NUTRITION AND GENETICS IN RETINAL HEALTH

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Professor Emeritus of Optometry and Vision Science, UAB
Optometry's Meeting 2019

Fact or Fiction?
- Nutritional supplements don't really work
- Only selected patients with dry AMD benefit from taking AREDS formula supplements
- All supplement formulations are essentially the same
- The evidence on macular pigment is weak
- Vitamins are completely safe
- Meso-zeaxanthin is a crucial carotenoid
- Taking Centrum Silver is generally enough for our AMD patients
- AREDS2 is better than AREDS1
- Only AMD patients benefit from nutritional supplements

How important is vision?
- The average person with 20/40 vision in the better-seeing eye was willing to trade 2 of every 10 [remaining] years of life in return for perfect vision,
- while the average person with CF vision in the better eye was willing to trade approximately 5 of every 10 remaining years of life in return for perfect vision.


What is AMD?
- Degenerative retinal disease that can cause central vision loss and blindness
- The leading cause of severe vision loss in people older than 50 years in the western world, and is becoming more prevalent with aging of baby boomers
- 2 forms
  - Non-neovascular (Dry)
    - 80%-90% of AMD patients
  - Neovascular (Wet)
    - 10%-20% of AMD patients
    - Responsible for 90% of vision loss

Disclosures – Leo Semes 2019
- Honoraria: Ameitek, EyePromise, Maculogix, Regeneron, Shire, Zeiss.
- Consultant: Maculogix, EyePromise.
- Stock Shareholder: HPO, ZeaVision (unexercised options; ownership < 0.01%)
- Grant/Research Support: OptoVue
**AMD STAGING REVIEW**

Derived from the AREDS Studies

**AREDS Staging**

Category 1
- No or few drusen (<63 microns*), no pigment abnormalities, neither eye wet
- 0% risk of wet at 5 yrs

Category 2
- Intermediate drusen (<125 microns*), mild pigment abnormalities, neither eye wet
- <2% risk of wet at 5 yrs

*Note: Central retinal vein is approximately 125 microns


**AREDS Staging**

Category 3/Intermediate
- Combo of extensive intermediate or any large druse, or GA
- 16% risk of wet in 5 yrs

Category 4/Advanced/High Risk
- One eye with wet or BCVA worse than 20/32 from Dry


**Natural Course of AMD**

- Classification of age-related macular degeneration

[Diagram showing normal to late AMD stages]

**Natural Course of Wet AMD**

Without treatment, chance of severe vision loss and legal blindness is high

Significant chance of 2nd eye becoming affected
- Annual rate of 4%-12%
- Unilateral neovascular AMD becomes bilateral in >40% at 5 yrs

As population ages, more people will have wet AMD: approximately 7.5 million in developed countries by 2020

NEI projections for the USA

<table>
<thead>
<tr>
<th>Eye Disease</th>
<th>Current Estimates</th>
<th>2020 Projections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Age-Related Macular Degeneration</td>
<td>1.9 (in millions)</td>
<td>2.9 (in millions)</td>
</tr>
<tr>
<td>Glaucoma</td>
<td>2.2</td>
<td>3.3</td>
</tr>
<tr>
<td>Diabetic Retinopathy</td>
<td>4.1</td>
<td>7.2</td>
</tr>
<tr>
<td>Cataract</td>
<td>20.5</td>
<td>30.1</td>
</tr>
</tbody>
</table>

*Another 7.3 million people are at substantial risk for vision loss from AMD*

Treatment

- Most treatment research has focused on neovascular AMD
- Anti-VEGF therapy has driven a paradigm shift in neovascular AMD therapy
  - Pegaptanib (Macugen)
  - Ranibizumab (Lucentis)
  - Bevacizumab (Avastin)
  - Aflibercept (Eylea) [VEGF Trap-Eye]

Reactive vs Proactive Approach

Majority of articles and research regarding AMD pertains to Wet AMD
Not enough attention paid to prevention and early detection

78yo Female
Veau vision OS 20/200
VA: 20/60 OD
S/P Avastin

AMD Risk Factors

**Non-Modifiable**
- Age (chronological)
- Gender
- Hereditary: Genetics
- Race/Pigmentation

**Modifiable**
- Smoking
- Cardiovascular disease
- Alcohol intake
- Light exposure
- Nutrition
- MPOD

MPOD = macular pigment optical density
How important is vision?


  **Vision and quality-of-life.**

  - B.C. Brown

    - Objectives: To assess the relationship of ocular health with quality-of-life.
    - Design: This cross-sectional, population-based, mailed survey of 2,046 respondents, aged 18 and older, was conducted to determine the relationship between ocular health and quality-of-life. The primary outcome of this study was the quality-of-life (QOL) score, which was calculated using the Short Form-12 (SF-12) Health Survey.
    - Results: The QOL score was negatively associated with the number of ocular symptoms reported. The number of ocular symptoms was also associated with the number of health-related quality-of-life (HRQOL) domains.

How important is vision?


  **Visual function and quality-of-life.**

  - B.C. Brown

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Quiz time: A little trivia

- “Let food be thy medicine and medicine be thy food”

  - Is attributed to whom among the following?
    - A. Socrates
    - B. Isosceles
    - C. Hippocrates
    - D. Aristotle

Quiz time: A little trivia

- “Let food be thy medicine and medicine be thy food”

  - Is attributed to whom among the following?
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    - D. Aristotle
Role of nutrition in ocular disease

- Poor nutrition has been associated with
  - Inflammation
  - Oxidative stress
    - Which may potentiate Obesity
  - All of which may increase the risk for cardiovascular disease

All the above are likely associated with AMD

Pioneering Clinical Study of supplementation for AMD

- Oral zinc in macular degeneration. (1988)
  - 155 subjects
  - AMD stabilization

- Conclusion
  - High dose zinc was reported to reduce the rate of visual acuity in patients with AMD after a follow-up of 2 to 24 months.

Fewer letters lost & improvement in disease appearance.


A 7-course meal

and 2 of the four food groups: beer, chips, pizza, hamburgers

You are what you eat

(and so is your macula)
What was the zinc dosage (mg)?

- 25
- 50
- 75
- 100

What was the zinc dosage (mg)?

- 25
- 50
- 75
- 100

What is the RDA/RDI for Zinc?

AREDS Design

Composition of the AREDS Formula

**Antioxidants**
- 500 mg vitamin C
- 400 IU vitamin E (= 280 mg)
- 15 mg beta-carotene (25,000 IU)

+ 80 mg zinc (+ 2 mg copper to prevent anemia)

AREDS Results at 5 Years

For patients in AREDS categories 3 and 4:

- Risk of progression to exudative AMD
  - Placebo: 28%
  - Antioxidants: 23%
  - Zinc: 22%
  - Antioxidants + Zinc: 20%

- Risk of ≥15-letter vision loss
  - Placebo: 29%
  - Antioxidants: 26%
  - Zinc: 25%
  - Antioxidants + Zinc: 23%

Keep these four groups in mind


AREDS: Demographic Data

- Category 1
  - No or few drusen (<50 microns), no pigment abnormalities, neither eye wet
  - 0% risk of wet in 5 yrs
- Category 2
  - Intermediate Drusen (126-250 microns), mild pigment abnormalities, neither eye wet
  - <2% risk of wet in 5 yrs
- Note: Central retinal vein is approximately 125 microns

AREDS Demographics cont.

- Category 3/Intermediate
  - Combo of Extensive infl. or any Large drusen, or GA
  - 18% risk of wet in 5 yrs
- Category 4/Advanced/High Risk
  - One eye with Wet or BCVA worse than 20/32 or BCVA worse than 20/50 in the other eye
  - >42% risk of wet in 5 yrs

Questions regarding patient guidance regarding nutrient supplementation.

- What is the evidence for patients who have advanced AMD?
- What is the evidence for patients who have early AMD?

More AREDS Results

- Dietary lutein/zeaxanthin intake inversely associated with
  - NV AMD
  - Geographic AMD
  - Large or extensive intermediate drusen


Dietary antioxidants and AMD risk—corroborating evidence (Rotterdam Study)

- Results (4170 followed; 560 incident AMD @ 8-yr F/U)
- High dietary intake of vitamin E (whole grains, vegetable oils, eggs, nuts) and Zinc (meat, poultry, fish whole grains, dairy) was protective
- Above-median intake of C, E, beta-carotene (carrots, kale, spinach), and Zn lowered risk ~ 35%

Conclusion (Rotterdam Study)

“Dietary anti-oxidants may delay the development of early AMD and, possibly, of AMD in general.”

Van Lente, L, et al. 2001; 262(26): 3101-7
AREDS report #23

“...dietary -3 long-chain polyunsaturated fatty acid intake is associated with a decreased risk of progression from bilateral drusen to GA.”

[Reference: AREDS, 2019]

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THE IMPORTANCE OF MACULAR PIGMENT

AND GENETICS

Enter Lutein and Zeaxanthin

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Macular Pigment Optical Density

- The 2 macular pigments are from yellow and orange carotenoids (L&Z), + MesoZ
- L&Z unable to be synthesized by humans
- Accumulation can protect RPE and photoreceptors
- MesoZ is synthesized from Lutein
- in the eye
- Lower MPOD associated with lower carotenoid intake/seum levels, females, smoking, diabetes, increased BMI....AMD
- Measurable


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Omni-3 is Associated with Reduced Risk of AMD

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Atrophic AMD Nutrition/Visual Function Trials

- Falsini Study – 2003
- LAST – April 2004 (1-year data)
- TOZAL – February 2007 – open case control
- LUXEA – February 2007 and April 2006 (1-year data)
- LUNA – April 2007
- LAST II – May 2007
- CARMIS – Feb 2008 (2-year data)
- Lutein in normal subjects July 09 Brit J Nutr
- ZVF – S. Richer: November 2011

AREDS 2 is not formally evaluating Macular Pigment


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Techniques for Measuring Macular Pigment Optical Density

- HFF- Heterochromatic flicker photometry – (gold standard)*
- MacuScope®
- QuantEye®
- SLO-based methods – HRA (scanning laser ophthalmoscope/Heidelberg retinal tomograph)
- Reflectometry
- Raman Spectroscopy – (absorbance re-emission)
- Fluorescence attenuation

*1 degree 460nm/440nm (filtering stimulus centrally and 7 degrees eccentrically)

[Courtesy Photomicrograph Courtesy of New Sandoz, PhD]
Zeaxanthin

- Relatively minor component of higher green plants
- Very limited data for zeaxanthin content of foods
- Zeaxanthin has an extra conjugated double bond, compared with lutein, which may make it a better antioxidant*

Lutein

- Found in most fruits and vegetables
- Role of lutein well known in plants
- Beta-carotene and lutein are predominant carotenoids found in higher green plants
- 8 possible isomers, only 1 is found naturally*

Lutein

- Western diets low in lutein2
  - NHANES adults: 6-1 mg/day
- How much lutein is thought to be an adequate level?
  - No current RDA or RDI amount
  - 10 mg studied in ARDS2
- How much lutein in Centrum Silver?
  - 1 mg/tablet
- How much lutein is safe?
  - Water soluble
  - No toxicity or side effects observed in elderly on 10 mg for 6 months3

Effect of Lutein and Zeaxanthin: Early AMD

- ZVF Study (builds on LAST study)
  - 60 older adults (57 men, 3 women) with mild-to-moderate AMD
  - randomized to zeaxanthin 8 mg, lutein 9 mg, or zeaxanthin 8 mg plus lutein 9 mg
  - Results: central foveal 1° MPOD increased in all 3 groups from low-normal to normal density
    - Zeaxanthin: high contrast central visual acuity improvements
    - Lutein: low contrast visual acuity improvements, glare recovery
  - Performance Benefit: Improved driving performance

Effect of Lutein + Zeaxanthin - Advanced AMD risk reduction

The Third Carotenoid: Meso-Zeaxanthin (MZ)

- MZ key carotenoid in the macula
  - Proven to increase MP via supplements
  - Enzyme conversion of lutein
  - Strong antioxidant
- Found in small amounts in some shrimp exoskeleton, fish skin, turtle fat
- Not in American diet...hence, some believe supplementation is needed
- Still controversial (but is synthesized from lutein in the eye)
FAST FORWARD TO AREDS 2 (2013)

AREDS 2 randomization

Primary Analysis – All Treatment Groups

18% Additional Risk Reduction by replacing Beta-carotene with L/Z
#1 Take-Home Message (AREDS 2)

Patients aged 50-85 years who are at high risk for progression of AMD, especially those who do not eat well, should use a supplement that contains 10 mg lutein, 2 mg zeaxanthin, and no beta-carotene

- L/Z was associated with additional reduction in risk for progression, beyond the original AREDS supplement:
  - By 28% in patients with low dietary intake of L/Z
  - By 18% L/Z vs beta-carotene

Beta-carotene did not affect the risk for progression and significantly increased the risk for lung cancer


Other Take-Home Messages

- Omega-3 was neither effective nor ineffective

- The 25-mg dose of zinc did not reduce the risk for side effects

(The role of supplementation in earlier stages of AMD and in primary prevention was not addressed in AREDS2)


2013 - Dawn of Genotype-Guided supplementation selection

- Analysis of 2258 white patients in AREDS who had category 3 AMD in at least 1 eye

- Results support individualized selection of supplements based on genotype — examples:
  - C250A genotype: Treatment with antioxidants alone, rather than the AREDS formulation, may reduce 10-year progression rate by 56%
  - C302A genotype: Treatment with zinc alone may reduce progression by 28%
  - C160A genotype: Treatment with antioxidants alone may reduce progression by 29%

Arch CC et al. Ophthalmology. 2013 Aug;20 (Epub ahead of print)

Genetic Tests Commercially Available

- Macula Risk from ArcticDx
- RetnaGene from Sequenom (not yet available for OBs)
- AMD Risk Assessment from Asper Ophthalmics
- University laboratories
Macula Risk Score

Risk of Progressing to Advanced AMD by 80 Years of Age

1 of 5 different categories that correlate to the patient's risk of developing AMD that progresses to vision loss.

Table 1. Anticipated Improvement in Progression Rate with Genotype-Optimized Puff-Puff among Individuals with CHD and ARMS2 Risk Alleles

<table>
<thead>
<tr>
<th>Market*</th>
<th>Antioxidants + Zinc</th>
<th>Antioxidants Alone</th>
<th>Zinc Alone</th>
<th>Progression Difference at 10 Years (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHF</td>
<td>0</td>
<td>45.8</td>
<td>11.7</td>
<td>21.7</td>
</tr>
<tr>
<td>ARMS2</td>
<td>0</td>
<td>45.8</td>
<td>11.7</td>
<td>21.7</td>
</tr>
</tbody>
</table>

Zinc alone or antioxidants alone can be HARMFUL depending on your genetic profile (compared to A + Z).

Selected supplements with promise*

- Resveratrol
- EGCG – epigallocatechin gallate
- CoQ-10 (ubiquinone)
- Vitamin D

* Information is preliminary; none has been scrutinized scientifically. Among humans in RCTs.
Resveratrol

- Attributes – antioxidant activity
- Systemic
- Ocular

- Dosing
- 10-50 mg / day

Resveratrol

- Sources – red grapes, cranberries, blueberries, wine
- Dosing - 10-50 mg / day

*Total Resveratrol Content of Wines and Grape Juice*

<table>
<thead>
<tr>
<th>Beverage</th>
<th>Total resveratrol (mg/liter)</th>
<th>Total resveratrol in a 5-oz glass (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White wines (Spanish)</td>
<td>0.05-1.80</td>
<td>0.01-0.27</td>
</tr>
<tr>
<td>Rosé wines (Spanish)</td>
<td>0.47-7.52</td>
<td>0.08-0.53</td>
</tr>
<tr>
<td>Red wines (Spanish)</td>
<td>1.92-12.59</td>
<td>0.99-6.89</td>
</tr>
<tr>
<td>Red wines (global)</td>
<td>1.98-7.13</td>
<td>0.30-1.97</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red grape juice (Spanish)</td>
<td>1.14-8.69</td>
<td>0.17-1.30</td>
</tr>
</tbody>
</table>

Calculating: 1.9 mg/5 oz glass ± 5 glasses @ 10mg.
1.9 mg/5 oz glass ± 26 glasses to achieve 50 mg !!!

- [http://pi.oregonstate.edu/infocenter/phytochemicals/resveratrol/](http://pi.oregonstate.edu/infocenter/phytochemicals/resveratrol/)

Resveratrol

- Dosing - 10-50 mg / day

Vitamin D

- Postulated mechanisms as protective against AMD (NHANES III)
- Anti-inflammatory (as anti-oxidant; e.g. reduced CRP)
- Anti-angiogenic

- Milk and Fish intake showed inverse relationship with Early and Late AMD as well as drusen and pigment abnormalities

Prevalence of drusen was significantly lower among people in the highest quintile of serum vitamin D level.

EGCG – epigallocatechin gallate

- Emerging evidence from the laboratory

Zhang B, Osborne NN. Oxidative-induced retinal degeneration is attenuated by epigallocatechin gallate. Brain Res. 2009;1254:176-87


CoQ-10 (ubiquinone), et al.

- N = 106 randomized to Tx / Placebo; 12-months

- Decrease in drusen-covered area (example)


73 yo White Male 1/16/2007

- Followed for 2+ years for dry AMD

- Taking 6 mg Lutein/day + Centrum Silver

- And a host of medications

- BCVA 20/40+, 20/40+

- Drusen and pigment changes in each macula
01/16/2007 20/40 20/40

Is there anything else that might be useful to reduce risk for vision loss at this point?

Photos courtesy of Leo P. Serves, OD

01/09/2008 20/60 20/60

Positive Amsler (wavy lines temporal and inferior OD)

What would you do now?

Photos courtesy of Leo P. Serves, OD

04/14/2009

I woke up in the middle of the night and I couldn’t see the middle number on the digital clock with my right eye.

Photos courtesy of Leo P. Serves, OD

Note significant RPE disruption

Photos courtesy of Leo P. Serves, OD

WHAT WOULD YOU DO NOW?

Underdiagnosis of early AMD

Published online April 27, 2017.
Table 1. Five-Year Rate of Developing Advanced AMD in AREDS Participants by Drusen Size and Degree of Pigmentary Abnormalities

<table>
<thead>
<tr>
<th>Drusen Size</th>
<th>Pigmentary Abnormalities</th>
<th>Pigmentary Abnormalities</th>
<th>Pigmentary Abnormalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>None</td>
<td>One Eye</td>
<td>Both Eyes</td>
</tr>
<tr>
<td>None</td>
<td>0.4% (410/100)</td>
<td>0% (0/44)</td>
<td>12.5% (18/145)</td>
</tr>
<tr>
<td>Intermediate drusen</td>
<td>5.5% (348/65)</td>
<td>5.6% (320/57)</td>
<td>12.2% (8/65)</td>
</tr>
<tr>
<td>Intermediate drusen</td>
<td>2.1% (41/147)</td>
<td>12.4% (6/50)</td>
<td>20.4% (20/145)</td>
</tr>
<tr>
<td>Large drusen one eye no large drusen</td>
<td>3.0% (112/38)</td>
<td>10.3% (172/169)</td>
<td>25.6% (320/17)</td>
</tr>
<tr>
<td>Large drusen both eyes no large drusen</td>
<td>13% (222/20)</td>
<td>27.8% (48/176)</td>
<td>47.3% (152/317)</td>
</tr>
</tbody>
</table>

AMD = age-related macular degeneration, AREDS = Age-Related Eye Disease Study.

AREDS Clinical Severity Scale for AMD

![Graph showing age-related eye disease clinical scale for age-related macular degeneration (AMD), demonstrating the 5-year risk of developing advanced AMD for various risk groups. AREDS = Age-Related Eye Disease Study.]

Prolonged Dark Adaptation Is NOT a Risk Factor for AMD

- Genetic testing and macular pigment density (MPOD) can indicate a heightened risk for developing AMD, but neither indicates the actual presence of disease.

- Impaired dark adaptation is NOT a risk factor.

- It IS the earliest manifestation of disease.

Early Symptoms of AMD

- Night vision impacted in early disease: >20 studies

- AMD patients often give up driving at night

- Night vision is impaired before day vision

- Difficult to determine whether night vision is impaired because of AMD or aging

AAO Preferred Practice Pattern® for AMD

- History:
  - An initial history should consider the following elements:
    - Symptoms
    - Metamorphopsia
    - Decreased vision
    - Scotoma
    - Photopsia
  - Difficulties in dark adaptation
  - Medication and nutritional supplement use
  - Ocular history
  - Medical history
    - Family history, especially family history of AMD
    - Social history, especially a quantitative smoking history
How AdaptDx® Works

DA impairment extends across the entire macula.

The stimulus location shown is the first and most severely affected by AMD.

This is where the AdaptDx tests

AMD Causes Major Impairment of Dark Adaptation

Extended Test: ≤20 minutes

AMD Causes Major Impairment of Dark Adaptation

Rapid Test: ≤6.5 minutes

Extended Test: ≤20 minutes
ALSTAR Study

Prospective Study of Subclinical AMD
Sample consisted of 325 adults without clinically detectable AMD. At baseline, 24% of the subjects exhibited impaired dark adaptation. AMD status determined at 3-year follow-up visit.

ALSTAR Study Results
- Impaired dark adaptation identifies subclinical AMD at least three years before it can be seen with other methods.
- Subjects with impaired dark adaptation were 2\times likely to develop clinically evident AMD and 8\times likely to advance beyond the earliest stage of AMD.

Case Example 3: 67 WM

Normal rod-intercept “R/C break” 4.1 min. (OS)

Why the asymmetry?
- OCT-angiography (OCT-A) gives the answer
**X-sect through macula-ONH axis**

Enhanced HD Line
Right/OS

Note area above ONH with demonstrable RPE loss and prominence of choroidal vasculature. AMD, absence of superficial as well as deep retinal capillary plexuses. Compare with OCT X-section showing thinned retina.

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**Is AREDS Formula Ideal?**

- **Beta-carotene:**
  - Numerous studies have demonstrated little or no effect from beta-carotene alone.
  - Smokers most at risk for AMD, but cannot take vitamin A (beta carotene).

- **Xanthophyll carotenoids:**
  - Lutein and zeaxanthin missing and evidence for benefit exists.

- **Omega-3:**
  - Numerous articles pointing to benefits.
  - Benefits of fatty acids through diet.

- **Zinc:**
  - Amounts may be excessive.


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**AMD risk factors**

- Family history
- CVD (gdp)
- Race, Gender
- UV Exposure
- Smoking
- Obesity
- High fat diet & diet of oils
- Nutrition & supplementation

Lifestyle issues that can be altered

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**What is our role as Optometrists?**

- Not likely to be administering injections or other treatments, unless topical.
- Even with potential topical treatments, our emphasis must be on prevention, think prevalence.
- How can we help our patients?
  - Ask questions
    - Open-ended
    - Disseminate accurate information
  - Recommend proper nutrition, whether via diet or supplements, or both.


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**Query Patient’s Lifestyle**

How is your diet?
Do you smoke?
How often do you eat fish?
What is your family history of AMD?
How often do you drink wine?
Describe your lifestyle, activity, exercise, meals.
How well do you think you see?
One other dietary influence

"Heavy drinking (four or more drinks daily) at baseline was related to the 15-year cumulative incidence of pure geographic atrophy in men (odds ratio, 9.2; 95% confidence interval, 1.7 to 51.2).

There were no consistent associations with the amount of beer, wine, or liquor consumption and the incidence or progression of AMD.

Alcohol consumption is unlikely to strongly influence the risk of AMD."

Relation of Smoking, Drinking, and Physical Activity to Changes in Vision over a 20-Year Period

The Beaver Dam Eye Study

Conclusions: Three modifiable behaviors—smoking, drinking alcohol, and physical activity—were associated with changes in vision. Further evidence that changes in these behaviors will result in less loss of vision is needed because of the expected increase in the burden of VA due to the aging of the population. Ophthalmology 2014;121:9-18 2014 by the American Academy of Ophthalmology.

Recommendations to reduce the risk of Type 2 diabetes

- If it . . .
  - is refined,
  - comes in a box,
  - is white (ex., cauliflower),
  - comes with a pop top,
  - contains high amounts of omega-6 fatty acids,
  - doesn’t require at least a few minutes to prepare,

- Don’t eat it!


Advice to patients (the three things to avoid)
Advice to patients
(three “food” sources to avoid)

What does that leave?
Wine and certain chocolates

- Chocolate consumption is associated with reduced risk of MI and
- Enhances mental acuity

What does that leave?

Chocolate intake is associated with better cognitive function: The Maine-Syracuse Longitudinal Study

Correspondence to
Dr Suzanne C Lenner, Unit of Nutritional Epidemiology, Institute of Environmental Medicine, Karolinska Institute, Stockholm 171 77, Sweden; suzanne.lennar@ki.se
Received: 18 December 2015 Revised: 8 February 2016 Accepted: 11 February 2016

Results: The results from eligible studies were combined using a random-effects model. During follow-up (1998–2010), 4417 MI cases were ascertained in the Swedish study. Chocolate consumption was inversely associated with MI risk. Compared with non-consumers, the multivariate relative risk for those who consumed ≥4 4 servings/week of chocolate was 0.87 (95% CI 0.77 to 0.98) for trend < 0.04. Five prospective studies on chocolate consumption and ischemic heart disease were identified. Together with the Swedish study, the meta-analysis included six studies with a total of 6851 ischemic heart disease cases. The overall relative risk for the highest versus lowest category of chocolate consumption was 0.90 (95% CI 0.82 to 0.97), with little heterogeneity among studies (P=0.76).

Conclusions: Chocolate consumption is associated with lower risk of MI and ischemic heart disease.

Original Article

Chocolate consumption and risk of myocardial infarction: a prospective study and meta-analysis
Suzanne C Lenner, Agneta Rosén, Bruno Sigurdsson,3 7 Anna Wall4

Abstract
Chocolate is commonly consumed and is commonly considered a delicacy. Chocolate consumption has been shown to provide nutritional benefits, but its association with myocardial infarction (MI) remains unclear. The objective of this study was to investigate the association between chocolate consumption and MI risk. The study included five prospective cohort studies from four countries. The prospective cohort studies were: the Swedish Mammography Cohort, the Danish Diet, Cancer and Health Study, the Copenhagen City Heart Study, the EPIC-Norfolk study, and the Zutphen Elderly Study. Chocolate consumption was assessed at baseline and was measured in terms of frequency of consumption (i.e., daily, weekly, or less than weekly) and type of chocolate (dark, milk, or both). The association between chocolate consumption and MI risk was examined using a random-effects model. The results showed a reduced risk of MI with increasing chocolate consumption. The relative risk (RR) for chocolate consumption compared with no chocolate consumption was 0.69 (95% CI 0.58 to 0.81) for daily consumption, 0.82 (95% CI 0.69 to 0.99) for weekly consumption, and 0.87 (95% CI 0.77 to 0.98) for less than weekly consumption. These findings suggest that chocolate consumption may have a protective effect against MI.
CF = cocoa flavonoids

Several reference items
- AOA recommendations
- USDA MyPlate
- Food babe
- Linus Pauling Institute

AOA’s Bottom-line Recommendations

Contemporary Dietary Patterns:
The recommendations
- Emphasis on proportional quantities of vegetables & whole grains to replace some animal protein
- Some dairy
- Includes equal portions of fruits & proteins
  - lean meats, poultry, fish, beans, eggs, and nuts
  - low in saturated fats, trans fats, sodium, and
  - reduce added sugars.
Food content resource

• Food babe

www.foodbabe.com

Micronutrient resource

• Linus Pauling Institute at Oregon State University

http://pi.oregonstate.edu/confcenter/

Thank you