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

Presenter Disclosure

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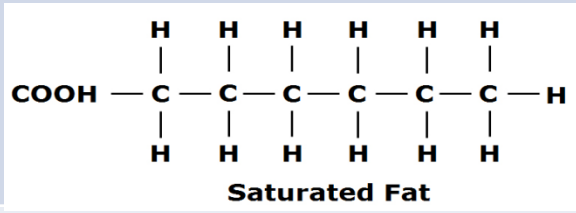
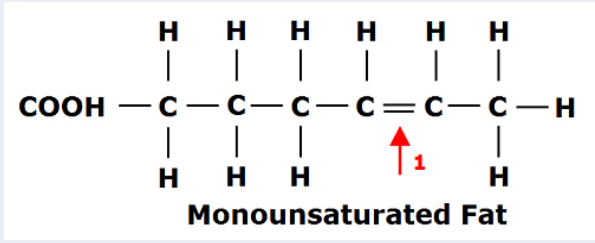
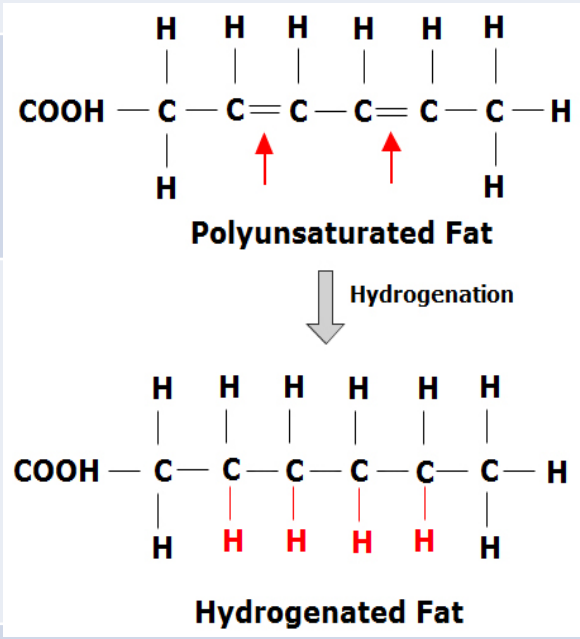
No Relationships to Disclose

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?

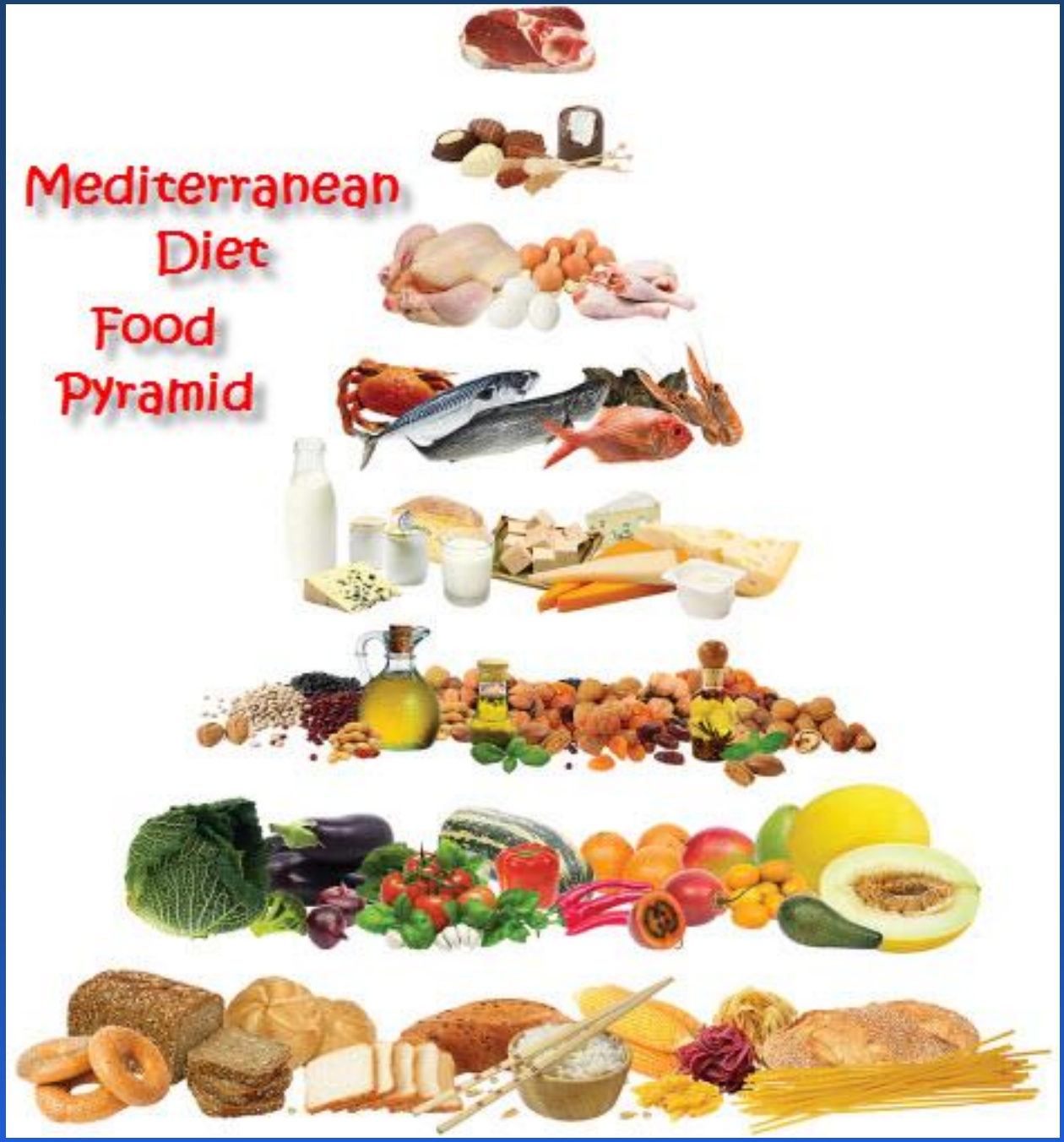
Recommendations for the General Population…

Types of fat Red: eat less Green: eat more Yellow: moderation	Food sources	Fatty acid structure
Saturated	Red meat, full fat dairy, palm and coconut oil, cocoa butter	
Mono-unsaturated	Olive oil, high oleic sunflower or safflower oil, avocado, nuts (hazelnut, almond, peanut, macadamia)	
Polyunsaturated: (Omega-3 and Omega-6)		
Omega-3 **Omega-6**	Salmon, flax seed, walnuts, canola, walnut oil poultry, eggs, cereals, corn safflower, soybean, peanut oil	
Trans fat:	Hydrogenated margarines,	

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 ω-3 to ω-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?

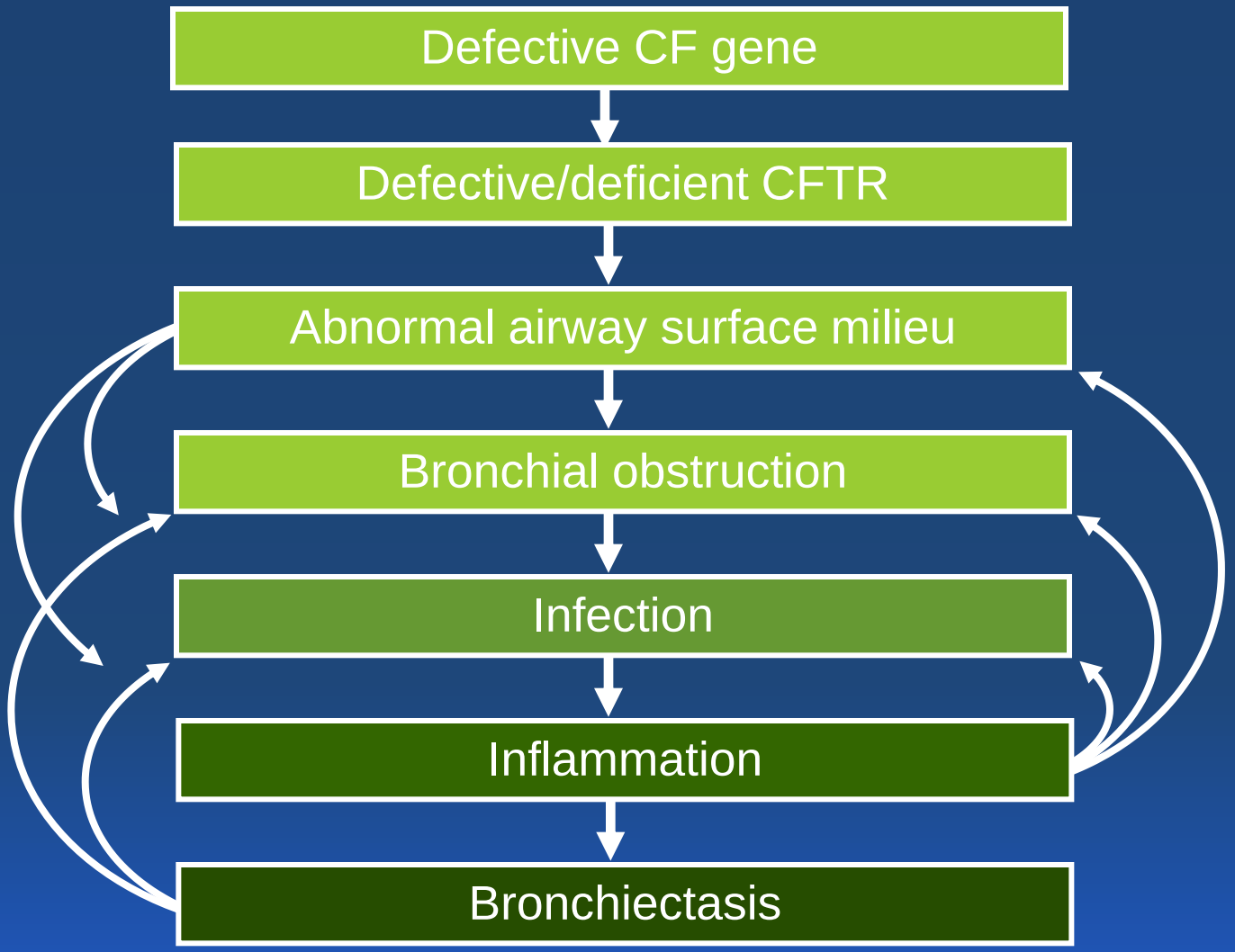
136 food diaries were analyzed in 27 children

- 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

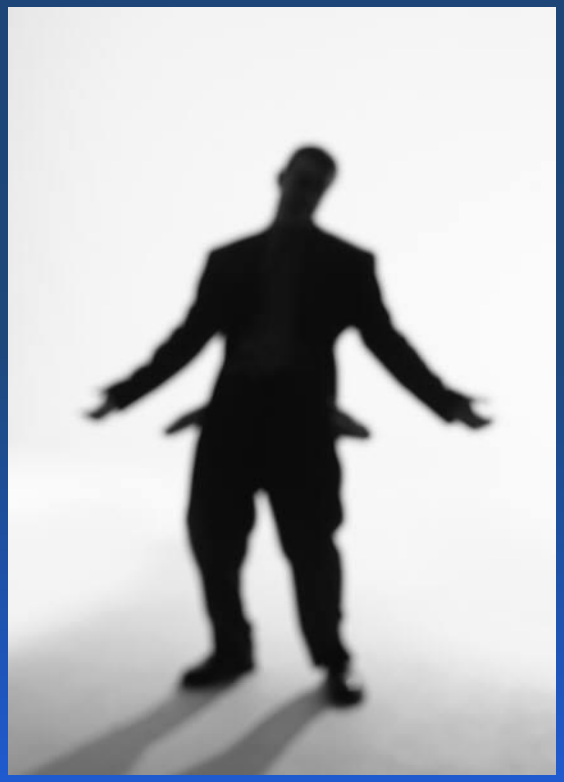


Davis & Konstan, AJRCCM 2000

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?



Current Literature

- 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)

Omega 3 Fatty Acid Supplementation Trials

First Author; Year	Number	Type	Intervention	Duration
Henderson; 1994	12	Randomized Control	ω-3 vs olive oil	6 weeks
Keen; 2010	35	Randomized Control	3 groups: ω -3, ω-6, and SFA	3 months
Lawrence; 1993	16	Randomized Control	ω-3 vs olive oil	6 weeks
Panchaud; 2006	17	Randomized Control	EFA supplements vs Placebo	6 months

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)

Omega 3 Fatty Acid Supplementation Trials

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 then 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 hypertriglyceridemia and risk for cardiovascular disease?
- What are the clinical implications of the increasing exposure of CF patients to cardiovascular risk factors (inflammation, hypertriglyceridemia, DM) ?

Bottom Line

- It is unknown whether diets high in saturated and trans fatty acids are harmful for people with CF
- Diets high in antioxidents/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 that quantity
    - Current average 1:16 ratio
    - Evolution of diet from 1:1 ratio
    - Optimal ratio currently thought to be $\leq$ 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

	Fish oil	Flax seed
Fat composition	Rich in EPA and DHA	Rich in ALA and lignans
Preparation	Capsule or oil	Ground meal or oil
Dosing	~ 1000 mg/day	1 tsp ground flaxseed = 1.6 gms
	Generally recognized as safe per FDA	Generally recognized as safe per FDA

Diet Make Over

High Calorie Diet

	Breakfast	Lunch	Snack	Dinner	Snack
	2 frozen waffles with 1 Tbsp butter & ¼ c. syrup, 2 eggs scrambled, 1 cup orange sections, 8 fl. oz whole milk w/ CIB packet	Cheese burger, French fries, 2 Tbsp ketchup, 1 c. carrot sticks, 2 Tbsp ranch dressing, 8 fl oz whole milk	Smoothie with 1 c. vanilla ice cream, 1 c. frozen strawberries, 4 fl oz orange juice, 1 scoop whey protein powder	3 slices pepperoni pizza, 8 fl. oz whole milk, 2 cups salad w/ 2 Tbsp ranch dressing and ½ avocado	Ice cream sandwich: ½ cup vanilla ice cream and 2, 2” chocolate chip cookies
Calories: 4253	1032 kcals	1022 kcals	510 kcals	1463 kcals	225 kcals
Total Fat: 228	39 gms	51 gms	20 gms	78 gms	13 gms
ω-3:ω-6 FA profile: 1:8	1:7	1:9	0:0	1:8	0:0

High Calorie Diet Make Over

	Breakfast	Lunch	Snack	Dinner	Snack
	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	10” flour tortilla wrap w/ 4 oz turkey, 3 oz cheddar cheese, 2 Tbsp hummus, ½ avocado; 2 oz roasted pecans; medium apple, water	Smoothie: 1 c. 1% milk, 3 Tbsp almond butter, 1 med banana, 1 Tbsp honey	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	Trail mix: 1 oz salted almonds, 1 oz walnuts, 1 oz pistachios, 1 oz dried cherries, and 2 oz dark chocolate
Calories: 4,203	711 kcals	1379 kcals	566 kcals	684 kcals	862 kcals
Total Fat: 253	27 gms	94 gms	29 gms	39 gms	63 gms
ω-3:ω-6 FA profile: 1:3	3.4:1	1:12	1:166	1:1.5	1:53

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

- Galland, L. Diet and Inflammation. *Nutr Clin Pract*. 2010;25:634-640.
- Georgiopoulou V, Denker A, Bishop K, Brown J, Hirsch B, Wolfenden L, Sperling L. Metabolic abnormalities in adults with cystic fibrosis. *Respirology*. 2010 Jul;15(5):823-9. Epub 2010 May 20.
- Henderson WR Jr, Astley SJ, McCready MM, Kushmerick P, Casey S, Becker JW, Ramsey BW. Oral absorption of omega-3 fatty acids in patients with cystic fibrosis who have pancreatic insufficiency and in healthy control subjects. *J Pediatr*. **1994** Mar;124(3):400-8.
- Keen C, Olin A, Eriksson S, Ekman A, Lindblad A, Basu S, et al. Supplementation with fatty acids influences the airway nitric oxide and inflammatory markers in patients with cystic fibrosis. *Journal of Pediatric Gastroenterology and Nutrition* 2010;**50**(5):537–44.
- Lawrence R, Sorrell T. Eicosapentaenoic acid in cystic fibrosis: evidence of a pathogenetic role for leukotriene B4. *Lancet* 1993;342 (8869):465-9.
- Panchaud A, Sauty A, Kernan Y, Decosterd LA, Buclin T, Boulat O, et al. Biological effects of a dietary omega-3 polyunsaturated fatty acids supplementation in cystic fibrosis patients: A randomised, crossover placebocontrolled trial. *Clinical Nutrition* 2006;**25**(3):418–27.
- Peretti N, Marcil V, Levy E. Mechanisms of lipid malabsorption in cystic fibrosis: the impact of essential fatty acid deficiency. Nutr Metab 2005,2:11. doi: 10.1186/1743-7075-2-11
- Rhodes B, Nash EF, Tullis E, Pencharz PB, Brotherwood M, Dupuis A, Stephenson A. Prevalence of Dyslipidemia in Adults with Cystic Fibrosis. *J Cyst Fibros*. 2010 Jan;9(1):24-8. Epub 2009 Oct 29.
- Simopoulos AP. The importance of the ratio of omega-6/omega-3 essential fatty acids. Biomed Pharmacother 2002,56:365-79.
- Smith C, Winn A, Seddon P, Ranganathan S. A fat lot of good: balance and trends in fat intake in children with cystic fibrosis. *J Cyst Fibros*. 2012 Mar;11(2):154-7. Epub 2011 Nov 25.
- Tisset H, Bernard H, Bartke N, Beermann C, Flachaire E, Desseyn JL, Gottrand F, Husson MO. (n-3) long-cahin PUFA differentially affect resistance to *pseudomonas aeruginosa* infection of male and female cftr $^{-/-}$ mice. J Nutr 2011,141:1101-1107.
- Tomkins, A. Assessing micronutrient status in the presence of inflammation. J Nutr 2003,133:1649S-1655S.
- Zaman M, Martin C, Andersson C, Bhutta A, Cluette-Brown J, Laposata M, Freeman S. Linoleic acid supplementation results in increased arachidonic acid and eicosanoid production in CF airway cells and cftr -/- transgenic mice. *Am J Physiol Lung Cell Mol Physiol 299: L599-L606. 2010.*