, low starch & fiber diets, lead to reduced SCFA production, reduced gut microbiota (numbers and diversity) and may cause reduced IgA production with increased autoantibodies. Though some reports show a possible increase in Bacteroidetes/firmicutes which may be of benefit for obesity, lowered lactobacillus strains, decr butyrate prod and incr bacteroides is associated w Beta cell autoimmunity found in T1D

Bolla A, et al. Nutrients. 2019 May; 11(5): 962

Ketogenic /Low Carb Diet Side Effects

- Constipation, gall bladder/gall stones, kidney stones, nausea, gastritis, dyspepsia, increased lipids. Hyponatremia and other mineral dysregulation, increased bruising.
- With gall bladder insufficiency, fat can be malabsorbed and lead to diarrhea. (Digestive enzymes with lipase.)
- Hypoglycemia – monitor blood glucose in people with diabetes on med
- Development of colitis* induced by ketogenic diet

*Chiba M, Tsuda S, Komatsu M, Tozawa H, Takayama Y. Onset of Ulcerative Colitis during a Low-Carbohydrate Weight-Loss Diet and Treatment with a Plant-Based Diet: A Case Report. *Perm J*. 2016;20(1):80-84. doi:10.7812/TPP/15-038

Individual Response to Carbs

- 800-person study, given standardized meals of different composition 1meal per day, put on continuous glucose monitor
- Wide variations among individuals to same glucose/mixed meal load
- Bread – < 100 mg/dl – 180 mg/dl

Zeevi D, et al. Personalized nutrition by prediction of glycemic responses. Cell 163, 1079–1094, November 19, 2015.

Factors that Affected PPGR

- Markers of IR – HbA1c, BMI, BP, and Alanine aminotransferase (ALT) were positively correlated
- Carb and fat content of meal –
- Microbiome- Proteobacteria and Enterobacteriaceae were positively correlated, higher Eubacterium rectale was negatively correlated
- Bacteroides thetaiotaomicron – non-beneficial
- Length of sleep
- Sodium content
- Subjects responded to personalized carbohydrate limits and intake.
- Researchers used **carbohydrate counting** as the way to control PPGR in the study

What is Carbohydrate Counting?

- A way to monitor intake of high glycemic foods
  - Measure or count carbs = **1 serving at a time**.
- **1 serving** = the amount of food it takes to get **15 g carb**
- Each 15 g of carb in a food = 1 serving
- 1/3 rice, quinoa or 1/2 cup of potatoes, beans, or pasta = **15 g carb**
- Crackers, chips and cookies (use label): **use net carb (**otal carb minus fiber grams)

Based on the Diabetes Exchange Lists

- **Starch Example of 1 serving**
- 1 slice bread
- ½ hamburger or hotdog bun
- ½ a 6 in pita
- ½ an English Muffin
- ¼ of a 4 oz bagel

- ¾ cup unsweetened dry cereal
- ¼ Grape Nuts
- ½ sugar-frosted cereal
- ½ cup cooked cereals
- 3 cups popcorn

Finding Carb Servings From a Label

- Find serving size – this product has 2 servings per packet, so serving size was 1 cookie
- Find carb grams/svg.
- Total 34g - 4 g fiber = 30 g net digestible
- Divide total carb by 15. 30 ÷ 15 = 2
- 1 cookie is 2 carb servings

Gut Immune Health Considerations

Fiber and Plant Intake

Allergen Considerations

Hormones of the Gut

Gastrin – stomach, stimulates acid secretion

Somatostatin – brain, induced by low pH, inhibits digestion and motility, decreases TSH

Cholecystokinin (CCK) – lower stomach, stimulates gall bladder, pancreatic enzymes, and motility

Ghrelin – stomach, stimulates hunger

Neuropeptide Y (NPY) – hypothalamus, stimulates hunger and decreases urge for physical activity, triggered by low blood sugar. Is inhibited by leptin.

Peptide YY (PYY) – large intestine -satiety

Glucagon like peptide-1 (GLP-1) – large intestine - incretin activity and satiety

Serotonin – intestinal mucosa, calming, influences motility

Murphy KG, Bloom SR. Nature 2006;444:854-859

Effects of GLP-1 agonists on Gut Health

- Liraglutide reduced LPS, via reduced pro inflammatory cytokines, and thus reduce intestinal permeability Nozu T, Miyagishi S, Kumei S, Nozu R, Takakusaki K, Okumura T. Glucagon-Like Peptide-1 Analog, Liraglutide, Improves Visceral Sensation and Gut Permeability in Rats. *J Gastroenterol Hepatol* (2018) 33(1):232–9. doi: 10.1111/jgh.13808
- GLP 1 receptor agonists – may induce mucin production and promote other factors that promote healing of intestinal mucosa https://bpspubs.onlinelibrary.wiley.com/doi/full/10.1111/bph.15611
- Case studies of liraglutide bringing partial remission of ulcerative colitis Lourie. Clin Med Rev Case Rep 2019, 6:6-8

Fat and Microbiome

- High fat diet – increases gram negative bacteria, increases LPS, gut permeability, systemic inflammation, and leads to leptin resistance, overeating and wt gain Cani PD, Amar J, Iglesias MA, et al. Metabolic endotoxemia initiates obesity and insulin resistance. ***Diabetes***. 2007;56(7):1761-1772.
- Western Diets (high fat and pro, low fiber) – decreases total gut bacteria as well as beneficial bifidobacteria and eubacteria species and is assoc w incr nitrosamines. Wu GD, Chen J, et al Linking long-term dietary patterns with gut microbial enterotypes. Science. 2011 Oct 7; 334(6052):105-8.Simpson.

Diet and Microbiome

- Switching from a low-fat, plant polysaccharide diet to a high-fat, high-sugar Western diet altered gut community structure and metabolic function within 1 day.
- 75% of microbial genes associated with obesity belonged to *Actinobacteria* and 25% to *Firmicutes*, whereas 42% of genes associated with leanness belonged to *Bacteroidetes*.

Turnbaugh PJ, et al. The effect of diet on the human gut microbiome: a metagenomic analysis in humanized gnotobiotic mice. Sci Transl Med. 2009 Nov 11; 1(6):6ra14.

Krajmalnik-Brown R, et al. Effects of Gut Microbes on Nutrient Absorption and Energy Regulation Nutr Clin Pract 2012 Apr; 27(2):201-214.

Plants for Polyphenol Intake

- Polyphenols – most abundant compounds in plants (veg, fruit, cereals, beans, tea, coffee, and red wine)
- Have antioxidant and anti inflammatory properties. Also anti-bacterial, anti-adipogenic, and neuroprotective
- Flavonoids are the largest subclass, phenolic acids, and others like ellagic acid and resveratrol
- Polyphenols – also aid the microbiome. Many polyphenols increase bifidobacteria, lactobacillus strains, and akkermansia while reducing staph aureus, e coli, clostridium and strains known to be associated with obesity
- Red wine and black tea reduce Bifidobacterium; Green tea increases it.

Wang X, Qi Y, Zheng H. Dietary Polyphenol, Gut Microbiota, and Health Benefits. Antioxidants (Basel). 2022 Jun 20;11(6):1212.

Plant – Based Diets vs Omnivore

- Plant – based diets lead to more diverse and stable microbiome. Bacterioidetes are signif higher compared to omnivores. Fiber as well as polyphenols contribute to effects. Front Nutr. 2019; 6: 47
- *Lactobacillus*, *Bifidobacterium* and *Bacteroides support synthesis of bile acids* Nicholson JK, et al. Host-gut microbiota metabolic interactions. Science. 2012 Jun 8; 336(6086):1262-7.
- Dietary protein serves as the major source of nitrogen for colonic microbial growth and is essential to their assimilation of carbohydrates and the production of beneficial products such as SCFA. Greenhaff, PL, et al. Am J Physiol Endocrinol Metab 2008 Sep; 295(3): E595–E604

Fiber = Benefits Gut Flora

- Any plant poly or di saccharide that does not digest in human GI tract = fiber
- Types of fiber – soluble, insoluble, prebiotics (FOS, inulin) and resistant starch, a starchy form of fiber.
- Sources (listed highest to lowest RS content) include waxy maize, beans and legumes, rolled oats, unripe banana, boiled and cooled potatoes and commercially processed potato starch products, intact whole grains, and products with added RS. Also, white fleshed sweet potatoes and cassava.

Resistant Starch

- Functions as a prebiotic = feeds beneficial flora (gut immune function/balance)
- Byproduct of probiotic /prebiotic metabolism = short chain fatty acids like butyrate, acetate, and propionate. Resistant starch is superior for SCFA production
- Primary source of fuel for intestinal epithelial cells, especially butyrate.
- RS upregulates GLP-1 and PYY in sustained manner in rodents
- Significant improvements in ins sensitivity, bl glu, and BMI in Type 2 Diab. (most were obese)

Zhang WQ, et al. Chinese J of Prev Med 2007 Mar;41(2):101-104.

Besten G, et al. The role of short-chain fatty acids in the interplay between diet, gut microbiota, and host energy metabolism Sept 2013 The Journal of Lipid Research, 54, 2325-2340.

Beneficial Fiber

- Partially hydrolyzed guar gum (Sunfiber) is another soluble fiber showing good affects on gut health, ↑ Bifidobacterium, ↓bacteroides, improved stool solidity, impr ins sensitivity, impr lipids Nutrients. 2019 Sep; 11(9): 2170.
- Mixes very well in water, not as filling as other fibers.

Fiber resource https://www.sciencedirect.com/topics/food-science/soluble-dietary-fiber

Reduced Beneficial Flora = Immune Dysregulation = Food Allergies/Sensitivities

- Food proteins trigger immune cell production of inflammation - damages insulin receptors and cause insulin resistance, a primary cause of weight gain.
- Stress hormones can shift gut flora leading to gut flora imbalance and the problems that follow.
- Food sensitivities/allergies - increase stress hormones production, contribute to insulin resistance, midsection weight gain and illnesses.

Stadnyk AW. Intestinal epithelial cells as a source of inflammatory cytokines and chemokines. Can J Gastroenterol. 2002;16(4):241-6.

Keltikangas-Jarvinen L, Ravaja N, Raikkonen K, et al. Relationships between the pituitary-adrenal hormones, insulin, and glucose in middle-aged men: moderating influence of psychosocial stress. Metabolism. 1998 Dec;47(12):1440-9.

Top 8 Food Allergens

- Wheat – breads, cereals, crackers, flours. Sourdough, has somewhat lower gluten but still contains gluten.
- Cow's milk (dairy) – and foods made from it. Includes dairy proteins like whey and casein. Yogurt (lower in lactose but still has dairy proteins)
- Soy – soy protein
- Eggs – watch mayonnaise
- Peanuts
- Tree nuts
- Fish/Shellfish
- Sesame

Food Allergens and Weight

- 82 subjects, randomized to elimination diet (based on IgG ELISA test) or calorie restricted for wt loss. Both diets were 58% C/13% P/ 29%F
- Elimination group - lost 8.6 kg in 6 mo (5 kg body fat), signif reduction in TG, slight reduction in Bl glu, Chol and LDL reduction
- Calorie restricted – lost 1 kg in 6 mo (no body fat), increased in Bl glu, slight reduction in Chol and TG

Yaman Onmus, et al. The Effect of Elimination Diet on Weight and Metabolic Parameters of Overweight or Obese Patients Who Have Food Intolerance. Journal of Food and Nutrition Research. Vol. 4, No. 1, 2016, pp 1-5.

Food Allergens and Weight

- Food allergens a source of inflammatory cytokines
- Inflammation drives insulin resistance
- Constipation

- Hotamisligil GS. Mechanisms of TNF-alpha-induced insülin resistance. Exp Clin Endocrinol Diabetes. 1999, 107: 119-125.
- Carrocci A, et al. Multiple food hypersensitivity as a cause of refractory chronic constipation in adults. Scand J Gastroenterol. 2006, 41:498-504.

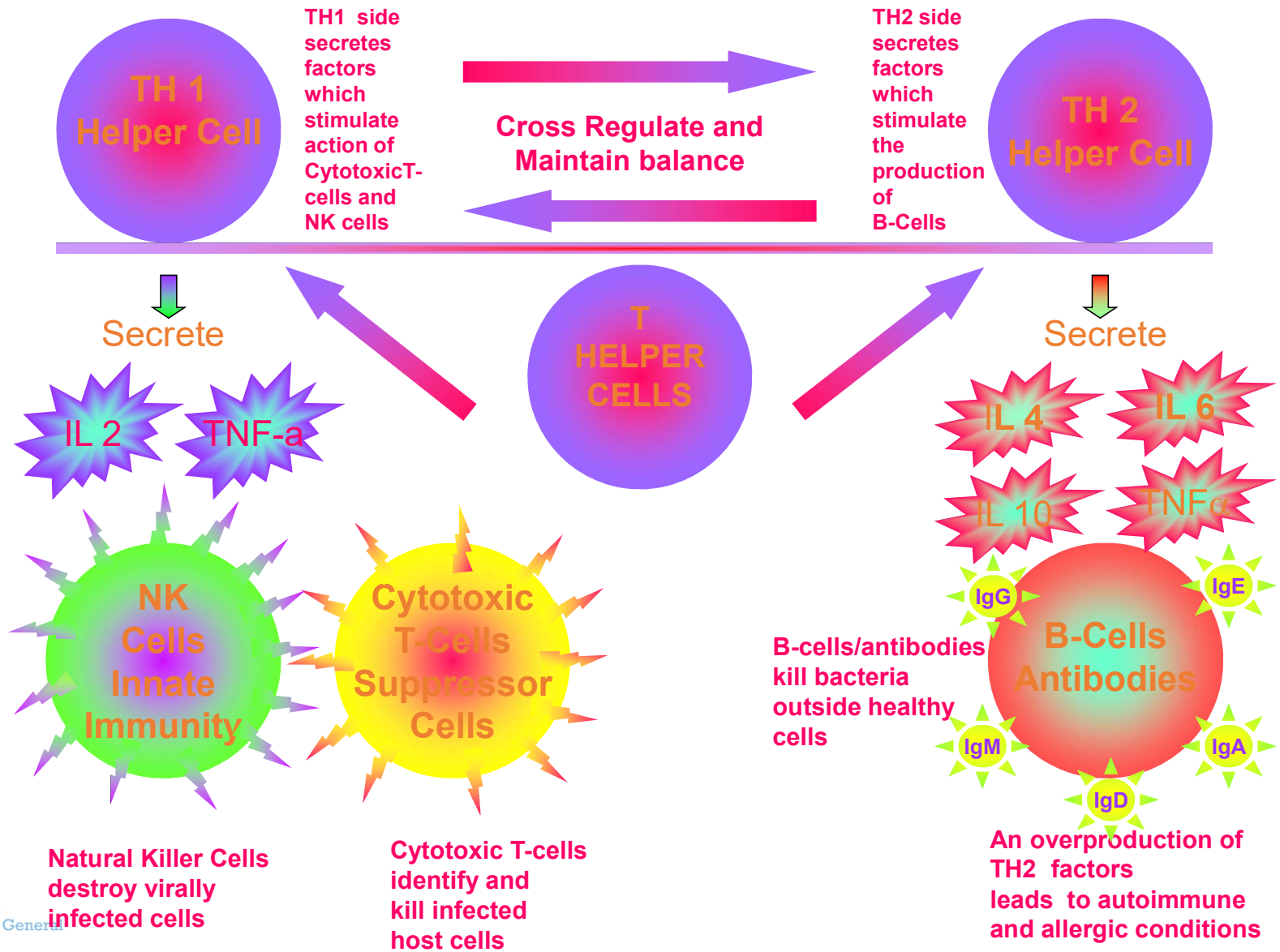
Dysbiosis and Disease

- Dysbiosis plays a role in obesity, metabolic syndrome, diabetes, inflammatory bowel disease (IBD), irritable bowel syndrome (IBS) and celiac disease.
- Dysbiosis could create aberrant immune responses leading to food allergies and admin of probiotics is suggested as a therapy for food allergies. (Bifidobacterium reduces inflammation by reducing e coli. Probiotics given to children with allergies increased IL10 and IGA)

Brown, K. et al. Diet induced dysbiosis of the intestinal microbiota and the effects on immunity and disease. Nutrients. 2012 Aug 21;4(8):1095–1119

Berni Canani, R, et al. Gut microbiome as a target for innovative strategies against food allergy. Front. Immunol. , 14 February 2019

Sec. Mucosal Immunity Vol 10 - 2019 | https://doi.org/10.3389/fimmu.2019.00191



Autoimmune Thyroid

- AIHT patients with or without CD benefit from a diet low in gluten as far as the progression and the potential disease complications are concerned. Liontiris M and Mazokopakas E. *Hell J Nucl Med 2017; 20(1): 51-56*

- GF diets lead to reduced beneficial bacteria in some studies. (Possibly due to lower fiber/starch)Gut Microbes. 2010 May-Jun; 1(3): 135–137

- Protect gut health by making sure of resistant starch and fiber intake and give probiotics.

Gut Immune Health Considerations

- Lots of plant foods
- High fiber intake especially resistance starch (beans/legumes, oatmeal, slightly green bananas, potato starch, cooked and cooled potatoes and rice. Cassava and white sweet potato)
- If have gut related symptoms/condition* or known food allergies – maintain low allergen diet during GLP-1 use and for maintenance after d/c. Food allergen testing and/or elimination diet.

*Seasonal allergies, Joint pain/arthritis, skin rash/eczema, IBS/IBD, GI complaints/gas & bloating, diverticular ds, autoimmune condition, mood issues, stubborn wt/insulin glucose dysreg/CVD markers, NAFLD/MASH, kidney health

Low Carb and Food Allergen Issues

- Food allergen - reactivity whether allergy or sensitivity creates inflammation that drives insulin resistance.
- Low carb diets – low carb and ketogenic diets, not Paleo, typically include cow's milk dairy foods, cheese and cream
- Elimination of gluten – people often turn to GF foods, which are high glycemic index, which should be controlled within daily carb intake limits.

Protein Digestibility

- Consuming meals with two oz-eq of animal-based protein foods resulted in more EAAs in the bloodstream compared to meals with two oz-eq of plant-based protein foods (black beans, raw almonds) in both young and older adults, separately and combined.*
- Affects the ability for our bodies to build body protein or muscle.
- Hemp PDCAA 75 (egg 1, chicken .95)

Nosworthy M, et al The in vivo and in vitro protein quality of three hemp protein sources 10 Sept 2023 https://doi.org/10.1002/fsn3.3652

*Connolly, Gavin (2023) et al. THE EFFECTS OF DIETARY PROTEIN ON POSTPRANDIAL ESSENTIAL AMINO ACIDS BIOAVAILABILITY AS A SUBSTRATE FOR PROTEIN ANABOLISM IN YOUNG AND OLDER ADULTS AND ON CARDIOMETABOLIC HEALTH-RELATED OUTCOMES. Purdue University Graduate School. Thesis. https://doi.org/10.25394/PGS.22665811.v1

Vegetarian Diets: Benefits

- Can be protective against ischemic heart disease
- Promotes healthy gut flora population numbers and diversity
- Higher intake of anti inflammatory compounds, e.g. antioxidants
- Protective for eye health
- Important for pH – esp veg's and fruit (careful with grains)

Vegetarian Nutrient Status

- Vegetarians – higher intake of many nutrients ie carbs, omega 6 fa's, vit C, Vit E, fiber, and Mg, but lower in pro, sat fat, omega 3, retinol, B 12, zinc
- Vegans – all above + very low in B 12 and calcium
- Vegans/Vegetarians have higher homocysteine compared to meat eaters

Key TJ, et al. Proc Nutr Soc 2006 Feb;65(1):35-41.

Veg and Bone Mineral Density

- Vegetarian and especially vegan diets are associated w signif reduced BMD
- Same study looked at kcal restr and IF, kcal restr also reduced BMD somewhat.
- IF did not reduce BMD.
- Make sure to monitor BMD, supplement vit D and calcium [other trace minerals]

Veronese N, Reginster JY. Aging Clin Exp Res 2019 Jun;31(6):753-758

- Vegetarian and vegan diets reduce BMD in hip and spine and vegan diets increase risk for fracture

Nutr Rev. 2019 Jan 1;77(1):1-18. doi:10.1093/nutrit/nuy045.

VEG/VEGETARIAN AND MUSCLE MASS

Signif decr in muscle mass and LBM in vegans compared to vegetarian and omnivore, signif incr in homocysteine, and omnivore diet had major antioxidant and myocyte differentiation compared to vegan and vegetarian diets, which led to cardiomyoblast cell death https://pubmed.ncbi.nlm.nih.gov/29319158/

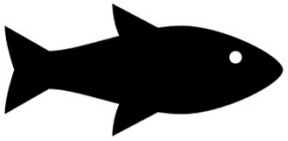
Comparison Study: Vegetarian vs Meat Eaters

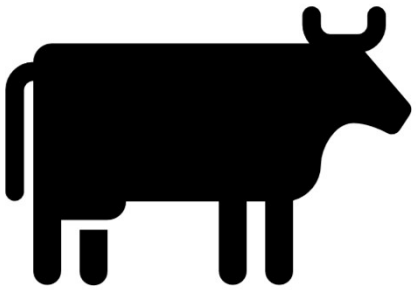
German study: compared vegetarians to health- conscious meat eaters – 21 yr prospectively f/u of 1225 veg, 679 meat eaters. Found slightly lower risk (non-significant) of ischemic heart ds in veg. group

Both groups had reduced mortality compared to normal diet, general population. (Exercise had most impact on mortality – mod and high physical activity reduced mortality significantly.

Chang –Claude, J. et al. Cancer Epidemiol Biomarkers Prev. 2005 Apr;14(4):963-8.

Food Quality





- Speaks to importance of organic or sustainably raised low chemical foods (ewg.org)

- Animal pro/fish intake – need emphasis on higher quality proteins (grass fed, free range, organic), lower mercury fish. Wild caught fish vs farmed (higher in PCB's)

- https://www.epa.gov/system/files/images/2021-09/fish-chart.jpg

Organic Foods vs Conventionally Grown

- From 1950's to 1999 – protein, calcium, phos, iron, riboflavin, and vitamin c all declined in 43 garden crops
- Decline in minerals in foods: ex. Mg in Brussels Sprouts dropped from 19.6 mg/100 g to 8 mg/100 g
- Explanations – high yield crops, gradual depletion of soil micronutrients and organic matter, and changes in pest complexes and levels

Davis, DR, et al. Changes in USDA food composition data in 43 garden crops from 1943 – 1999. Am Coll Nutr 2004 Dec 23(6), 669-682.

Mayer, A. Historical changes in mineral content of fruits and vegetables Brit Food J 99(6), 1997; 207-211.

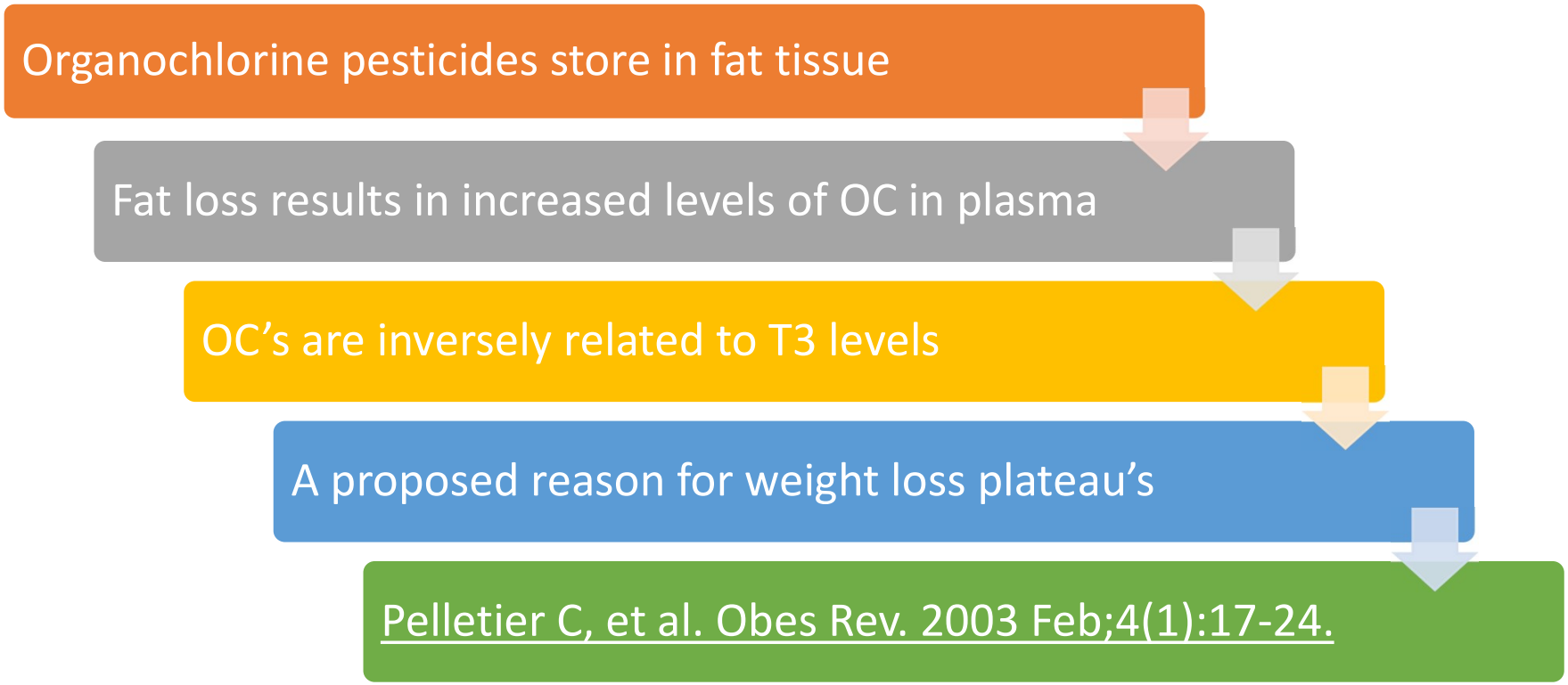
Organic Center Report

Highlights:

- Organic apples have higher levels of antioxidants including flavonols and phenolic acids, raised by 66 percent and 31 percent respectively, compared to conventional apples.
- Organic oranges contain 11 percent more vitamin C, in addition to almost 22 percent more essential oils than non-organic oranges.
- Organic passion fruits have higher levels of vitamin C, as a result of higher plant immune system activity throughout their development.
- Organic lemons have 20 to almost 40 percent more of three of the most common aroma-inducing compounds than non-organic. They smell better!
- Organic green beans, aided by their longer shelf-life, contain more key nutrients like the minerals potassium, magnesium, sodium, calcium, iron, zinc, and more vitamin C.

https://organic-center.org/discover-benefits-organic-produce?utm_source=press-release&utm_medium=toc-website&utm_campaign=produce_report&_gl=1*1lbd4gd*_gcl_au*OTg2NzgyMTk2LjE3NTE1NjIwNzc.

Pesticides Affect Wt Loss:



Pesticides and Insulin Resistance/Diab Risk

- Prevalence of DM strongly positively associated with serum concentration of pollutants.
- Individuals in highest category of exposure (>90 percentile) had prevalence of DM 38X higher than lowest category
- Persistent organic pollutants cause insulin resistance

Lee DH, Lee et al. DiabetesCare 2006;29:1638-1644.

Ruzzin J, Petersen R, Meugnier E, et al. Persistent organic pollutant exposure leads to insulin resistance syndrome. Environ Health Perspect. 2010 Apr;118(4):465-71. Epub 2009 Nov 19.

Pesticides and the Microbiome

- Organophosphorus Pesticides
  - Chlorpyrifos – used on fruits and veg's, reduces lactobacillus and bifidobacterium strains, incr'd enterococcus (UTI's, bacteremia) and bacteroides fragilis (contains high LPS and is a major source of systemic inflammation, which can induce NF-kb in the brain and incr risk fo Alz Ds)
- Herbicides - glyphosate in rats: had changes in the villi morphology in duodenum and jejunum. Also had increased inflammatory responses a.e.b. upregulated expression of genes involved in IL-1, IL-6, TNF-, caspase-3, Mapk3, and NF-B. This reduced the antioxidant system.
- Organochlorine Pesticides (DDE) - Significant alterations in composition of gut microbiome; extended effects on bile acid metabolism, with potential effects on human health

Asghar, A., AlHussaini K. Pesticides: Unintended Impact on the Hidden World of Gut Microbiota. Metabolites. 2024 Mar 7;14(3):155

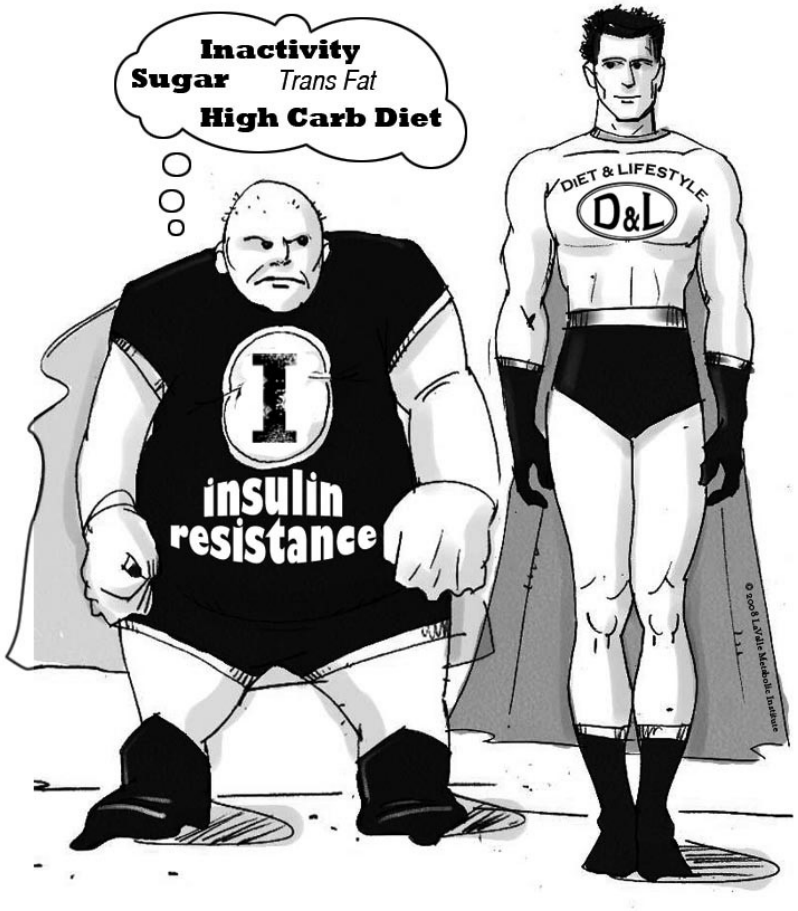




Diet for GLP-1 RA's

Diet Summary

- Proteins – maximize intake to protect lean mass
- Carbs – eat modest portions, but definitely eat them to avoid low blood glucose. After GLP-1, eat amount of carb that continues to maintain wt loss (personalized to person) using carbohydrate counting.
- Plant food intake – needed for nutrient density, muscle protective effect, for fiber and polyphenol intake. Veg's, some fruit, beans/legumes, nuts seeds, whole grains (GF)
- Fats – don't overdo them. Small servings to aid gastric emptying.
- Continue with any known needed diet components – allergen elimination, sat fat if ApoE ¾ or stubborn high LDL
- Organic - as can afford. EWG.org Dirty Dozen Clean Fifteen
- Vegetarian/Vegan – monitor bone density, supplement protein with Hemp protein.



Thank you!

Laura LaValle RDN, LD

llavalle@metaboliccode.com