A major goal of our nutritional research endeavors is to slow the progressive loss of visual function and preserve usable sight until a reliable treatment or cure is found for your disease.

Although you may not qualify for various clinical trials, you can do your part by controlling your diet and nutrition; you may slow the progression of your disease.

Biological variability…
- Same gene mutation…different disease severities
- Members of the same family with same gene mutation
  - Disease progression varies
- Gene modifiers
- Environment (e.g., smoking, sunlight)
- Diet
  - Influence gene expression
  - Different metabolic rates
  - Process nutrients differently

Retina Nutrition Resources
- **FFB** web pages:
  - Eye on the Cure Blog
  - [http://www.blindness.org/research-news](http://www.blindness.org/research-news)
- **Retina Foundation of the Southwest** web pages (Resources):
  - [http://retinafoundation.org/resources/#additional_info](http://retinafoundation.org/resources/#additional_info)

- In the US, the Recommended Daily Intake for nutrients is determined by the USDA.
- Sufficient to meet the requirements of 98% of healthy individuals.

- Those with Retinal Degenerations fit that 2%
- In general “what’s good for your heart, is good for your eyes.”
  - 1) fruits (berries), vegetables, kale & collard greens
  - 2) healthy oils (soy, canola, olive…low ω6, high ω3);
  - 3) eat fish at least twice a week;
  - 4) for the healthy individual, a balanced diet is the key.

Typical WESTERN DIET: fast food, junk food, packaged foods, snacks, & is low in fruits, vegetables, grains, seafood, & poultry.
- favors ω6 fatty acid
- ω6 (pro-inflammatory) & ω3 fatty acids (anti-inflammatory)
  - Assess ω6/ω3 balance
  - RBC fatty acid profiles… index of body’s status
  - OmegaQuant ([http://www.omegaquant.com/faq-for-omega-3-index/](http://www.omegaquant.com/faq-for-omega-3-index/))…DRH has no COI.
  - ω6 & ω3 fatty acids in foods on RFSW webpage.

Lifestyle changes: sunglasses, exercising, & smoking.
- Disclaimer: consult physician or ophthalmologist about foods & supplements; identify any to avoid.

- FOR RP: 15,000 IU/day Vitamin A palmitate, 1-2 servings cold-water fish /week (salmon, tuna, mackerel, halibut, herring, or sardines) containing DHA or supplement 200 mg DHA / day and 12 mg lutein
- Yearly blood liver function tests
- Avoid 400 IU Vitamin E SUPPLEMENTATION; ~40 IU is fine

**Stargardt’s disease**
- Patients with AbcA4 gene mutation avoid Vitamin A SUPPLEMENTATION
Genotyping for patients with clinical characteristics of macular degeneration (Best Disease, Cone-Rod Dystrophy, early AMD)

Some patients with recessive RP have AbcA4 gene mutation.

**Age-related Macular Degeneration (AMD)**

- Slow risk of AMD progression:
  - 400 I.U. Vitamin E, 10 mg lutein, 2 mg zeaxanthin, 500 mg Vitamin C, 80 mg Zinc oxide, 2 mg Cupric oxide.
  - AMD Patients who SMOKE should avoid beta-carotene

**Western Diet**

- Goal is to prolong shelf-life of foods and increase profits by reducing healthy ingredients such ESSENTIAL FATTY ACIDS.
- These GOOD FATS are polyunsaturates needed for important structural & functional roles but are susceptible to oxidation so manufacturers eliminate the polyunsaturates from their foods.
- Oils rich in ω6 fatty acids used for cooking and are overloaded Western Diet with ω6.

- Dietary ratio of ω6 to ω3 in our foods in US is 16-to-1 vs ω6/ω3 ratio in Japan of 4:1; target is 2:1.
- The Japanese consume about 25 oz of fish per week compared to an average of 5 oz per week in the US.

**Natural sources of Omega-3 Fatty Acids:**

- α-Linolenic acid (ALA) is an ESSENTIAL FATTY ACID as the body cannot make the ω3 bond.
  - About 1% is converted to biologically active EPA and DHA
- ALA in soybean oil, canola oil, walnuts, flaxseeds & chia seeds

- US Dietary Reference Intake for ALA is 1.1 g/day (women); 1.6 g ALA/day (men)
  - ~½ oz/day English & black walnuts; ~¼ tablespoon/day flaxseed oil; ~6 oz/day olive oil
Dietary Long-chain ω3 polyunsaturated fatty acids:
- EPA and DHA enriched in salmon, tuna, mackerel, rainbow trout, herring, halibut, & sardines.
- Fish consume algae that make the ω3 fatty acids.
- DHA is highly enriched cell membranes of our brain & retina
- For a list of DHA in Foods (see RFSW webpage)

DHA Recommendations of Expert Panels
For healthy adults:
- 500 mg DHA & EPA/day Acad of Nutri & Dietetics & ISSFAL
- 250 mg DHA/day WHO & EFSA
  o (Deckelbaum et al. Am J Clin Nutr 2008)

Average Daily Intake of DHA in the US:
- 70 mg DHA per day (and 35 mg EPA)
- Compared to 620 mg DHA/day in Japan (also 360 mg EPA/d)
  o (Suzuki et al. 2004 Br J Cancer).

Recommendations for Fish Consumption
- 2 fish meals per week (cold water, fatty fish) to potentially achieve an intake of 500 mg DHA+EPA per day
  o (http://www.ajcn.org/cgi/reprint/83/6/S1526.pdf)

- Mercury in Fish (see RFSW webpage)

- Farmed vs Wild Salmon:
  - Farmed: more fat, more saturated fat but more ω3. Wild salmon…fewer calories. Toss up.
  - Farmed: more organic pollutants & antibiotics. Wild salmon may have more mercury.
  - Best bet for nutritional value: Wild salmon.
Sources of DHA (& EPA) Supplements to Consider (DRH has no COI):
Fish oil, liquid and capsules:
- “Carlson” is a quality brand
- Nordic Naturals “Ultimate Omega Xtra” is a liquid with 2000 mg EPA and 1000 mg DHA per teaspoon (relatively decent taste!)
- DSM Nutritional Products: brand name is “LifesDHA” (was Martek) algal DHA oil…It typically provides 200 mg DHA per 500 mg capsule. Used in Berson and RFSW clinical trials
- “OmegaVia” produces high quality, concentrated, cost-effective DHA and EPA capsules

From the Literature: DHA supplementation in X-linked RP Trial
4-year randomized, placebo-controlled clinical trial with 30 mg DHA/kg bodyweight/day with 60 participants with early-stage XLRP
- Participants received btwn 600 and 3600 mg DHA/day
- Increased DHA from 3% to 10% of total RBC fatty acids
- Did not improve cone ERG function or visual acuity
- At 30 mg/kg/day, the loss of visual field sensitivity was reduced by 55% (p<0.0001)
- At 17% RBC-DHA, the loss of field sensitivity may be completely eliminated (45 mg DHA/kg/day)…CAUTION these are extrapolated results.

Safety: 30 mg/kg/d x 4 years with XLRP minimum adverse events (intolerable in one participant with Crohn’s disease)
- X-linked Rett syndrome study using 70mg DHA+120mg EPA/kg/d x 12 months, no adverse events.

Publications: Primary outcome: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4795002/

- Ratio of 1:1:1 of L:Z:mZ optimizes neuroprotection in the retina
- Antioxidants scavenge free radicals generated by BLUE light
- Lutein per cup (kale=24mg, spinach=20mg, collard greens=15mg, & turnip greens=12mg)
- L, Z & mZ in natural food sources; greater bioavailability
From the Literature:
- Correlations were found for lutein intake, macular pigment optical density & improved visual function (meta-analysis of 1176 patients; 20 mg L / day) (Liu et al IOVS 2014)
- Correlations found for serum lutein and cognitive function (Kelly et al. J Alzheimers Dis. 2015)… currently CREST trials in Ireland with 10mg L / 2mg Z / 10mg mZ/day x 12 months
- Clinical Trial RESULTS: 40 mg L / day x 9 wks then 20 mg L / day x 17 wks… improved visual fields of participants with retinal degenerations, p=0.038 (Dagnalie et al. Optometry 2000)

Antioxidants & Neuroprotectants:
- Saffron (Italian species) improved ERG function in patients with early AMD (Bisti et al. Vis Neurosci 2014)
  - N-Acetyl Cysteine Amide (NACA): potent antioxidant, anti-inflammatory, anti-apoptosis (cell death; human cell cultures)
  - Bilberry extract (anthocyanins inhibited apoptosis in rabbit model; Wang et al. Molecules 2015)
  - Curcumin (turmeric; spice of the ginger family) neuroprotection in animal models of Alzheimer’s & RP
  - Grape extract preserved retinal function after oxidative stress in mice (Patel et al. Nutrition 2016)
- Table of Antioxidants in 3100 Foods (M Carlsen et al 2010)
  - http://www.biomedcentral.com/content-supplementary/1475-2891-9-3-S1.PDF
    - Japanese green tea = 1347 mmol /100g (3 oz)
    - Sangre de Grado (S. Am Dragon’s blood) = 2897
    - Pomegranate = 55
    - Green mint leaves = 142
    - Bilberries = 8 to 48
    - Grape seed extract = 216

Anti-inflammatory actions of ω3 FAs
- DHA & EPA metabolized to neuroprotectins & recoverins
- Anti-oxidant, Anti-apoptotic, Anti-inflammatory