Objectives

• Define the keto diet
  • History
  • Research
  • Health effect
  • Goals
• Effects on on Diabetes
• Effects on CKD
• Recommendations
• Future
Before we go any further

- No matter what weight loss diet our clients follow, weight loss cannot occur without a calorie deficit!
Keto History

- **Fasting** - The precursor to the ketogenic diet for people with epilepsy
  - Used as a treatment 2500 years ago
  - Harvard University Medical School, 1921 - Dr. Lennox and Dr. Cobb found decreases in epileptic episodes after 2-3 days of fasting

- **Keto Diet**
  - Mayo Clinic 1921 - Dr. Wilder discovered the benefits of fasting can be reproduced with a ketogenic diet
    - Starving the body of carbohydrates instead of macronutrients
  - Today - used as a last resort for controlling seizures due to the difficulty in maintaining the diet
Keto Diet in the modern era

- 1972-Robert Atkins published his first diet book
  - Centered on eating fat and very little carb to induce ketosis...[with] minimum deprivation

- 1976-Robert Linn, D.O. & Dr. Stephen Phinney-Last Chance diet
  - Drink a protein-rich concoction to lose weight
    - Under a physicians supervision to prevent malnutrition
    - 60 people died as a result of heart problems.
    - Despite the lawsuits Phinney went on to create the more nutritionally complete Optifast
1990s-Dan Duchaine-responsible for introducing diet to bodybuilders to “drop fat quickly

2000-rediscovery of Atkins diet

2013-Article published showing
  - Antioxidant and anti inflammatory genes were activated by beta-hydroxybuterate
  - Claiming KD could slow the aging process and prevent
    - Heart disease
    - Alzheimers
    - Cancer
      - Starving cancer cells prevented growth and reduced size of tumors
Ketones

- What are they?
  - Acetone, acetoacetic acid and beta-hydroxybutyric acid from normal metabolic products of lipid metabolism in the liver and oxidized in the muscle

- Carbohydrates
  - Sugars, starches and fibers broken down in the small intestine
Nutritional Ketosis vs Diabetic Ketoacidosis

- **Nutritional Ketosis**
  - Important state allowing body to run on fat for energy
  - Happens when
  - Fat is broken down by the liver
  - Ketone levels between 0.5 and 3 mmol/L

- **Diabetic Ketoacidosis**
  - Dangerous and potentially fatal
  - Happens mostly in T1 diabetics when not enough insulin is administered to bring glucose into cells
  - Body thinks it is starving so it releases ketones at an alarming rate
  - Happens when there is high ketones and high blood glucose
  - Ketone Levels between >5.0 mmol/L
Ketosis testing

- Signs and symptoms
  - Increased Ketones
    - Urine, breath or blood tests performed by a physician, or home testing kits are available
  - Weight Loss
    - During the first few days, usually water weight
  - Thirst
    - Side effect of water loss
    - Can Lead to dehydration & electrolyte imbalance
      - Increases Risk of Kidney Stones
Ketosis signs and symptoms

- Muscle cramps and spasms
  - Dehydration & electrolyte imbalances
- Headaches
  - Related to decrease in sugar & dehydration
- Fatigue and weakness
  - CHO provides quicker bursts of energy
- Stomach complaints
  - Indigestion and constipation
- Changes in sleep
  - May experience difficulty falling asleep or nighttime walking
- Bad Breath
  - Ketones leave the body through breath and urine. Breath may smell sweet/fruity
Keto Recommendations

- **Macros**
  - 70-80% of calories from fat
  - 20-25% Protein
  - 15-20 net carbs per day

- **Net Carbs**
  - Total Carbohydrate per serving minus # grams of fiber
<table>
<thead>
<tr>
<th>Meal Description</th>
<th>Calories</th>
<th>Fat (g)</th>
<th>Carbs (g)</th>
<th>Fiber (g)</th>
<th>Sugar (g)</th>
<th>Protein (g)</th>
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<tbody>
<tr>
<td>KETO COBB BOWL</td>
<td>557</td>
<td>49</td>
<td>7</td>
<td>4.5</td>
<td>2</td>
<td>21</td>
</tr>
<tr>
<td>KETO SHRIMP SCAMPI</td>
<td>420</td>
<td>10</td>
<td>8</td>
<td>2</td>
<td>4</td>
<td>54</td>
</tr>
<tr>
<td>LEMON BAR FAT BOMBS</td>
<td>330</td>
<td>32</td>
<td>10</td>
<td>4</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>SAVORY CHICKEN SAUSAGE EGG MUFFIN</td>
<td>389</td>
<td>30</td>
<td>20.5</td>
<td>12</td>
<td>4</td>
<td>13</td>
</tr>
</tbody>
</table>

1800 kcal Keto Diet meal plan
Keto Recommendations

- **Snacks**
  - high-fat snack such as a bacon strip or some cucumber with avocado mayo

- **General Recommendations**
  - Instead of lean meats,
  - skin-on poultry
  - fattier parts like chicken thighs
  - rib-eye steaks
  - grass-fed ground beef
  - fattier fish like salmon
  - beef brisket or pork shoulder
  - Bacon

- **Vegetables (non starchy)**
  - Leafy greens
  - spinach, kale and lettuce,
  - Broccoli
  - Cauliflower
  - cucumbers
Ketogenic diet and diabetets

- Review of literature shows
  - Weight loss is on par with Low Calorie Diets in those with T2DM
  - Reduction of HbA1C levels
    - Benefits can be achieved in absence of weight loss
  - Reversing Nephropathy
    - By raising blood levels of 3-beta-hydroxybuteric acid and reducing glucose metabolism in the kidneys
- Cardiac benefits
  - Improved cardiac efficiency by 25%
- Lipid Profile
  - Decrease in LDL, TG and increase in HDL
Disadvantages for diabetics

- Patients with T2DM on oral hypoglycemic agents we’re at an increased risk for developing hypoglycemia
  - May need to reevaluate hypoglycemic agents
- Diet could be too extreme
  - May cause unwanted iatrogenic effects
- Bariatric surgery
  - Patients scheduled for bariatric surgery who were put on low carbohydrate ketogenic had increased catabolic state and increased oxidative stress
    - Can have a negative effect on surgical outcomes.
Ketones and Kidneys

- Renal systems serve as a compensatory mechanism in acid base balance.
  - As Ketones increase serum pH lowers
  - Respiratory ventilation changes to accommodate the need to reduce pCO2 (partial pressure CO2)
    - Respirations become deep and labored (Kussmaul's respirations)
- Drop in pH increases risk of kidney stones
- Can have a blood pressure lowering effect in those with CKD
  - Loss of electrolytes
Sustaining Keto diet with Kidney failure

- Increased fluid needs with Keto Diet vs. Fluid restriction for Dialysis patients
- Further restricted diet and confusion

Suggested Keto Fruits (high fat/low carb)
- Avocados
- Apricots
- Peaches
- Berries
  - Strawberries, blueberries, raspberries
- Melons (Cantaloupe, Honeydew, watermelon)

Restricted Keto Fruits
- Bananas
- Apples
- Pears
- Grapes
- Mangoes
- Pineapples
Sustaining Keto diet cont..

- Suggested Keto diet vegetables
  - Cauliflower
  - Cabbage
  - Broccoli
  - Zucchini
  - Spinach
  - Asparagus
  - Kale
  - Green Beans
  - Brussel Sprouts

- Vegetables to avoid on Keto
  - Russet Potatoes
  - Sweet Potatoes
  - Pumpkin
  - Winter Squashes
    - Butternut, Spaghetti squash
  - Carrots
  - Beets
  - Parsnips
  - Corn
  - Peas
Adherence (WHO, 2013)

Diabetic + Renal + Keto Diet?

**T1DM**
- SMBG-26% as recommended
- Insulin-52%-92% as recommended
- Diet-70%-75% non adherence

**T2DM**
- SMBG-33% as recommended
- Medication-15% to 75% took oral hypoglycemic agents as recommended
- Diet-70%-75% non adherence
  - Those with T2DM lose less weight than their non-diabetic counterparts

Dialysis diet
- Up to 75% non-adherence!
- 57% miss one phosphorus binder does per day
Conclusion & Future research

- More research is needed about the long term safety
- Few long term studies of >10 years of ketosis
  - Concerns of heart health
  - Diet is very difficult to follow in the long term for diabetics and CKD
- Short term
  - Weight loss benefits are on par with other weight loss plans
  - Shown benefits in diabetics in adherence of <1 year
  - Little evidence of iatrogenic side effects in CKD
    - Blood pressure should be monitored
    - Hydration should be monitored to prevent Kidney Stones.
Thank You!
Resources

5. http://apps.who.int/medicinedocs/en/d/Js4883e/8.4.4.html#Js4883e.8.4.4
6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3595318/