Optimal Diet for CF: Is the fast food really that bad for our patients?

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Presenter Disclosure

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No Relationships to Disclose
Our Question:

Are diets high in saturated fat, trans fatty acids and polyunsaturated fats detrimental for people with Cystic Fibrosis?
Should we worry that the current prescribed diet will contribute to inflammation and/or heart disease in our patients?
Recommendations for the General Population...
### Types of Fat

<table>
<thead>
<tr>
<th>Red: eat less</th>
<th>Green: eat more</th>
<th>Yellow: moderation</th>
</tr>
</thead>
</table>

#### Saturated
- **Food sources:** Red meat, full fat dairy, palm and coconut oil, cocoa butter

#### Mono-unsaturated
- **Food sources:** Olive oil, high oleic sunflower or safflower oil, avocado, nuts (hazelnut, almond, peanut, macadamia)

#### Polyunsaturated: (Omega-3 and Omega-6)

##### Omega-3
- **Food sources:** Salmon, flax seed, walnuts, canola, walnut oil

##### Omega-6
- **Food sources:** poultry, eggs, cereals, corn safflower, soybean, peanut oil

#### Trans fat:
- **Food sources:** Hydrogenated margarines, commercial baked goods

#### Fatty Acid Structure

![Saturated Fat](image)

![Monounsaturated Fat](image)

![Polyunsaturated Fat](image)

![Hydrogenated Fat](image)
Relationship Between Diets and Inflammatory Processes

- Inflammation is likely an important component in the pathophysiology of many chronic diseases, including type 2 diabetes, Alzheimer’s disease, and many types of cancers
- The Mediterranean diet (increased ratio of Mono-unsaturated fatty acids to Saturated fatty acids and \( \omega-3 \) to \( \omega-6 \) fatty acids) has shown anti-inflammatory effects when compared with a typical North American and Northern European diet

(Galland, L; 2010)
Mediterranean Diet Food Pyramid
Diet Composition in Cystic Fibrosis: Is there a concern?

136 food diaries were analyzed in 27 children

- **High proportion of calories from fat**
  - Mean calorie contribution from fat was 38% (recommendation is 40% for CF)

- **High proportion of fat from Saturated fat**
  - Mean Saturated fat consistently contributed greater than 134% of reference nutrient intake
  - Mean Poly unsaturated fat intake was 92%

(Smith et al; 2012)
Role of Inflammation in Cystic Fibrosis
Pathogenesis of Lung Disease in Cystic Fibrosis

- Defective CF gene
- Defective/deficient CFTR
- Abnormal airway surface milieu
- Bronchial obstruction
- Infection
- Inflammation
- Bronchiectasis

Davis & Konstan, AJRCCM 2000
Factors Affecting Inflammation in Cystic Fibrosis

- Low Glutathione levels
- Defective fatty acid metabolism
  - ↓ linoleic and DHA levels, ↑ arachidonic acid levels
- Diet
  - high proportion of Saturated fat, Trans fat, and Omega 6 fatty acids
What is the evidence?
Supplementation with linoleic (omega-6) fatty acids increased fatty acid derangements in CF knock out but not wild type mice.

Elevated Omega 6 acid levels were associated with increased secretion of IL-8 and increased neutrophil infiltration in the airways of CF mice.

(Zaman et al; 2010)
<table>
<thead>
<tr>
<th>First Author; Year</th>
<th>Number</th>
<th>Type</th>
<th>Intervention</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Henderson; 1994</td>
<td>12</td>
<td>Randomized Control</td>
<td>ω-3 vs olive oil</td>
<td>6 weeks</td>
</tr>
<tr>
<td>Keen; 2010</td>
<td>35</td>
<td>Randomized Control</td>
<td>3 groups: ω -3, ω-6, and SFA</td>
<td>3 months</td>
</tr>
<tr>
<td>Lawrence; 1993</td>
<td>16</td>
<td>Randomized Control</td>
<td>ω-3 vs olive oil</td>
<td>6 weeks</td>
</tr>
<tr>
<td>Panchaud; 2006</td>
<td>17</td>
<td>Randomized Control</td>
<td>EFA supplements vs Placebo</td>
<td>6 months</td>
</tr>
</tbody>
</table>
Omega 3 Fatty Acid Supplementation Trials

Results:
- All were randomized control trials including both adults and children
- No reported deaths
- Adverse events included
  - steatorrhea, requiring enzyme adjustment
  - diarrhea occurred and caused subjects to withdraw in both treatment and placebo groups
  - Some experienced abdominal pain (treatment vs control group not specified)
Omega 3 Fatty Acid Supplementation Trials

Results:

- One study found a significant improvement in FEV1 and FVC in the omega-3 fatty acid treated group vs the placebo group (Lawrence et al; 1993)
- Two studies found improved fatty acid status within cellular membranes in the treatment group (Keen et al; 2010) (Panchaud et al; 2006)
- One study found a decrease in inflammatory markers in the treatment group (Keen et al; 2010)
Conclusions:

- Supplementation with omega-3 fatty acids may provide some benefit for people with CF with limited side effects.
- However, there is insufficient evidence to support the recommendation of omega 3 fatty acid supplements in CF patients.
- If patients wish to use omega 3 fatty acid supplements it is recommended that they take no more than the recommended dose and increase their pancreatic enzymes.
Cardiovascular Disease in CF
Dyslipidemia in Adults with CF

- Retrospective review
- N = 334
- PS patients were more likely than PI patients to have total cholesterol of greater than 201 mg/dl
- 5% had TG levels > 195 mg/dL
- Lipid profiles were similar between diabetics and non-diabetics
- Total cholesterol and TG both increased with age and increasing BMI
- Authors recommended monitoring fasting lipids in CF patients especially those with PS, older age, and high BMI

(Rhodes et al, 2009)
Dyslipidemia in Adults with CF

- Retrospective review
- N= 221
- Mean age 30 ± 10 years
- TG levels were increased in CF patients in the 30-39 yr age group compared to controls
- Total cholesterol levels were lower in CF patients compared with control subjects across all age groups

(Georgiopoulou et al, 2010)
Cardiovascular Risk in Cystic Fibrosis

- **We know:**
  - Lipid abnormalities exist
  - Cardiovascular complications are uncommon

- **Questions remain:**
  - What is the significance of isolated hypertriglycerideridemia and risk for cardiovascular disease?
  - What are the clinical implications of the increasing exposure of CF patients to cardiovascular risk factors (inflammation, hypertriglycerideridemia, DM)?
Bottom Line

- It is unknown whether diets high in saturated and trans fatty acids are harmful for people with CF
- Diets high in antioxidants/anti-inflammatory foods may be helpful
Is following an anti-inflammatory diet achievable while following a high calorie diet?
Anti-Inflammatory Diet

Well balanced meals:

- **↑ Foods high in omega-3 fatty acids**
  - Walnuts, ground flaxseed/oil, dark green vegetables, salmon, sardines

- **↑ Foods high in antioxidants**
  - Red/yellow/orange vegetables, dark leafy greens, green & black tea, citrus fruits, allium vegetables

- **↑ Foods high in fiber**
  - Whole grain breads and cereals

- **↑ Spices & herbs**
Fatty Acid Intake in the General Population

- “North American/Northern European diet”
  - Ratio (omega 3:omega 6) may be more important than quantity
    - Current average 1:16 ratio
    - Evolution of diet from 1:1 ratio
    - Optimal ratio currently thought to be ≤ 1:4 ratio
Omega-6 Fatty Acids

- Poly unsaturated fat acid
- Food sources
  - Palm, rapeseed, sunflower, corn, and soybean oil
  - Avocado
- Typically food sources provide more than adequate intake daily
Omega-3 Fatty Acids

- Poly unsaturated fatty acid
- Types
  - Alpha-linolenic acid (ALA)
    - seeds, vegetable oils (canola, flaxseed, and soybean), green leafy vegetables, nuts, and beans
  - Eicosapentaenoic acid (EPA) & docosahexaenoic acid (DHA)
    - salmon, mackerel, herring, and tuna, and algae oils
Omega 3 Fatty Acid Supplements

- Capsule or oil form
- Safety
  - Generally Recognized as Safe by FDA
  - No standardized testing in the U.S.
- Recommended dosing
  - 1000 mg/day
## Supplement Profile

<table>
<thead>
<tr>
<th></th>
<th>Fish oil</th>
<th>Flax seed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fat composition</strong></td>
<td>Rich in EPA and DHA</td>
<td>Rich in ALA and lignans</td>
</tr>
<tr>
<td><strong>Preparation</strong></td>
<td>Capsule or oil</td>
<td>Ground meal or oil</td>
</tr>
<tr>
<td><strong>Dosing</strong></td>
<td>~ 1000 mg/day</td>
<td>1 tsp ground flaxseed = 1.6 gms</td>
</tr>
<tr>
<td></td>
<td>Generally recognized as safe per FDA</td>
<td>Generally recognized as safe per FDA</td>
</tr>
</tbody>
</table>
Diet Make Over
# High Calorie Diet

<table>
<thead>
<tr>
<th></th>
<th>Breakfast</th>
<th>Lunch</th>
<th>Snack</th>
<th>Dinner</th>
<th>Snack</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 frozen waffles with 1 Tbsp butter &amp; ¼ c. syrup, 2 eggs scrambled, 1 c. cup orange sections, 8 fl. oz whole milk w/ CIB packet</td>
<td>Cheese burger, French fries, 2 Tbsp ketchup, 1 c. carrot sticks, 2 Tbsp ranch dressing, 8 fl oz whole milk</td>
<td>Smoothie with 1 c. vanilla ice cream, 1 c. frozen strawberries, 4 fl oz orange juice, 1 scoop whey protein powder</td>
<td>3 slices pepperoni pizza, 8 fl. oz whole milk, 2 cups salad w/ 2 Tbsp ranch dressing and ½ avocado</td>
<td>Ice cream sandwich: ½ cup vanilla ice cream and 2, 2” chocolate chip cookies</td>
</tr>
<tr>
<td>Calories:</td>
<td>4253</td>
<td>1032 kcals</td>
<td>1022 kcals</td>
<td>1463 kcals</td>
<td>225 kcals</td>
</tr>
<tr>
<td>Total Fat:</td>
<td>228</td>
<td>39 gms</td>
<td>51 gms</td>
<td>78 gms</td>
<td>13 gms</td>
</tr>
<tr>
<td>ω-3:ω-6 FA profile:</td>
<td>1:8</td>
<td>1:7</td>
<td>1:9</td>
<td>0:0</td>
<td>1:8</td>
</tr>
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<tr>
<td>Yogurt parfait: ½ cup granola, 1 oz walnuts, 1 Tbsp ground flaxseeds, 1 c. 2% fat Greek yogurt, ½ cup blueberries, 8 fl. oz orange juice</td>
<td>10” flour tortilla wrap w/ 4 oz turkey, 3 oz cheddar cheese, 2 Tbsp hummus, ½ avocado; 2 oz roasted pecans; medium apple, water</td>
<td>Smoothie: 1 c. 1% milk, 3 Tbsp almond butter, 1 med banana, 1 Tbsp honey</td>
<td>4 oz baked salmon with ½ cup brown rice, 2 c. spinach salad, with ¼ avocado and 1 Tbsp EVOO + 1 Tbsp vinegar, 8 fl oz 1% milk</td>
<td>Trail mix: 1 oz salted almonds, 1 oz walnuts, 1 oz pistachios, 1 oz dried cherries, and 2 oz dark chocolate</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Calories: 4,203</th>
<th>711 kcals</th>
<th>1379 kcals</th>
<th>566 kcals</th>
<th>684 kcals</th>
<th>862 kcals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Fat: 253</td>
<td>27 gms</td>
<td>94 gms</td>
<td>29 gms</td>
<td>39 gms</td>
<td>63 gms</td>
</tr>
<tr>
<td>ω-3:ω-6 FA profile: 1:3</td>
<td>3.4:1</td>
<td>1:12</td>
<td>1:166</td>
<td>1:1.5</td>
<td>1:53</td>
</tr>
</tbody>
</table>
Challenges with a diet make over

- Challenges:
  - Increased fullness and satiety
  - Decreased variety
  - Cost
  - Food availability
Summary

- Concern exists regarding the prescribed CF diet and the potential pro-inflammatory effect and cardiovascular disease impact.
- There is evidence that the North American and Northern European diets produce an increase in inflammation, which may be a contributing factor to the increased incidence of chronic disease.
- The Mediterranean diet may provide a benefit with reducing inflammation, however, implementation of the diet may pose some challenges.
References