Clinical Nutrition and the Metabolic Triads
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Metabolic Triad Nutrition
What and How to Eat for Today’s Health Needs and Goals

Nutrition Needs
- Macronutrients
  - Carbohydrates, Protein, Fats, Fiber, Water
- Micronutrients
  - Vitamins, Minerals, Trace Minerals, Phytonutrients

Carbohydrates
- Compounds of sugars or multiples of them in plants or milk. Starch is stored form of carbs in plants.
- The preferred fuel source for the body. Glycogen = stored form in the body.
- Micronutrients needed to break down for energy – Niacin, Thiamin, Riboflavin and other B vitamins, zinc, magnesium,
- Need – around 50% of total caloric intake
- Common Sources: – grains, fruits, vegetables, sugar, milk (lactose)
Energy Needs

- Healthy adults to maintain weight – 30-35 kcals/kg (Jee Jee Bhoi)
- Children
  - 0-6 mo. 108kcal/kg
  - 6-12 mo. 98 kcal/kg
  - 1-3 yr. 102 kcal/kg
  - 4-6 yr. 90 kcal/kg
  - 7-10 yr 70 kcal/kg
  - 11-14 yr males 55kcal/kg, females 47 kcal/kg
  - 15-18 yr males 45 kcal/kg, females 40 kcal/kg

Estimating nutrient needs in adults

1. Use the Harris-Benedict equation to predict basal energy expenditure (BEE)
   - Men: BEE = 66 + (13.75 X weight in kg) + (5 X height in cm) — (6.8 X age in years)
   - Women: BEE = 655 + (9.6 X weight in kg) + (1.8 X height in cm) — (4.7 X age in years)

2. Obtain total energy expenditure by multiplying the BEE by the appropriate factor:
   - Bed rest 1.2
   - Ambulatory 1.3
   - Anabolic 1.5

Protein

- Source of amino acids for building body tissues and cells
- Used for gluconeogenesis when necessary
- Deficiencies in childhood affect growth, in adulthood affect enzymes, antibodies, transport vehicles, cellular oxygen carriers, tendons and ligaments, hair skin nails, tissue maintenance and repair and immunity

Protein needs

- RDA’s for children:
  - 0-6 mo. – 2.2 g/kg
  - 6-12 mo. – 1.6 g/kg
  - 1-3 yr. - 1.2g/kg
  - 4-6 yr. – 1.1g/kg
  - 7-14 yr. – 1.0g/kg
  - 15-18 yr. Males - .9g/kg

Protein needs in Adults

- Maintenance 0.8-1.0 g/kg
- Repletion 1.3-1.5 g/kg
- Liver failure 0.5-0.8 g/kg
- Renal failure 0.5-0.8 g/kg
- Intermittent hemodialysis 1.1-1.3 g/kg
  - Continuous renal replacement therapy (CRRT) 1.5—2.0 g/kg
- Continuous ambulatory peritoneal dialysis (CAPD) 1.2 – 1.5 g/kg
Fiber

Essential for health of gastrointestinal tract, colon cancer prevention, healthy cholesterol levels, healthy blood sugar regulation, helps lower blood pressure when combined with low fat diet, helps with satiety/weight loss

Fiber recommendations

Dietary Reference Intakes (DRI) for Fiber:
- Children 1-3 years: 19 g/day
- 4-8 years: 25 g/d, 9-13 yr: 26-31 g/day
- Adults avg.: 25-30 g/day

Sources: Fruits (2 g/svg.), veggies 2 g/svg, whole grains 2 g/svg, dried beans 8 g/svg

Water

- Carrier of nutrients, waste products, and electrolytes
- Component of cushioning and lubricating tissues, needed for proper muscle contraction, helps maintain body temperature

Fluid needs

- Adults: 1 ml/kcal or 32 ml/kg
  - DRI – males 3.7 L/day, females 2.7 L/day
- Children
  - 1-10 kg – 100 ml/kg
  - 11-20 kg – add an additional 50 ml/kg
  - 21 kg, or more – add an additional 25 ml/kg
- DRI: age 4-8 1.7 L/day

RDA vs. DRI

- RDA’s established in 1941 by National Academy of Sciences – levels of intake adequate to meet needs of healthy persons to prevent deficiencies
- DRI’s – established in 1997 by Food and Nutrition Board of the Institute of Medicine, supposed to shift emphasis toward nutrient levels needed to prevent disease. Est. 4 categories EAR, RDA, AI, and UL’s.

RDA vs. DRI

- Comparison
  - RDA
  - RDI
  - Folate: 200 mcg
  - Vitamin C: 60 mg
  - Calcium: 1200 mg
  - Vitamin E: 10 mg
  - 400 mcg
  - 90 mg
  - 1000 mg
  - 15 mg
The Low-fat Craze and Food Manufacturing:
Processed “fat free” foods
- carbohydrate loaded foods marketed as “fat free”
- extra sugar and additives needed for flavoring of lower carb foods

The Final Product: Fat-free Foods
- High sugar
- processed
- high sodium
- additives
- preservatives
- artificial fat

Harvard’s Healthy Eating Pyramid
1. Foundation = exercise
2. Whole Grain Foods (at most meals).
4. Vegetables (in abundance) and Fruits (2 to 3 times).
5. Fish, Poultry, and Eggs (0 to 2 times)
6. Nuts and Legumes (1 to 3 times)
7. Dairy or Calcium Supplement (1 to 2 times)
8. Red Meat and Butter (Use Sparingly)
9. White Rice, White Bread, Potatoes, Pasta, and Sweets (Use Sparingly)
10. Multiple Vitamin
11. Alcohol (in moderation)

Healthy Eating Indexes
Harvard study findings:
- Men who followed USDA’s Food Guide pyramid had 11% lower risk, women 3% lower risk of developing chronic disease
- Men who followed Harvard’s Healthy Eating Pyramid had 40% lower risk, women 30% lower risk
Mediterranean Diet
HALE* Project Findings

• Adhering to Mediterranean Diet reduced risk of death from any cause 23%
• Moderate alcohol consumption reduces risk 22%
• 30 min walking/d reduced risk 35%
• Combining two or more healthful behaviors reduced risk 65%

*(Healthy Ageing: a Longitudinal Study in Europe) JAMA, 2004;292:1433

Further Evidence

• 44 mo. Follow up of 22,043 adults in Greece: Adherence to Med-type diet reduced all-cause death risk 25%, reduced CHD deaths 24%, reduced cancer deaths 33% (NEJM, 2003;348:2599)
• Nurses Health Study – combination of Med-type diet, moderate alcohol, and regular physical activity was associated with an 83% lower rate of CHD deaths over a 14 yr. follow up. (NEJM, 2000;343:16.)

Mediterranean Diet

• 7-10 whole fruits and vegetables/day
• High Fiber foods – whole grains
• Fish or other Omega 3 sources – 1 - 2 svg/wk.
• Protein - Lean red meat, skinless poultry, and low fat dairy
• Nuts and Legumes
• Alcohol – one glass of wine, beer or 1.5 oz. hard alcohol with dinner
• No Trans fats

Limited or Excluded Foods

• Creamy or buttery sauces
• Refined carbs/sweets
• Deli meats, bacon, sausage, whole milk, ice cream
• Fried foods – any food made with partially hydrogenated oils
• Omega 6 oils (corn, sunflower, soybean, safflower)
• Up to 2 drinks daily for men, 1 drink for women (anything over that, risk starts to increase)

Diet Breakdown

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<thead>
<tr>
<th>Diet Type</th>
<th>Carbohydrate</th>
<th>Protein</th>
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</thead>
<tbody>
<tr>
<td>Ketogenic</td>
<td>5-10%</td>
<td>0%</td>
</tr>
<tr>
<td>Very Low Carb</td>
<td>5-10%</td>
<td>0%</td>
</tr>
<tr>
<td>Low Carb Diet</td>
<td>15-20%</td>
<td>0%</td>
</tr>
<tr>
<td>Mediterranean Diet</td>
<td>40%</td>
<td>0%</td>
</tr>
<tr>
<td>Low Fat</td>
<td>50 or greater</td>
<td>0%</td>
</tr>
<tr>
<td>Modified Lower Carbohydrate</td>
<td>20-25%</td>
<td>0%</td>
</tr>
</tbody>
</table>

MyPlate New ADA Food Pyramid

Fruits
Grains
Dairy
Vegetables
Protein

Choose MyPlate.gov

Carbohydrates
mainly from vegetables, modest grain intake
**Inflammation, Insulin Resistance and Diet**

**Inflammation and Diet**

- Trans fatty acids (found in hydrogenated oils) are extremely pro-inflammatory.
- Even small intakes are associated with increased health risks (heart disease and cancer).
- Trans fats induce insulin resistance and increase belly fat.
- Of all fats, trans fats have the strongest association with weight gain.


**Antioxidant-rich diet can be one of the best defenses against inflammation**

- Focus on getting adequate Omega-6 fatty acids from fish, plant foods, walnuts and wild game.
- Studies have shown that fish oil significantly lowers C reactive protein, compared to omega 6 fats like safflower oil.


**Prostaglandins**

- Hormones synthesized at the cellular level and used almost instantaneously.
- Research is limited-difficult to study in controlled setting.
- Over 30 prostaglandins have been identified.
- Three general categories.

**Prostaglandin E-1 and prostaglandin E-3 have health promoting activities**

- Immune modulating
- Anti-inflammatory
- Anticoagulant (prevent platelet aggregation)
- Dilate arteries

**Prostaglandin E-2 (PGE-2), thromboxane-A2, and leukotrienes have health diminishing effects**

- Pro-inflammatory
- Immune suppressing
- Increase platelet stickiness
**Prostaglandins**

- All prostaglandins have a purpose, the important quality is their ratio
- factors that increase PGE-2 and decrease PGE-1 and PGE-3 are
  - poor quality fats
  - lack of omega-3 fatty acids
  - hydrogenated oils

**Hydrogenated Oils**

- Developed in response to the demand for fewer saturated fats
- hydrogenation creates polyunsaturated oils
- hydrogenation artificially saturates the carbon molecules of a fatty acid chain with hydrogen
- done under high heat and pressure with a metal catalyst

**Hydrogenated Oils**

- The degree of hydrogenation determines the solidity of the oil
- *partially hydrogenated* are semi-solid at room temperature
- retards spoilage
- easy to work with
- high “flash point” (burning temperature)

**Sources of Essential Fatty Acids**

- Omega-6
  - evening primrose oil
  - safflower oil
  - borage oil
  - sesame oil
  - canola oil
  - peanut oil
  - poultry
  - pork

- Omega 3
  - flax oil
  - leafy green vegetables
  - salmon
  - tuna
  - mackerel
  - sardines
  - trout
  - cod liver oil
  - wild game

**Essential Fatty Acids**

- Must be obtained in the diet
- used to synthesize prostaglandins
- enzyme function, ratio of omega-3 to omega-6 and the presence of certain nutrients determine the pathways
  - healthy vs. unhealthy prostaglandins
Delta-6-desaturase

- Enzyme critical for the conversion of linoleic acid to gamma linolenic acid
- GLA needed for the production of PGE1 and PGE3 (anti-inflammatory prostaglandins)

Conditions that Block PGE-1/PGE-3 Synthesis

- Trans fatty acids
- Excess saturated fat
- High serum cholesterol
- Alcohol
- Sugar and excess insulin
- Diabetes
- Impaired glucose tolerance
- Hyperinsulinemia
- Lack of protein
- Heavy metal toxicity
- Radiation
- Oxidative stress
- Cortisol
- Yeast

Nutritional Co-factors

- Necessary for PGE-1 and PGE-3 synthesis
  - Vitamin B3
  - Vitamin B6
  - C
  - Zinc
  - Magnesium
  - Insulin

Phytochemicals

- Naturally occurring substances in fruits, vegetables, legumes, and whole grains that plants naturally produce to protect themselves against viruses, bacteria, and fungi. They include hundreds of naturally-occurring substances, including carotenoids, flavonoids, indoles, isoflavones, capsaicin, and protease inhibitors.
- Their role in promoting health is still being determined. Certain phytochemicals protect against some cancers, heart disease, and other chronic health diseases.

Lifestyle and Insulin Resistance

- After 15 years, those who ate at fast-food restaurants more than twice each week compared to less than once a week had gained an extra ten pounds and had a two-fold greater increase in insulin resistance.

Many Diets Trending Toward Lower Carb or Different Types of Carb

- Mediterranean Diet
  - When eating grains, eat only whole grains

- Harvard Food Pyramid
  - Limits “whites” - white flour, white sugar, potatoes, rice

- Modified Low Carb
  - The Zone or South Beach reduce all carb intake to no more than 40% of calories (showing effectiveness in insulin resistance)

Low Fat vs. Low Carb
Sample Studies

<table>
<thead>
<tr>
<th>Study</th>
<th>n</th>
<th>Wt. loss kg</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foster</td>
<td>37</td>
<td>-2.5</td>
<td>.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low fat</td>
<td>Low Carb</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.9</td>
</tr>
<tr>
<td>Stern</td>
<td>132</td>
<td>-3.1</td>
<td>-5.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.0</td>
</tr>
</tbody>
</table>

All Carbs are Bad?

Potatoes? Carrots? Look back in the 1940’s and 1950’s vs 2000 and on . . .

– Stress is higher now
– Choices are not balanced and lean heavily to increased intake of refined sweeteners
– Exercise levels have dropped
– Portions are larger
– Food quality is poorer

Comparison of 4 diets

• LEARN diet, -2.6 kg
• Zone, - 1.6 kg.
• Ornish (vegetarian, low fat), -2.2 kg
• Atkins, - 4.7 kg

Looking Beyond Weight Loss

• Ornish and LEARN favored LDL at 2 mo., differences leveled out and were not signif. at 6 and 12 mos
• Lowest carb was most effective for weight loss, lowering of trigs, increasing HDL and lowering BP
• Author’s conclusions - Atkins diet led to greatest wt loss and most beneficial metabolic effects through 1 yr of follow up

Is It Ok to Say, “Choose your diet”??

• Jul 08 NEJM - 322 overwt or obese subjects for 2 yrs.
• Low fat - < 30% fat, lost 7 lb, slight incr in bl glu, no drop in CRP
• Med diet - 35% fat w 2-3 tbs olive oil, low red meat. Lost 10 lb, people w diab had signif drop in bl glu, lowered CRP
• Atkins < 20 g carb - Lost 12 lb. Greatest impr in chol/HDL, Hba1c dropped by 1 point even though bl glu decr’d but not significantly, signif drop in trig’ s. Compliance by end of 2 yr, subject were eating 40% carb

Comparison of High vs. Low Carb for Weight and Ds. Risk

• Low Carb High Protein (HP)diets were compared to high fat (HF) and High Carb High Fiber (HC) diets in 96 overweight women. 16 wk
• Participants were given general weight loss counseling during first 8 weeks, cont’ d diets on their own during second 8 weeks.

High vs. Low Carb Results

<table>
<thead>
<tr>
<th></th>
<th>HC</th>
<th>HF</th>
<th>HP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>- 6.2 lb</td>
<td>-5.9 lb.</td>
<td></td>
</tr>
<tr>
<td>Waist</td>
<td>- 7 cm.</td>
<td>-10.5 cm</td>
<td>-8.7 cm</td>
</tr>
<tr>
<td>Trig</td>
<td>.32 mmol/L</td>
<td>- .56 mmol/L</td>
<td>- .63 mmol/L</td>
</tr>
<tr>
<td>LDL</td>
<td>LDL sigif lower, but 35% had incr LDL</td>
<td>LDL sigif lower, but 7% had incr LDL</td>
<td></td>
</tr>
<tr>
<td>Insulin</td>
<td>4.2 mU/L</td>
<td>5.9</td>
<td>3.8</td>
</tr>
</tbody>
</table>

Author’s Conclusions

High protein diet is best overall approach for weight loss and risk of CVD and Type II Diab in insulin resistant people.

Low Carb Diets and Lipids

- Low carb diets lowered trig, increased HDL and lowered apoB even in absence of wt. loss or presence of higher sat fat when compared to low fat (50-60% carb) diets

Krauss, et al. AJCN 2006;83:1025-1031

Low Carb studies

- Brehm B, J of Clin Endocrin and Metab, April 2003
- Westman EC, American Journal of Medicine, Jan. 2002
- Bravata AM, JAMA, Apr. 2003
- Foster GD, NEJM May 2003

For Further Review

- Westman et al. Provide an excellent review of low carb diets for wt. mgmt, CVD, and diabetes.

What Are Our Desired Endpoints

- Support health/Prevent Disease
- Control weight
- Control inflammation
- Strong, balanced immune system
- (Neuro-endocrine-immune)

- Anti-inflammatory
- high antioxidant
- nutrient dense
- low glycemic load
- non-reactive (low allergen)
- pure, unprocessed
Insulin Resistance and Inflammation

- Looking at excess carbs or inappropriate response to carbs as source of inflammation
- Prolonged post meal insulin shuts down delta 6 desaturase

Low Carb and Metabolic Syndrome

- Low carb/high fat diet improved BP, increased HDL, lowered trig, reduced bl glu and insulin, and reduced weight.
- Low fat/High carb diet exacerbated Metabolic Syndrome
- Authors discussed the persistence of AHA/NHBL in recommending low fat diets as being in error for Met Syndrome

Low Carb vs High Carb for Wt. Loss

- Brehm et al compared women on 15/28/57 vs 54/18/32
- 8.5 kg. vs 3.9 with no changes in bone mineral content in either group
- Low carb group had same body water as low fat group. Low carb had spontaneous restriction of caloric intake (this effect seen in other studies.)

Low Carb and Hypertension

- Obese subjects placed on low carb, high fat diet. No kcal restriction. Sodium intake went from 2 g to 20 g
- Lost 5% of b.w. in 6 weeks, had significant reductions in fasting insulin and mean arterial pressure
- Author conclusions – stop paying so much attention to sodium and start paying attention to fasting insulin

More Low Carb Support

- “Considering the effectiveness of VLCDs in promoting fat loss and improving the metabolic syndrome, discounting or condemning their use is unjustified. We encourage a more unbiased, balanced appraisal of VLCDs.”

Comparison of GI and GL

- 120 young adults - comparing 2 low vs. 2 high GL (all diets were low fat, reduced kcal)
- All groups lost wt. and waist circumference
- High carb groups - one had lower GI, 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
Low vs High GI

- 162 subjects RDB study 1 yr. comparing high carb/ high GI, high carb/low GI, and low carb/high MUFA
- In well controlled Type 2 Diabetics (bl. glu near normal) a low GI diet led to lower 2 hr post load glucose and CRP’s lowest in the low GI diet (1.95), highest in high carb/high GI (2.75)

Low GI Foods and Stress Hormones

- Subjects (teenage boys) were given equal kcal meals with either high, med. or low GI
- High GI meals led to incr kcal intake and higher serum insulin, lower plasma glucagon, and elevated serum plasma epinephrine

Low Glycemic Improves Nutrition Status

- “Kidneys possibly lose their ability to retain magnesium during periods of hyperglycemia (significantly elevated blood glucose). The increased loss of magnesium in urine may then result in lower blood levels of magnesium [4]. In older adults, correcting magnesium depletion may improve insulin response and action [42].”

Low Carb and REE

- 2 calorie restricted diets, either low fat or GL
- Bl glu, trig, CRP and BP all improved more in low GL group
- REE’s reduced less in the low GL group
- Low GL group also had less hunger

High Glycemic Index Foods

- Most diets - even 50 to 60% carb low kcal diets are now offering low glycemic index, higher fiber options
- High GI foods even if quantity controlled stimulate appetite and lead to increased kcal intake.

Low Carb and Cancer Risk

- Low glycemic load intake is associated with lower risk
- Higher GL intake is associated with increased risk colorectal and endometrial cancer


Safety of High Pro and Fat Evaluated

Carb Restricted Diets high in MUFA or Pro are equally effective at promoting fat loss and improving blood lipids when substituted for carb, protein enhances fat loss.

This study looked to see if the effect was from HP or higher MUFA. Both higher fat and protein diets led to fat loss, lower glucose and insulin responses and NO calcium loss, bone loss or renal changes.


Evaluation of Ketosis

6 Weeks

- Ketogenic (KLC) vs. Non ketogenic (NLC) diet
- REE and insulin sensitivity increased in both.
- Beta hydroxybutyrate was 3.6 x higher in KLC and was directly LDL correlated.
- Vigor, happiness, energy rated much higher in NLC

Summary Ketogenic vs. Non Ketogenic low Carb diet

<table>
<thead>
<tr>
<th></th>
<th>LDL Chol Increase</th>
<th>LDL Chol Decrease</th>
<th>Wt. Loss</th>
<th>Fat Loss</th>
<th>REE</th>
<th>QOL</th>
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</thead>
<tbody>
<tr>
<td>Ketogenic Diet</td>
<td>5</td>
<td>4</td>
<td>6.3 kilo</td>
<td>3.4 kilo</td>
<td>+++</td>
<td></td>
</tr>
<tr>
<td>Non Ketogenic Carb</td>
<td>2</td>
<td>8</td>
<td>7.2 kilo</td>
<td>5.5 kilo</td>
<td>+++</td>
<td>+++</td>
</tr>
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</table>

High Protein Diet and Hip Fx in Elderly

- Five hundred seventy-six women and 370 men from the Framingham Osteoporosis Study-no previous hx of hip fx
- 946 participants-mean age 75 yrs.
- Mean pro intake of 68g/d
- Increased protein intake associated with decreased risk of hip fracture compared to participants with lowest protein intake

Net Acid Comparisons

- Paleolithic era- meat was the only acid producing food. Net acid producing load (NEAP) was -78 to -23 mEq/d
- Modern NEAP is 48 to 132 mEq/d
- The primary dietary change in ancient vs. modern diet was replacement of roots, tubers, leafy greens, vegetables with grains and energy dense nutrient poor foods (separated fats and sugars)
Net Acid Load (cont’d)

- Authors of the study stated that by replacing grains and NDEP foods with vegetables/plants would “allow animal food intake to increase considerably” without becoming a net-acid producing diet
- And proposed metabolic alkalinizing diet should be considered for preventing/treating osteoporosis, age-related muscle wasting, hypertension, kidney stones, infertility, age and disease related renal insufficiency, and even improved exercise performance.

Sebastian et al. AJCN 76 (6): 1308-16.

Diet, Obesity, and IR

- High refined sugar/carbohydrate diet and low protein promotes fat storage and muscle catabolism
- High protein diets that restrict carbohydrates lack essential nutrients and fiber
- Serotonin-carbohydrates at mealtime satisfy carb cravings but exacerbate IR.
- Weight gain leads to increased resistin, decrease adiponectin, and inflammation.


Dietary Recommendations in IR

- A modified low carb/higher protein diet
- Increase non-starchy vegetable intake - improves adiponectin levels
- Utilize high fiber foods like beans to fulfill carb cravings without high adverse glycemic effects
- Lean meats - fish, chicken, bison
- A low allergen diet may be helpful, i.e. low wheat and/or cow’s milk.


Lowering Carb/Carb Modified

- The Metabolic Code Diet carb modified vs. very low carb
- Carbs are eaten in proportion to activity and ability to achieve weight loss and/or maintain weight loss. Can liberalize with increased activity and/or to level that the patient can still maintain weight, healthy bl/glu and other parameters.

Metabolic Code Diet - Primary Foods

- Vegetables
- Beans and Legumes
- Nuts and Seeds-Raw
- High quality meats/animal protein
- Dairy (sheep’s/goat’s milk depending on tolerance) other dairy substitutes available albeit usually lower in protein and calcium, they help flavor and satisfaction with foods.
- Per individual tolerance:
  - Berries-(not crunch-berries) and other fruit
  - Starchy vegetables, whole grains
**Fructose**

- Signif contributor to increased appetite, incr triglycerides, and incr risk insulin resistance and heart disease
- Major dietary sources- high fructose corn syrup, fruit juices, fruit
- Authors of this review urgently called for the reduction of high fructose additives in food supply
- Reason that even intake of fruit and esp fruit juice needs to be controlled


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**Metabolic Triad Nutrition (continued)**

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**Fruit: What to Do?**

- Fruit is a significant source of fiber, antioxidants, micronutrients, but also fructose
- Threshold effect – rat and human studies show hyperlipidemic effects occur at higher intakes
- Human study in men showed hyperlipidemia started to occur at 7.5% of calories in insulin resistant individuals


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**What is missing in avg. American diet?**

- 6 out of the 10 leading causes of death are associated with dietary behavior.
- Fruits and vegetables (preferably organic due to increased nutr., decreased heavy metals) - consumption still under 5 a day(NHANES-II found 91% eating <5/d). Newer studies recommending >9/day, i.e. the DASH diet, newer pyramid designs

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**Quality Proteins**

- Concerns regarding antibiotic residues, pesticides concentrated in animal fats, mercury levels in fish.
- Can avoid by buying free-range poultry, beef and pork fed organically-grown foods and given no hormones, dairy should be antibiotic free. Limit fish to 1-2x/wk. Use organically grown beans and soy to meet some of the protein need.

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**High Quality Carbs**

- Too many refined flours in pasta, cereals, breads
- Whole grains are cholesterol free, low fat, high in fiber, good source of B vitamins and trace minerals
- Current recommendations 3 svg/day. Avg Am., only 13% eat 1 or more svg./day.
Fiber

- Significant Health Benefits with adequate intake- bowel health, aids blood sugar control, decreases certain cancer risks, heart health
- Breast Cancer and fiber - fiber inhibits Beta glucoronidase activity (elevated beta glucoronidase is associated with increased risk breast cancer)

Fiber, cont’d

- Recommended intake > 25 g./day
- Foods - frts&veg’ s - 2g/svg., whole grain breads - 2 g/svg., beans - 7 g/svg, metamucil - 15 g/svg.

Vitamins and Minerals

- Crucial coenzymes biochemical pathways- Remember the Kreb’ s Cycle!!
- Crucial component of body tissues and cells
- Other functions - antioxidants, blood clotting, hormone-like activity

Vitamins and Minerals

- Inadequate intakes are associated with inadequate fruit, vegetable, and whole grain consumption and intake of excessive sugar (Sugar increases excretion of minerals, incl. Calcium, chromium, magnesium, zinc, and copper.)
- RDA’s being updated for adequacy - still based on level needed to maintain health

Vitamins

- Fat soluble - adequate bile needed for digestion of and need fats for carriers, stored in liver so can be toxic with excessive intakes (except Vit. E) Vitamin D most toxic at only 4x the RDA. Foods rarely toxic - only documents cases Vit. A from liver
- Deficiencies likely when diet is consistently low, in cases of fat malabsorption, or in bulimia

Vitamins

- Water soluble - B vitamins and Vit. C - easily absorbed and excreted. Food forms never toxic. Supplement forms rarely toxic. B6 toxicity has been reported on as little as 200 mg/d (pins and needles in hands)
- Deficiencies - at risk group for B12 - vegetarians, the elderly.
Vitamins, cont’d

• Vit. C - high doses can cause diarrhea, high doses can give false positive test in urine tests for diabetes, at risk groups = Sephardic Jews, Asians, and some black Americans with an inherited enzyme deficiency are susceptible to high doses.

Mineral and Trace Minerals

• Absorption is tricky - some minerals in excess lead to depletion of other minerals/trace minerals, i.e. excess zinc can lead to copper depletion (see Table 12)
• Deficiencies are clinical and subclinical and are not rare. Toxicity’s are varied i.e. excess Mg. Can cause diarrhea,

Minerals, cont’d

• Excess sodium causes hypertension, excess potassium into the bloodstream and cause heart failure, excess iron can cause heart disease,
• Trace minerals - emerging area of research, ie Boron’s role in bone formation, vanadium’s role in blood glucose regulation

Nutrients in Foods Declining

• From 1950’s to 1999 – protein, calcium, phos, iron, riboflavin, and vitamin c all declined in 43 garden crops
• Due to – high yield crops, gradual depletion of soil micronutrients and organic matter, and changes in pest complexes and levels

Mayer, Brit Food J 99(6), 1997

Nutrients in Corn


Other Foods

• From USDA Food Composition Tables

<table>
<thead>
<tr>
<th>1975</th>
<th>2001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lemons (calcium)</td>
<td>61 mg</td>
</tr>
<tr>
<td>Grapefruit (Fe)</td>
<td>.4 mg</td>
</tr>
<tr>
<td>Peaches (vit. A)</td>
<td>1330 IU</td>
</tr>
<tr>
<td>Cherries (vit. C)</td>
<td>10 mg</td>
</tr>
</tbody>
</table>
**Drug-Induced Nutrient Depletions Influence Metabolism**

Female Hormones: FA, B6, B1, B2, B3, B12, C, Mg, Se, Zn, tyrosine, CoQ10, E

Anticonvulsants: D, K, FA, Ca

Anti-diabetic Drugs: CoQ10, B12

Anti-hypertensives: B6, CoQ10, Ca, Mg, K, Zn,

Anti-inflammatory: Ca, K, Zn, Fe, B6, C, D, FA,

Statins: CoQ10, Vitamin D

Beta-blockers: CoQ10, melatonin

Phenothiazines/TCA’s: B2, CoQ10

Benzodiazepines: Melatonin

Anti-ulcer medications: B12, FA, D, Ca, Fe, Zn, Mg, protein

Antibiotics: B-vitamins, vitamin K

---

**Drug Nutrient Depletion**

- Special concerns: Folate deficiency related to depression, dysplasia, anemia, elev. Homocysteine, increased colorectal and breast cancer, and birth defects. Can test folate status with a neutrophil hypersegmentation index

---

**Drug Nutrient Depletion, cont’d**

- CoQ10 needed for cell respiration (ATP production) and especially for optimal cardiac function. Depleted by statin drugs, beta-blockers, and sulfonylureas

---

**Are the RDA’s enough?**

- Vitamin D - used to say 400 to 800 IU per day. Now minimum 2,000 to 10,000/day.
- Magnesium - RDA was increased in 1997 from 350 to 420 mg.
- Vitamin C - RDA was increased in 2004 to 75 mg and 90 mg. up from 60 mg. previously for adults
- Vit E was incr from 8 or 10 mg. to 15 mg. for adults

---

**RDA for Vit. C**

- Antioxidant experts plea with Institute of Medicine, Food and Nutrition Board to increase RDA for vitamin C
- Old studies saying blood plasma levels maxed out at 200 mg were incorrect and that current levels are inadequate for human health
- Believe minimum intake should be 1000 mg./d, 2,500 mg./d is the equivalent to other species blood plasma levels

---

**Examples from Nurses Health Study**

- Those who took multivitamins with folate for 15 years cut colon cancer risk by 75%
- Multivitamins with B6 reduced heart disease risk by 30%, the more B6 the lower the risk

Vitamin D

- 2009 study reported that 75% of US teens and adults are Vitamin D deficient
- Compared (25[OH]D) levels from NHANES III from 1988 - 1994 to levels from NHANES 2001-2004
- 32,252 patients total
- 45% from 1988-1994 had 30ng/ml (25[OH]D) compared to 23% from 2001-2004


Vitamin D

- Low Vitamin D levels are linked to increased blood sugar and insulin resistance
- Women with low Vitamin D more prone to gain visceral fat
- Also linked to low testosterone in men and depression in men/women

Am J Clin Nutr. 2010 April 14

Magnesium

- 98 subjects
- Lowest plasma magnesium concentrations
- Higher fasting plasma insulin
- Mg concentration associated with increased insulin resistance

Magnesium

– 50 controlled, 110 non-controlled type 2 diabetes patients
– 190 healthy volunteers
– Serum HDL-cholesterol value showed significant graded increase with serum magnesium values regardless of glucose values.


Magnesium supplementation 500mg elemental form for 4 wk in overweight individuals: distinct changes in gene expression

• ↓ C-peptide 4ng/ml
• ↓ Insulin -2.2uU/ml
• 24 gene up regulation and 36 down regulation
• All related to metabolic and inflammatory pathways

Trial registered at clinicaltrials.gov as NCT00737815.

Magnesium Supplementation, metabolic and inflammatory markers, and global genomic and proteomic profiling: a randomized double-blind, controlled, crossover trial in overweight individuals. Chacko, Sara, Sul, James, Song, Yiqing et al; Am J Clin Nutr February 2011 vol 93 no2 463-473

Magnesium and Stroke Risk

Meta Analysis

• 7 studies pooled
• For every 100mg increase intake magnesium meant a 8-9% decreased total and ischemic stroke risk.


Foods Rich in Magnesium

<table>
<thead>
<tr>
<th>Magnesium-Rich Foods</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumpkin seeds (roasted)</td>
<td>532</td>
</tr>
<tr>
<td>Almonds</td>
<td>300</td>
</tr>
<tr>
<td>Brazil nuts</td>
<td>225</td>
</tr>
<tr>
<td>Sesame seeds</td>
<td>200</td>
</tr>
<tr>
<td>Peanuts (roasted, salted)</td>
<td>183</td>
</tr>
<tr>
<td>Walnuts</td>
<td>158</td>
</tr>
<tr>
<td>Rice</td>
<td>110</td>
</tr>
<tr>
<td>Whole-grain bread</td>
<td>85</td>
</tr>
<tr>
<td>Spinach</td>
<td>80</td>
</tr>
<tr>
<td>Cooked beans</td>
<td>40</td>
</tr>
<tr>
<td>Broccoli</td>
<td>30</td>
</tr>
<tr>
<td>Banana</td>
<td>29</td>
</tr>
<tr>
<td>Potato (baked)</td>
<td>25</td>
</tr>
</tbody>
</table>

(Milligrams per 100 grams). Source: USDA nutrient database.

Chromium

• Important in insulin regulation and blood sugar control
• Metabolism of carbs and fats
• Improves satiety
• ↓ Carbohydrate cravings
• Helps convert T4 to T3

Chromium

- Diets high in simple sugars (comprising more than 35% of calories) can increase chromium excretion in the urine.


Zinc

- Co-factor in the insulin receptor complex
- Shortage leads to insulin resistance and fat storage
- Hyperglycemia can lead to zinc depletion


Vitamin C

- Antioxidant
- Low vitamin C levels found in overweight/obesity
- Low levels associated with:
  - Cardiovascular diseases, including hyperlipidemia, hypertension, endothelial dysfunction, arrhythmias
  - Insulin resistance/Type 2 diabetes
  - Blood abnormalities
  - Ocular diseases including macular degeneration, cataracts
  - Immune imbalances
  - Cancer


Vitamin C and Exercise

- Vitamin C – up-regulates carnitine synthesis and increases fat burning.
- Study found people with marginal Vitamin C deficiency burned 25% less fat during exercise. Repletion of Vitamin C raised fat burning 4 fold.


Vitamin C, Oxidative Stress, and Inflammation

- 298 healthy adults
- Plasma ascorbic acid inversely correlated with
  - C-reactive protein
  - F2-isoprostanes
  - Malondialdehyde
  - P < 0.0001
- C-reactive protein strongly correlated with MDA/isoprostanes

Leptin

- Antioxidants, Vitamins and Minerals effect leptin levels
- Leptin a hormone that regulates calorie intake, calorie expenditure & inflammation
  - Nutr Cancer 2009;61(2) 225-231

Part II: The Health Effects of Food Additives

- Pesticides
- Flavorings/preservatives
- GMO’s
- Sugar
- Antibiotics and growth hormones
- Hydrogenated oils
- Caffeine

Top Food Trends

- Supersizing/Obesity trends
- Renewed interest in eating together/nostalgia
- Convenience – speed scratch, semi-homemade, hand-held foods
- Eating healthy/functional foods, organic foods, vegetarianism
- Food safety – food borne illness
- Ethnic foods

What is in food supply that shouldn’t be, cont’d.

- Sugar - problem is the large amounts consumed, avg. 130-150lb./person/yr. When considering all caloric sweeteners- 158 lb. per capita.
  - Increase is attributed to the increased use of added sweeteners in processed foods and increased soda intake (sugar sweetened drinks are the primary source of added sugars in the diets of U.S. children

Sugar statistics, cont’d

- Total energy intakes of Americans continues to rise, as do obesity rates, Type II diabetes, and insulin resistance (syndrome X)
- Studies show obese children and adults have higher soft drink intake than lean counterparts.

Sugar, cont’d

- Dental caries rates are now at same levels prior to fluoridation of water.
- Sugar provides calories but no vitamins or mineral or fiber and displaces more nutritive calories, making it hard for individuals to meet RDA’s for micronutrients.
Sugar guidelines

- USDA Dietary Guidelines say to use sweets “sparingly”
- ADA recommends consuming no more than 5-10% of kcal from sugar. (Approx. 6 tsp/d. on 1600 kcal, 12 tsp/d. on 1800 kcal.) Avg. daily intake in person>2yr.=21 tsp.
- The avg. 12 oz. soda contains 10 tsp. Sugar-

Chemicals in the U.S.

- Over 3000 chemicals are used for the growth, appearance, and preservation of food.
- 2.5 billion pounds a year are used on food crops, lawns, parks, lakes, ponds.
- Over the past 50 years, 75,000 new chemicals have been developed for commercial use.

Chemicals in the U.S.

- 78 percent of the most widely used chemicals have not undergone “minimal toxicity testing”
- the EPA has identified 66 carcinogenic pesticides, but restricted the use of none.
- EPA has established an “acceptable cancer risk” for pesticides

Pesticides

- 1989 Resource Defense Council study findings:
  - children on average receive up to four times more exposure to carcinogenic pesticides than adults
  - children are more vulnerable to the damaging effects of pesticides because of developing nervous and endocrine systems

Childhood Cancer

- Is there a link to pesticide exposure?
- The Children’s Cancer Study Group findings:
  - of 204 children with leukemia, the most consistent association was the link between prolonged pesticide exposure and development of non-lymphoblastic leukemia in their offspring.
  - The risk increased if the child had direct exposure to pesticides in the home, or if the mother was exposed to household pesticides during pregnancy

Pesticides as endocrine disrupters

- Hormone mimics- chemical binds with receptor sites and stimulates cellular activity
- Hormone masking- chemical binds with receptor site and blocks hormone
- Hormone binding- chemical binds with the hormone, rendering it inactive
Endocrine Disrupters

- Halt or stimulate hormone production
- Increase or decrease cellular activity
- Disrupt metabolism and immune function
- Alter reproduction and development

Endocrine Disrupters

- Hormone-specific birth trends:
  - Between 1970 and 1990, male births declined 2.2 per 1000 live births in Canada and 1 per 1000 in the U.S.
  - While the ratio of male births has declined, the number of male reproductive tract defects are on the rise
    - Incidence of hypospadias in the U.S. doubled between 1963 and 1993 (the ratio of severe cases also increased)

Foods Most Contaminated by Pesticides

1. Strawberries
2. Bell peppers
3. Spinach
4. Cherries (US)
5. Peaches
6. Cantaloupe (Mexico)
7. Celery
8. Apples
9. Apricots
10. Green beans
11. Grapes (Chile)
12. Cucumbers

Genetically Modified Organisms (GMO’s)

- Genetic engineering
  - Altering the genetic code of living things
  - Crossing the genes of different species: gene splicing (gene source + unmodified organism/UMO=GMO)
  - Genetic engineering of food theoretically improves resistance to disease and pests, decreases ripening time, increases tolerance to herbicides.

Commonly Gene-Modified Foods

- Tomatoes
- Potatoes
- Soybeans
- Processed foods (most)
- Corn
Safety of GMO’s?

- Increased chance of allergic reactions
- Introduction of potential toxins
- Reduction in nutritional quality
- Disruption of the balance of nutrients and phytochemicals
- Alterations in enzymes of the GMO

John Fagan, PhD., a molecular biologist and biochemist who has devoted his career to genetic research, has remained outspoken about the dangers of genetically engineered foods since 1994. His major concerns include the environmental impact of GMOs (introducing unwanted changes in food-producing organisms) and the unintended characteristics of GMOs that can not be foreseen.

"Frankenstein Foods"

GMOs

- Genes are the blueprint for proteins; food produced by genetic modification will contain proteins that we have never observed
- Gene source proteins can come from viruses, pigs, bacteria, plants or any other living organism
- Safety tests are conducted based on the known health hazards of the gene source and UMO, not the final GMO

GMO Labeling

- The FDA does not require GMO foods to be labeled as such
- Even “certified organic” foods can be GMOs.
- This has created a mammoth controversy in the food industry
- Responsible growers and packagers are using voluntary “negative labeling” as a solution. ("Contains no GMOs")

Antibiotics/Hormones

- Encourage weight gain
- Reduce spread of infection
- Inhibit overgrowth of intestinal flora from grain-fed diet (low grass)
- Encourage ongoing lactation and reproduction
Antibiotics/Hormones

- Beef
- Poultry
- Dairy
- Eggs
- Pork

Antibiotics/Hormones

- BST/BGH (bovine somatotropin and bovine growth hormone) are naturally occurring growth hormones in dairy cattle
- rBST and rBGH are genetically modified growth hormones. Polisac manufactured by Monsanto Corp. to increase milk production
- Used in 30 percent of dairy cows

rBGH: Health Hazards

- Studies have shown that insulin-like growth factor 1 (IGF-1) is higher in growth hormone-treated milk than in milk form non-treated cows
- IGF-1 has been linked to cancer in numerous studies
- IGF-1 may also increase the risk of diabetes in those prone to the disease

rBGH: Health Hazards

- 90 day rat study found that rBGH does enter the bloodstream, where it caused adverse immune reactions (lesions and antibody production)
- Increases the need for antibiotics due to mastitis and udder swelling

In 1999, Canada rejected approval of rBGH, despite the reported “enormous pressure” from Monsanto.

Antibiotics

- Enter the milk
- Enter those who drink the milk
- Increase the problem of antibiotic resistance
Food-Timing

Blood glucose levels vary during the day

Eat based on cortisol rhythm to:
- Maintain constant high energy
- Prepare body for sleep

Fit Type of Food to Metabolic Need

- Morning = Highest Cortisol Levels Most Glucose Sensitive
- Eat protein in AM- don’t feed carbohydrates with high morning cortisol, can signal fat storage
  - Protein shakes
  - Egg White omelets
  - Veggies
- Carbs in evening when body wants to rest and restore and brain will cool down.
  - Brown rice
  - Oatmeal

Breakthrough: Diurnal Carbohydrate Intake Study

- Greater Weight Loss and Hormonal Changes After 6 months Diet With Carbohydrates Eaten Mostly at Dinner

Breakthrough: Diurnal Carbohydrate Intake Study

- 78 Police officers with BMI<30 assigned either experimental carbohydrate diet or control weight loss diet (1300-1500kcal)
- 6 month trial Blood samples taken at 0,7,90,180 days hunger scores taken every 4 hours from 8 am-8pm

Breakthrough: Diurnal Carbohydrate Intake Study

- It is reported that insulin resistance is highest in the morning.
- Goal is to alter diet to shift peak leptin levels to day
- Result to decrease appetite and increase fatty acid oxidation
- Carbohydrate fasting until dinner resulted in 30 overweight police officers losing 28%
Summary: Diurnal Carbohydrate Intake Study

• Greater weight loss
• Greater abdominal circumference loss
• Greater body fat mass reduction
• Hunger scores lower
• Greater fasting glucose reduction
• Improved average insulin

Summary: Diurnal Carbohydrate Intake Study

• Improvements in:
  - HOMA(IR)
  - T-cholesterol
  - Low density lipoproteins (LDL)
  - High density lipoproteins (HDL)
  - C-reactive protein (CRP)
  - Tumor Necrosis Factor α (TNF-α)

Results: Blood Parameters

• Experimental Diet modified daily leptin and adiponectin compared to controls.

Summary: Diurnal Carbohydrate Intake Study

Metabolic Triad Nutrition (continued)
Gut Health

Intestinal Influences on Weight Gain

Gut Function

• Primary function - digestion and absorption of nutrients while maintaining a barrier between intestinal contents and blood stream
• Immunity - secretory IgA, Gut associated lymphoid tissue (GALT)
• Flora - number $10^{14}$, over 400 species, aid digestion and immunity
• Peptides/hormones made in gut aid insulin, alter pancreas to presence of glucose, affect blood sugar and appetite regulation

Gut Function

• Houses 70% of immune system from tonsils through intestines
• MALT-lymphatic tissue along mucosal linings
  – Immune cells-T lymphocytes, B lymphocytes, macrophages, dendritic cells
• GALT = Peyer’s patches (recognize antigens)
• Gut flora teach immune cells which antigens are harmful
• Induces “tolerance” against luminal antigens involving SIgA

Intestinal Permeability

• Dependent on the regulation of intercellular tight junctions
• Made from multiple proteins inc. occludin, claudins, junction adhesion molecule (JAM)
• Form a selective seal of the intracellular space regulates passage of ions and molecules through the paracellular space
• Must have rapid response due to diverse challenges epithelial barrier is subjected to.
• TNFα, INFγ and nitric oxide trigger dysfunction

Intestinal Permeability-Zonulin

• Zonulin-reversibly modulates tight junction permeability
• Protects proximal intestine from colonization of microbes (innate immunity)
• Regulates fluid, macromolecules, & leukocytes from intestinal lumen to blood stream and vice versa.
• The gatekeeper of the gut, allows some substances through while not allowing others.
• Upregulation is associated with increased permeability

Intestinal Permeability, Gliadin and Autoimmunity

• Intestinal cells of both celiac and non-celiac patients exhibited increased permeability when exposed to gliadin
• Chronic gliadin exposure resulted in down-regulation of both ZO-1 (zonula occludens-1) and occludin gene expression.
• Loss of the protective function of mucosal barriers is a key element necessary to develop autoimmunity (in gastrointestinal and lung mucosa).


Curr Opin Gastroenterol. 2006;22(6):674-679
Gluten Sensitivity vs. Celiac

- Celiac patients – immune response is transglutaminase autoantibodies
- Gluten sensitivity – GI and other symptoms from gluten but wheat allergy is ruled out
- Immune response in is innate immunity vs adaptive immunity.
- Gluten sensitivity showed increased TLR-2 and AGA IgA and IgG were increased in 50%, but leaky gut and increased IL 6 were not seen.


Intestinal Immunity

- Major Histocompatibility Complex (MHC)
- Human Leukocyte Antigen (HLA) class I and II both located in MHC on chromosome 6
- These genes encode glycoproteins that bind to peptides
- Result= HLA-peptide recognized by T cell receptors in intestinal mucosa
- Susceptibility to over 50 autoimmune disorders are assoc. With HLA I and II alleles

Intestinal Barrier Physiology Long Term
Goal Prevention: of Autoimmunity

- Intestinal epithelium-largest mucosal surface of body
- Interface between external world and host
- Two key functions that govern the relationship: Intestinal permeability and mucosal defense

Probiotics and SCFA

- Probiotics - beneficial gut flora, different strains being ID’d for different effects
- Butyrate - short chain fatty acid produced by probiotics
  - increases gut mucosa cell proliferation
  - decreases apoptosis of intestinal cells
  - keeps immune system activity in check/predicts overactivity

Probiotics

- Increase production of anti-inflammatory cytokines
- Decrease pro-inflammatory cytokines

**Probiotics**

- Hold down inflammation via proper immune cell response to antigens
- Up-regulate beneficial IgA-prevent allergies, inflammation and disease
- Produce SCFAs (like butyrate)
  - fuel for intestinal cells
  - mucus production of goblet cells—prevents lectins from nuts, seeds, legumes and grains (wheat agglutinin) from damaging mucosal lining
  - Promote proper pH of intestines (slightly acidic)—yeast control

**Probiotics**

- Improve mucosal barrier function - suppress growth and invasion of pathogens
- Prevent apoptosis of epithelial cells
- Prevent antibiotic associated diarrhea
- Decreases childhood gastroenteritis
- Increases lactose digestion

**Probiotics and Propionic Acid**

- SCFA-Propionic acid (PA) created by fermentation of dietary fiber in the intestine
- PA stimulated leptin mRNA expression and secretion by OAT and SAT
- PA reduced pro-inflammatory resistin mRNA expression
- May explain dietary fiber’s protective role in obesity, insulin resistance and type 2 diabetes

**Resistant Starch**

- Undigestible starch in foods. Undigestible either due to protected by hulls or structure of the starch (tightly packed amylose or retrograded=cooked and cooled starch.)
- Starch travels to large intestine and is fermented by gut bacteria.
- Upregulates SCFA production in large intestine, especially butyric acid (Cummings JH, AJCN 2001 73(2 S):415S-420S.

**Resistant Starch cont’d**

- Improves insulin sensitivity and bl glu regulation. (Maki KC et al. Poster presentation Experimental Biology Apr 10, 2011.)

**Resistant Starch (RS)**

- Based on early findings may be key to further improved insulin sensitivity and appetite.
- Resistant starch Diets? Promote dramatically increased intake of carbs as source of RS
- Foods that contain highest RS – ie slightly green bananas contain at most 5 g RS per 15 gram serving. Other foods such as potatoes contain only 1. Foods still have a lot of digestible starch.
- Our solution – do carbs on sliding scale of tolerance. Can emphasize foods higher in RS (slightly green bananas, rolled oats, beans/legumes, yams, peas, quinoa, cooked and cooled rice and potatoes)
Strain Specific Functions

- L. plantarum (3 strains of) and 2 strains of L. paracasei found to control C. Diff (Med Microbiol 2004;53:551)
- L GG - improves gut barrier function
- S. thermophillus and L. acidophilus - enhance tight junction proteins and can prevent E.coli (World J Gastroenterol Oct 7, 2006; 12(37):5941-5950)

Factors Influencing Intestinal Flora and Gut Integrity

- Antibiotics
- OC’s/HRT
- Radiation/chemo
- Corticosteroids
- NSAID’s
- Sugar in the diet
- Bactericidal chemicals in drinking water
- Pesticides in food
- Alcohol
- Heavy metals
- H. pylori
- Gastrointestinal pH
- Stress
- Bowel transit time

Factors Leading to Bowel Dysfunction

- Change in beneficial flora due to ABX
- High stress + increased cortisol =
  - hypochloria and poor digestion
  - reduced IgA production
- Poor diet high in sugar, refined flours, alcohol, processed foods
- Yeast overgrowth (Candidiasis) as probiotics die out yeast multiplies
- Decrease in gut enzymes (amount and potency) = poor digestions and nutrient absorption

Antibiotics and Gut Health

- Can wipe out gut flora-dependent on dosage, length of administration
- Studies show profound effects that can last for months
- Yeast overgrowth occurs when good bacteria are lacking

Effects of Yeast on the Gut

- Ferments ingested sugars and starches creating gas and bloating after meals
- Puts out mycotoxins which can:
  - Damage and destroy intestinal cells
  - Dampen immune response of T cells in the gut, preventing normal food substances recognition.
- Crowds out good bacteria which direct production of tight junction proteins
- Produces acetaldehyde which can interfere with mood, mental clarity and can lead to chemical sensitivities.

Yeast and the Endocrine System

- Yeast toxins have a particular affinity for the endocrine organs
- Receptors for both estrogen and corticosteroids, identical to human receptor sites identified on the cell wall of Candida albicans
  - Create hormone masking and mimicry
  - Disrupt the negative feedback to the pituitary
Dietary Link to Yeast Overgrowth

- Women who had increased urinary sugar levels were more prone to vaginal yeast infections.
- Higher urinary sugar levels were linked to higher sugar and dairy intake (perhaps secondary to ABX residues)


Antibiotics from Food Sources

- Antibiotics used in feedlot animals - cause weight gain in animals. (Antibiotics may cause weight gain in humans.)
- Antibiotics used in dairy cattle for infections, enter the milk or foods made with it (non-organic milk.)
- Enter those who drink the milk/consume foods, enough to shift gut flora.
- Both uses increase the problem of antibiotic resistance.

Bowel Dysfunction

- Dysbiosis
- Leaky Gut
- Food allergies

Definition of Leaky Gut

- Loss of tight junction proteins
- Destruction of mucosal barrier
- Influenced by medications, antibiotics, NSAIDS

Allergenic Proteins and Immune Response

- Lack of probiotic colonization in the gut results in immune cell activation
  - Pro-inflammatory cytokines
  - Immune cells mature into antibodies, IgG, IgA, IgE that also produce inflammatory cytokines
  - Inflammatory cytokines = inflammation, contribute to accelerated aging process and chronic disease

Ghoshal UC, Ghoshal U. Trop Gastroenterol. 2007;28(2):45-6

Allergenic Proteins and Food Intolerances

- Many people have compromised gut integrity due to high sugar intake, NSAIDS, alcohol, and antibiotics predisposing them to food sensitivities
- Ability to properly digest wheat and dairy becomes compromised
- Up to 1 in 7 people have gluten intolerance
- Up to 1 in 4 have lactose intolerance
- If intolerant, causes inflammation which can contribute to insulin resistance and weight gain
Food Allergies and Intolerances

- Food allergies trigger immune cell production of inflammatory substances - internal 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 allergies can increase stress hormones production - can contribute to insulin resistance and midsection weight gain or belly fat.


Effects of Flora Shift

- Can lead to immune shifts/increased inflammation
- Immune shifts can result in food allergies and eventually to autoimmunity (e.g., Hashimoto’s thyroiditis)
- Food allergies can also cause food cravings and unbalanced eating habits.
- Lack of beneficial flora and yeast overgrowth in gut can greatly reduce nutrient absorption, many of which are key to weight management.

Allergenic Foods

- 7 foods make up 90% of food allergies
  - Peanuts/Walnuts
  - Shellfish
  - Wheat
  - Cow’s milk
  - Eggs
  - Soy
  - Yeast
- Food Rotation Diets help prevent food allergies and are strongly encouraged by LMI

Aflatoxin

- Primary Sources - foods that grow black mold
- Peanuts - from soil
- Grains - during storage
- Certain strains of probiotic bacteria block intestinal absorption of aflatoxin fungus, thereby leading to reduced urinary excretion of an aflatoxin metabolite associated with liver cancer

Food Allergies- References


Mercury in the Intestines

- Ingested or inhaled mercury inhibits neutrophils and their subsequent TH1 and TH2 cytokine effects which control Candida. Lowered neutrophil activity allows proliferation of candida.
- Candida organisms methylate mercury vapor from the mouth in the intestines and the mouth.
- Candida albicans may trap mercury.
- Candida albicans and its mycotoxins are associated with chronic fatigue and autoimmune disorders.

Mercury and Candida References

- (235) H.J.Hamre, Mercury from Dental Amalgam and Chronic Fatigue Syndrome”, The CFIDS Chronicle, Fall 1994, p44-47.

Assessment Questions

1. Do you have seasonal allergies?
2. Do you often feel mentally foggy?
3. Do you often get bloated and gassy, especially after eating?
4. Do you have chronic sinusitis?
5. Do you have constipation or diarrhea?
6. Do you have a history of taking antibiotics, birth control pills, NSAIDS or steroids?
7. Do you have unexplained chronic conditions, ie headache, joint pain, or depression?
8. Do you have eczema or other skin rash problems?

Supplements for Optimal Gut Health

- Probiotic
- L-glutamine
- IgG powder
- Grapefruit seed extract
- Cat’s claw
- Vitamin D
- High mucin sialic acid
- Zinc carnosine
- Sterols/Sterolins
- Rhodiola or proprietary blend of extracts from magnolia officinalis bark and phellodendron amurense bark for improved stress response

Food Allergies

Most common food allergens

- Wheat and/or wheat gluten - gluten free diets effective for many GI tract disorders and complaints
- Dairy - especially milk and cheeses, yogurt, kefir and buttermilk better tolerated even in lactose intolerance, many people do not tolerate
- Citrus, Corn, Soy, Eggs

Potential Testing

- Simple test is elimination diet.
- Labs tests:
  - OAT test
  - Comprehensive Digestive Stool (DNA)
  - Allergy Panel IgG and IgE
  - Gluten and Gliadin antibodies
  - ANA, TNF alpha, IL6
Diet for Gut Health-Elimination Diet

• Low sugar - sugar promotes proliferation of yeast
• Fermented foods are source of beneficial flora
• High fiber - fructo oligosaccharides promote growth of beneficial flora and SCFA production
• If symptomatic may need elimination diet:
  – Wheat and dairy-most allergenic foods
  – Processed foods-likely to contain traces of wheat and dairy
  – Nitrite and nitrate-containing foods
  – Sugar and all forms of sucrose-containing foods including maple syrup, honey, molasses, brown sugar, etc.

Diet for Optimal Gut Health-Elimination Diet Initial Phase

• Look for breads, crackers, wraps made with alternative grains
• Alternative grains for wheat and wheat flour:
  – Brown rice or white rice (flour)
  – Tapioca or potato (flour or starch)
  – Corn (starch or meal)
  – Sorghum (flour)
  – Bean flours such as chickpea, fava or other bean flours
  – Teff
  – Millet

Diet for Optimal Gut Health-Elimination Diet Initial Phase

• Avoid:
  – Wheat/whole wheat
  – White
  – 100% rye flour (contain gluten)
  – Spelt (gluten)
  – Barley(gluten)

Diet for Optimal Gut Health-Elimination Diet Initial Phase

• Reintroduction after 3 to 6 weeks
  – Choose wheat or dairy to re-introduce (never both at once)
  – Eat a small amount of allergenic food such as a piece of wheat bread, 3 or 4 wheat crackers and note symptoms including:
    • Digestive discomfort such as gas and bloating, runny or stuffy nose
    • Joint aches
    • Rashes
    • Headaches
    • Fatigue
    • Mood changes

Diet for Optimal Gut Health-Elimination Diet Initial Phase

• Alternatives for cow’s milk dairy
  – Choose unsweetened non-dairy milks and milk products including cheeses*, yogurts made from:
    • Rice milk
    • Almond milk
    • Soy milk
    • Hemp milk
    • Coconut milk
    • Goat’s or Sheep’s milk

*Note: most non-dairy cheeses contain casein, the highly allergenic milk protein. Vegan Gourmet makes soy-based cheese products that are casein-free.
Diet for Optimal Gut Health - Elimination Diet Phase 2

- If elimination of wheat does not alleviate symptoms, consider:
  - Elimination of gluten
  - Gluten-containing grains include wheat, bulgar wheat, kamut, spelt, rye, couscous, barley, barley malt, etc.
  - Then assess other highly allergenic foods, eg nuts, eggs, corn, tomatoes, oranges

Diet for Optimal Gut Health - What to Eat

- Organic pastured (grass-fed) meats and eggs
- Organic non-starchy vegetables - at least 6 to 8 servings/day
- Limit starchy veg. such as potatoes, sweet potatoes and corn to 1-2 servings or according to client’s metabolic status.
- Organic fruit in moderation (1-2 servings per day)

Diet for Optimal Gut Health - What to Eat

- Healing fats-organic butter (source of butyrate), coconut oil (contains monolaurin which enhances immunity), EVOO (heart healthy.)
- High fiber foods including beans, legumes, ground flax seed - great source of FOS. (May need to limit due to starch content.) Use Beano if needed.
- Naturally fermented foods made w/o vinegar such as sauerkraut and pickles, goat/sheep’s milk yogurt and/or kefir

Dietary Considerations for Candida Overgrowth (Yeast)

- Low sugar/starch - most important component
- No yeast - more important with incr severity of symptoms
- Yeast fermented foods - ie beer, wine, vinegar. Limited or eliminated depending on severity
- Allergen elimination usually very important in severe yeast/candida patients

Metabolic Code Triad: Components of Diet Portion

- Low carb, high fat and protein
- High emphasis on low-starch plant foods (vegetables, leafy greens)
- Fruits, beans/legumes eaten to tolerance
- Starches - grains, starchy veg’s (corn, peas, potatoes) - usually no more than 1-2 servings/day
- Low allergen diet - wheat and dairy free
- Low refined, processed foods - a whole foods diet (no trans fat, refined sugar)
- Considers food purity - encourages organic foods to avoid pesticide residues, GM foods, antibiotics, growth hormones

Special diets

- Vegetarian -useful even if not completely successful to increase whole foods intake
  - Vegan - no animal products at all, no gelatin or gelatin caps unless from plant sources
  - Lacto-Ovo - will consume milk and eggs
- Need to get all essential A.A.’s, beans and rice, cornmeal and beans are complimentary
High Protein Diets, i.e. Atkins, The Zone Diet

- Encourage decreased carb intake to induce a controlled ketosis for fat burning
- High meat and low carb vegetable intake
- Very little fruit or breads or cereals
- Will induce weight loss in most people.
- Challenges: carb cravings, don’t address food allergies/sensitivities.

High Protein Diets, Paleolithic Diet

- Encourages intake of foods based on typical diet of Paleolithic Era men (pre agriculture).
- High animal protein but wild animals (so lean), fish, vegetables, root vegetables, fruit and nuts. (No processed foods including separated fats/oils, no grains, beans or legumes, no dairy, no added salt.)

Paleolithic Diet

- Paleo diet in Type 2 diab subjects greater improvements in cardiovascular risk factors compared to subject on diab diet (50-60% carb from fruit and whole grains, low fat). However glucose tolerance was no different. (Jonsson, T, et al. Cardiovasc Diabetol. Jul 16 2009; 8:35.)
- Paleo diet improved glucose tol. more than Mediterranean-like diet in people with ischemic heart ds. (Jonsson, LS et al. Diabetologia. 2007;50(9):1795–1807)

Paleolithic Diet – Pros/Con-Challenges

- Achieves lower carb intake, eliminates refined foods. Increases intake of fruits/veg’s.
- Gut health – question maintenance of gut integrity with very low starch and not digging vegetables (source of probiotics.)
- Hard to obtain wild meats to duplicate true Paleo
- Compliance may be very difficult with no added fats, no added salt, no starchy carbs of any kind not even beans.

Vegetarian diets

- Vegetarian – can be useful even if not completely successful to increase whole foods intake
  - Vegan - no animal products at all, no gelatin or gelatin caps unless from plant sources
  - Lacto-Ovo - will consume milk and eggs
- Need to get all essential A.A.’s, beans and rice, cornmeal and beans are complimentary.

Vegetarian, cont’d

- Lots of data to suggest many health benefits for a vegetarian diet which is associated with significantly reduced risks for hypertension, heart disease, cancer (many studies of Seventh Day Adventists)
- Some risk of B12 deficiency or inadequate protein intake if vegan.
- Trendy among teens - not always good vegetarians
- Pseudo-vegetarians - just eat fish or chicken, no red meat
Vegetarian Diets

- Challenges – very high carb, don’t address allergies/sensitivities, B-12 deficiencies do occur, whole grain diets high in anti-nutrients like phytates.

Macrobiotic Diet

- Seven levels - classifies food according to Chinese system of Yin and Yang. Brown rice and herbal teas allowed on every level. Grains, vegetables, fruits, nuts, and seeds make up bulk of the diet. Fish allowed on lower levels. No meat, dairy or processed foods. Seventh level is brown rice only. Dangerous!

Food Combining Diets

- Started by a movement called “Natural Hygiene” started by Herbert M. Shelton
- Based on suppositions that certain digestive enzymes work best at certain pH levels
- Should be called food un-combining
- Basic premises - Eat fruits alone, eat vegetables with starches or proteins, do not combine starches and proteins.
- There are celebrity versions - i.e. Suzanne Somers’ diet books.
- Generally healthy diet as long as do not become fruitarian.
- No harm in finding out if client responds to it.

Blood Type Diet

- Books by Dr. Peter J. D’Adamo Eat Right for Your Type and Live Right for Your Type
- Gives lists of foods for each blood type based on his personal research showing each blood type will develop immune responses to certain foods.
- Type A’s should be vegetarian, Type O’s thrive on animal protein.
- Generally healthy and well rounded food lists. Won’t induce nutrient deficiencies if done right.
- Difficult to fully comply.

Criteria to Evaluate Diets

- Does it provide adequate calories?
- Does it eliminate any food group entirely or eat only one food group?
- Is it based on the “whole foods” concept, meaning recommends unprocessed foods and lots of vegetables, whole grains, and fruit?
- Does it address food sensitivities?

Vegetarian, cont’d

- Lots of data to suggest many health benefits for a vegetarian diet which is associated with significantly reduced risks for hypertension, heart disease, cancer (many studies of Seventh Day Adventists)
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