EGG XANTHOPHYLLS AND HEALTH

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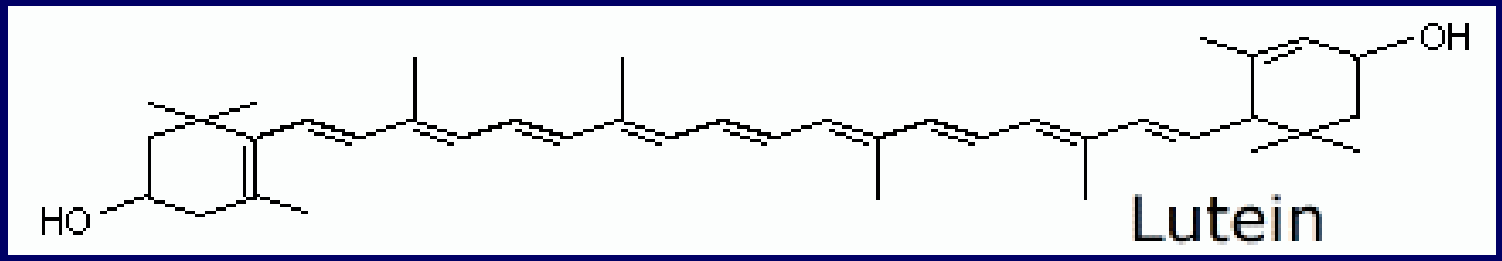
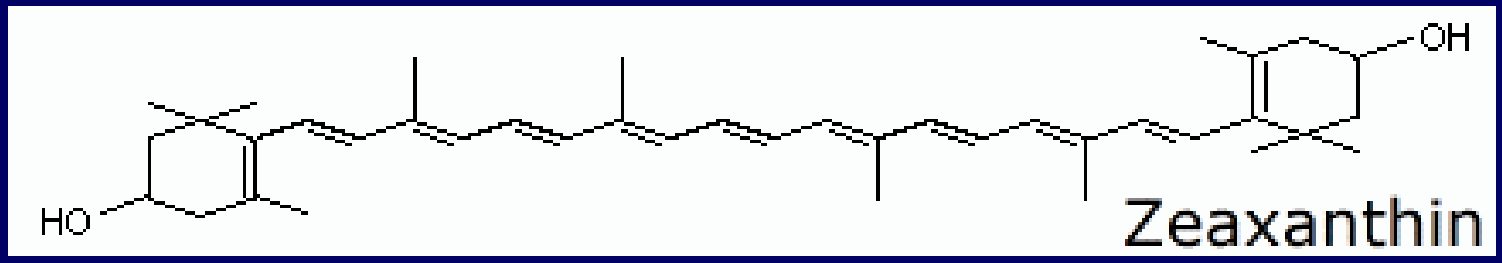
XANTHOPHYLLS IN EGGS



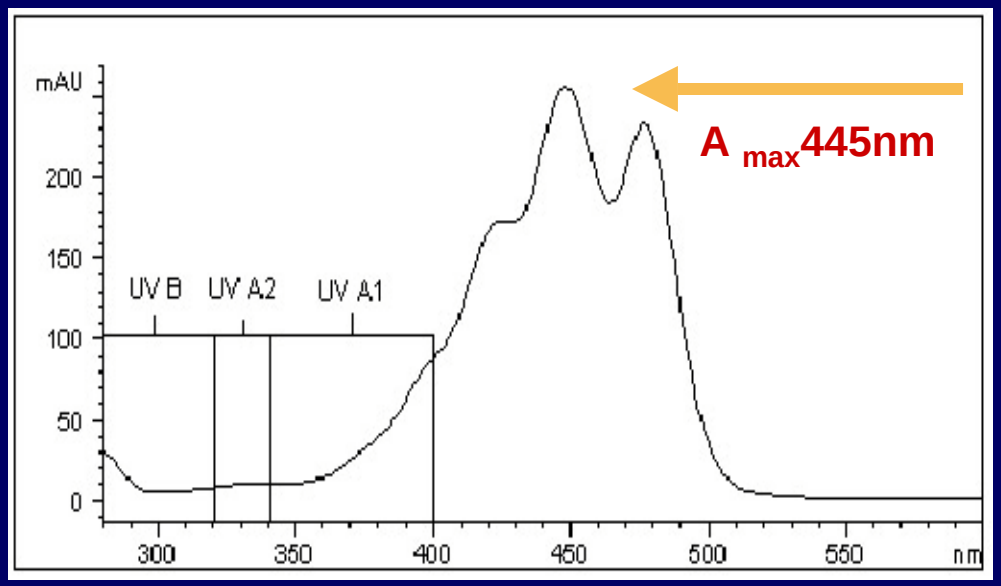
Lutein

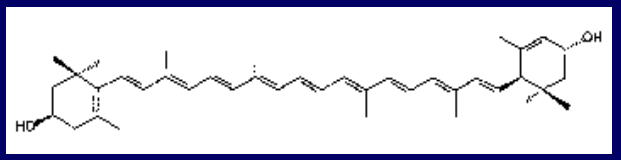


Zeaxanthin

- Present in plasma and various tissues.
- Not Vitamin A precursors.
- Antioxidants and UV - blue light filters.
- Only carotenoids concentrated in the eye.

LUTEIN ABSORPTION SPECTRUM





440nm=high-energy blue light

Ultraviolet **Infrared**

XANTHOPHLLS & HEALTH

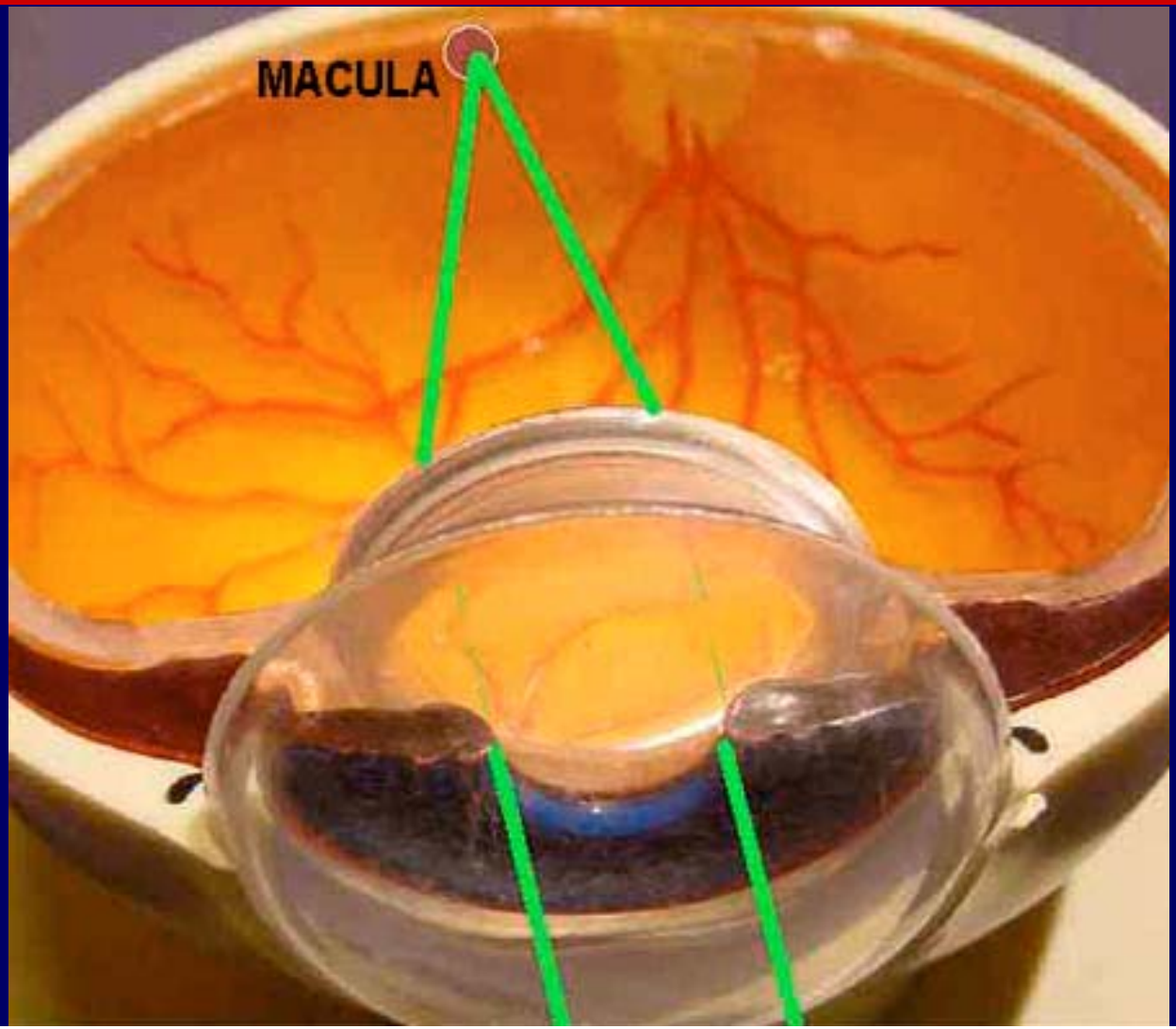
High plasma levels of lutein related to:

- Lower risk of age-related macular degeneration (AMD)
- Lower risk of cataract extraction
- Lower risks for some types of cancers
- Lower risk of atherosclerotic progression

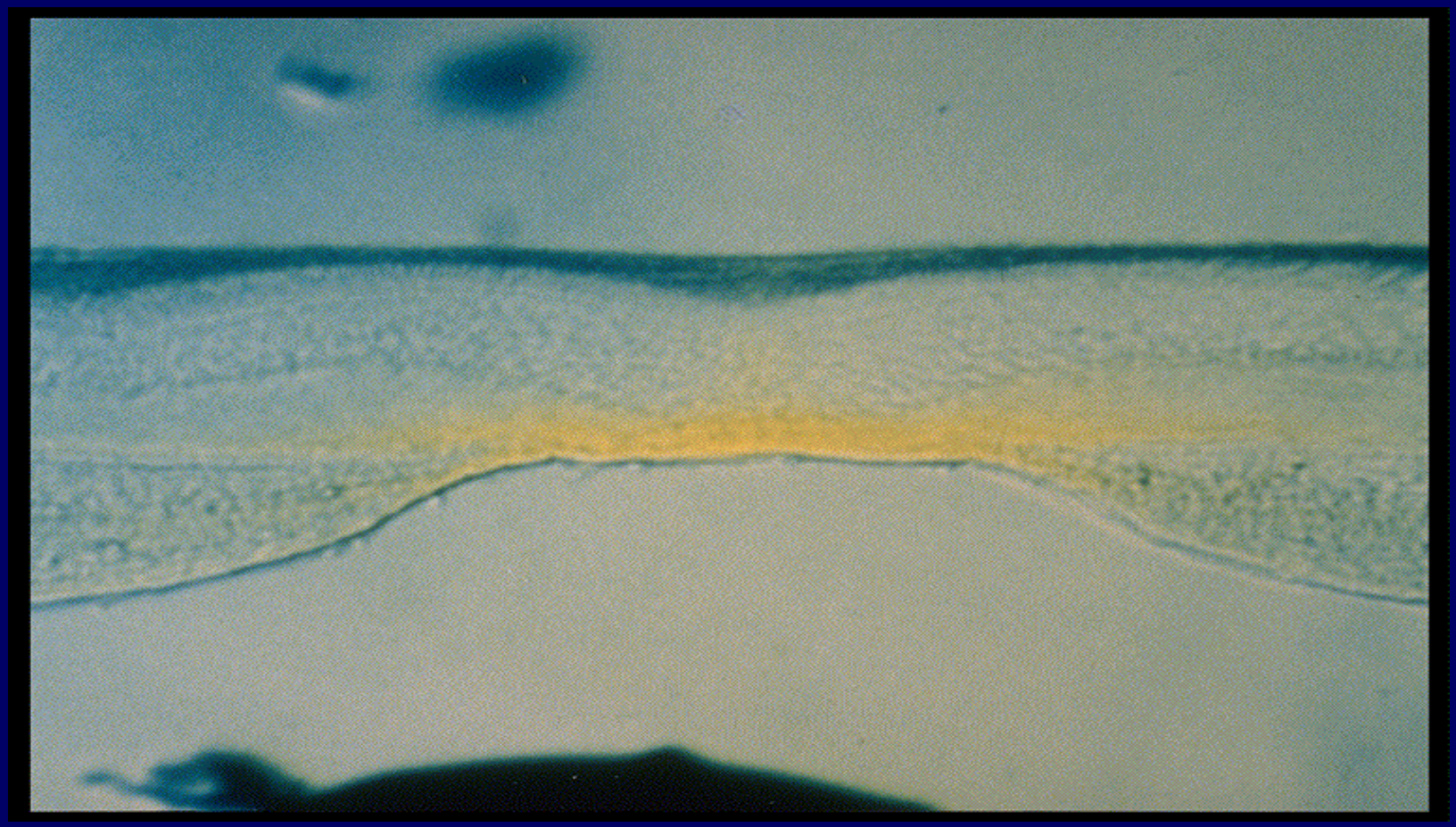
AGE-RELATED MACULAR DEGENERATION [AMD]

- Leading cause of irreversible blindness in people over age 65.
- Affects 25-40% of all those over age 65.
- Females have higher risk than males.
- People with light-colored eyes at increased risk.
- Risk related to total sunlight exposure, cigarette smoking, obesity, and intake of antioxidants.
- Antioxidant-rich fruits and vegetables are linked with lower rates of AMD.

MACULA REGION



LUTEIN AND ZEAXANTHIN IN THE FOVEA



Photomicrograph courtesy of Dr. Joanne Curran-Celentano.

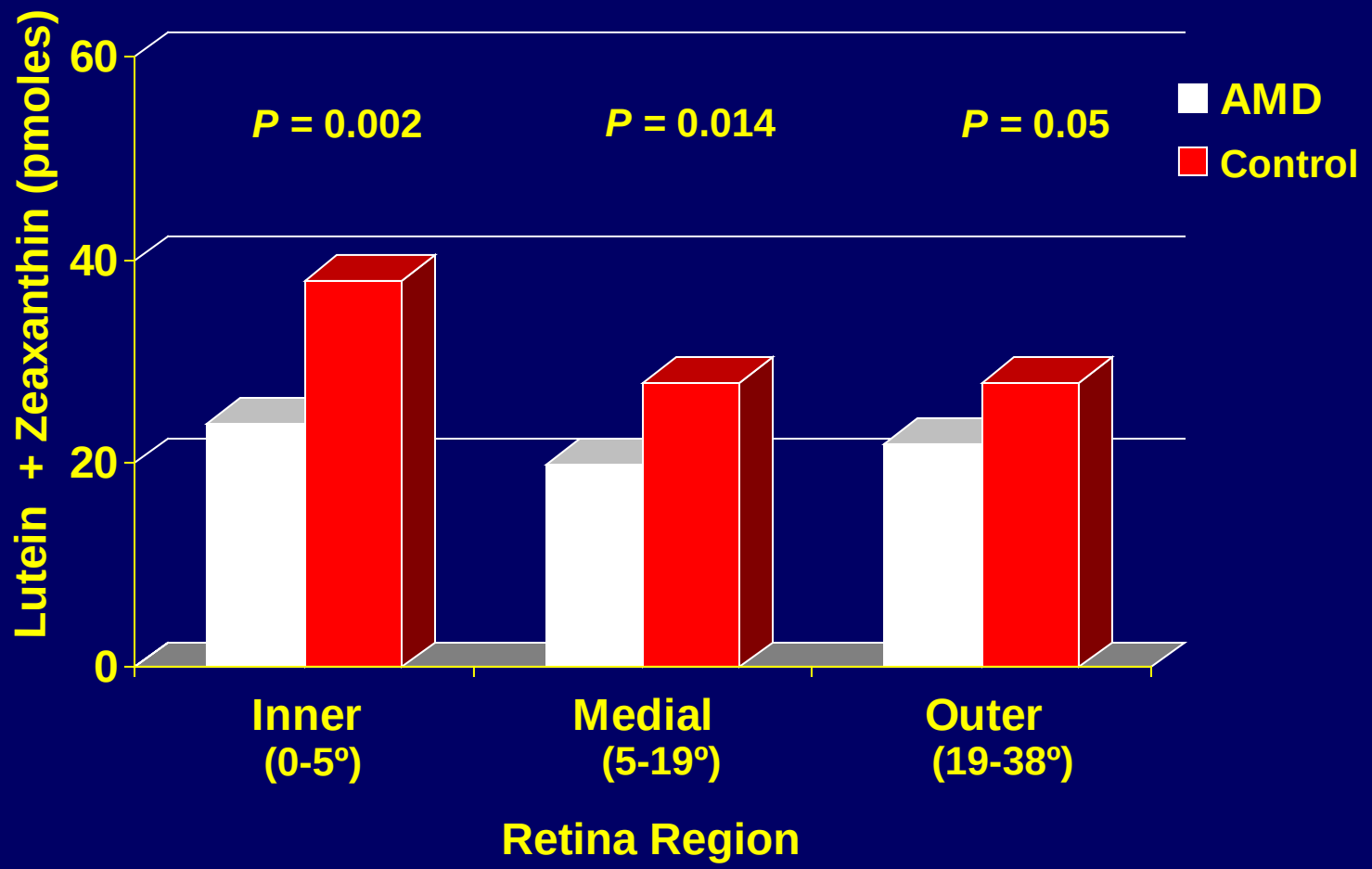
AGE-RELATED MACULAR DEGENERATION (AMD)

Normal Vision

AMD

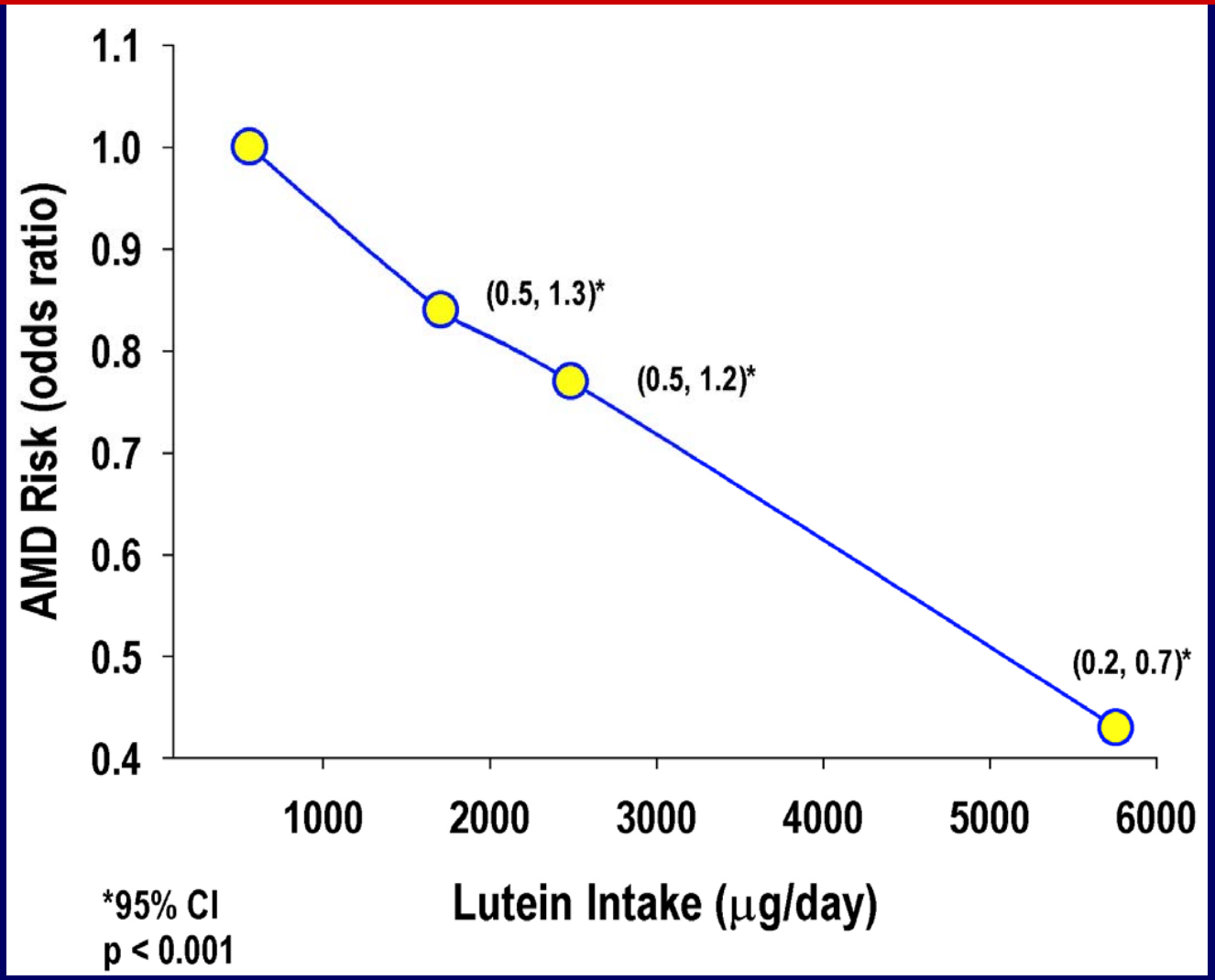
Late-Stage AMD

Lutein + Zeaxanthin Content of Human Retina from AMD and Control Subjects



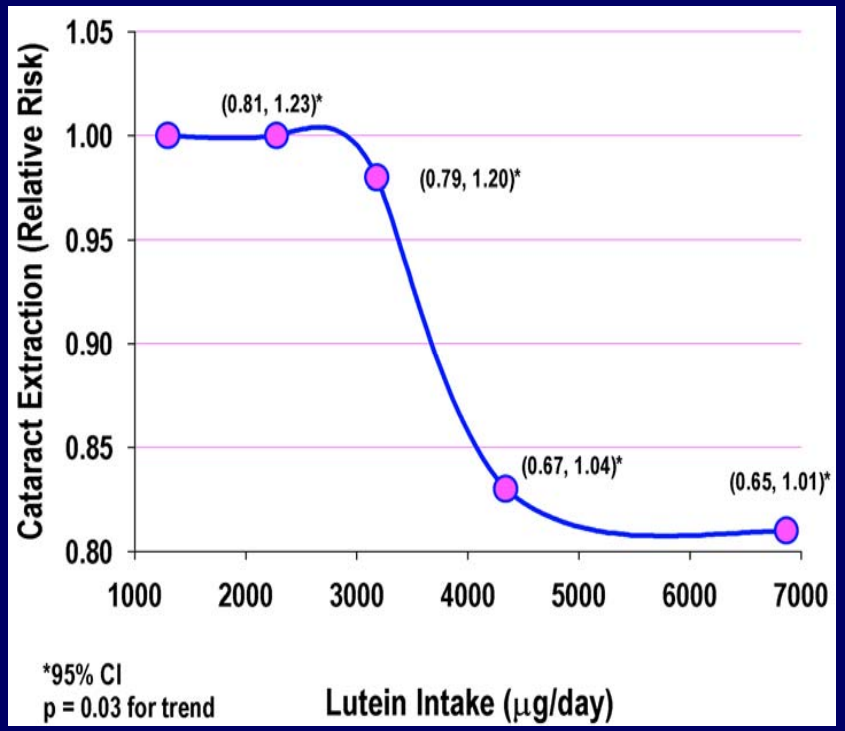
Bone et al. *Invest Ophthalmol Vis Sci* 2001

LUTEIN AND AMD RISK

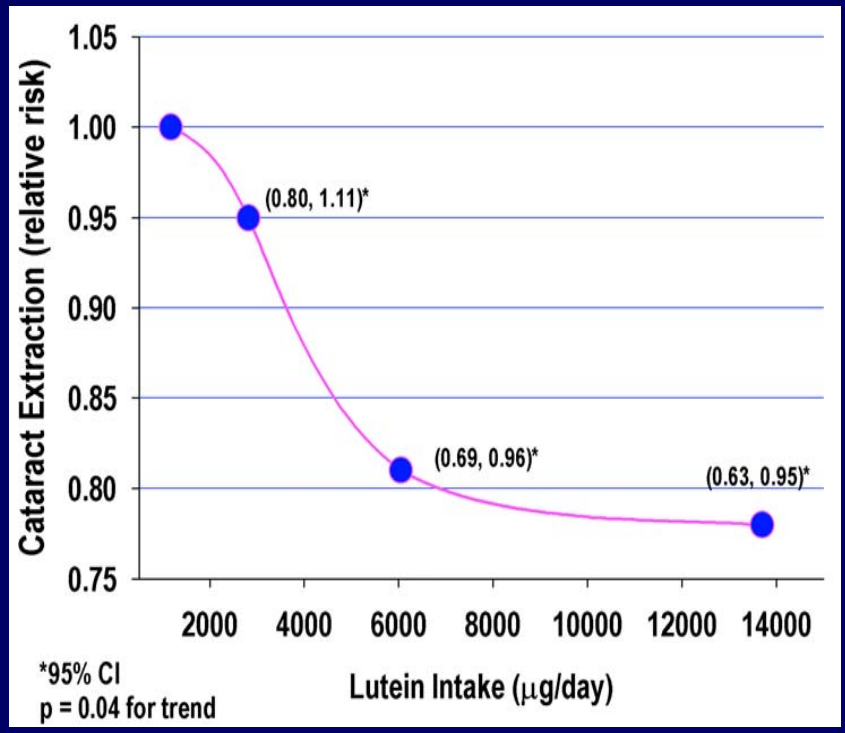


Seddon *et al.* 1994

LUTEIN & CATARACTS



n = 36,664 men

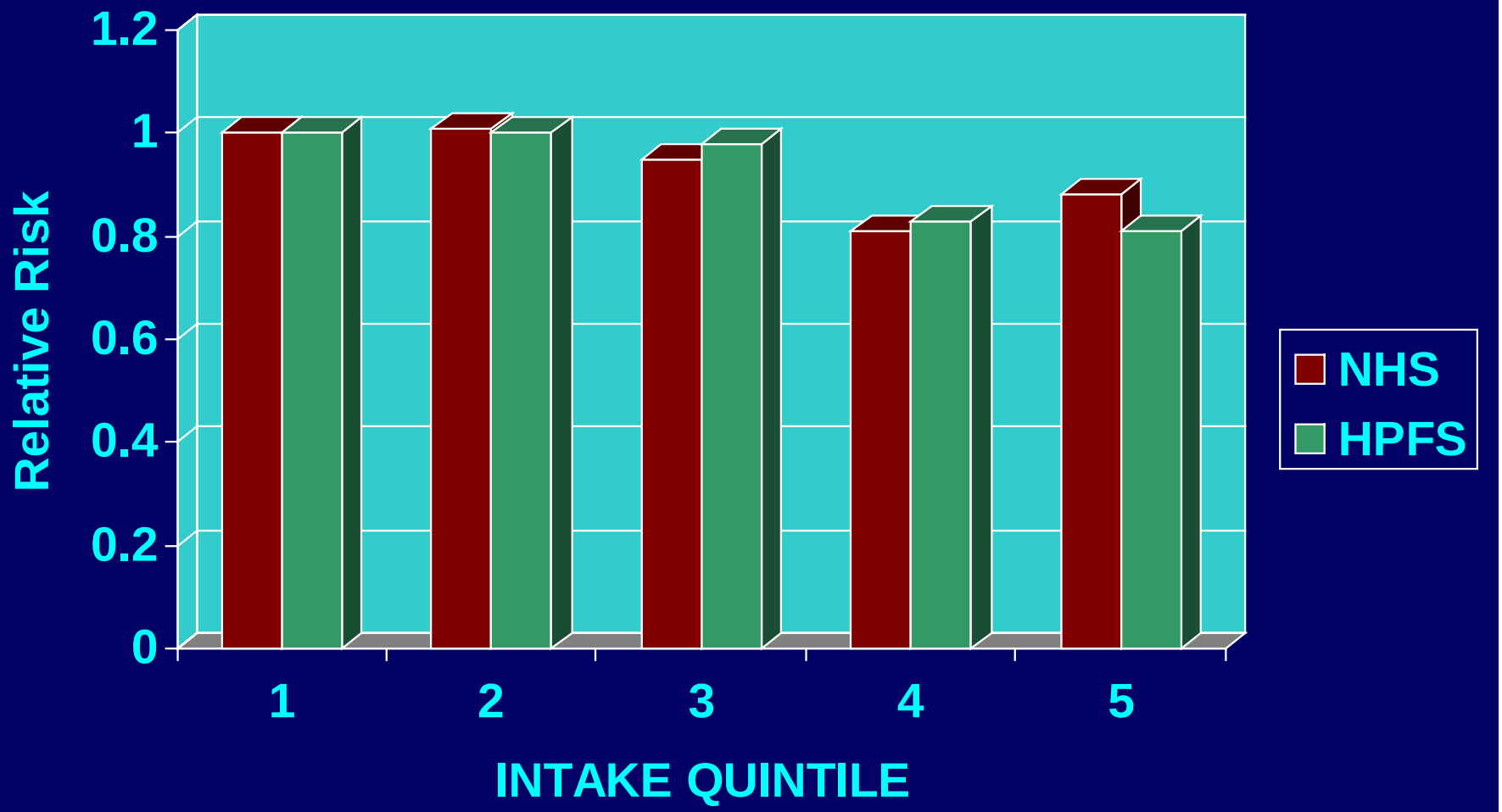


n = 77,466 women

Brown *et al.* 1999.

Chason-Taber *et al.* 1999.

L+Z INTAKE & CATARACT RISK



COLON CANCER & XANTHOPHYLLS

Lutein (μg)	**300**	**550**	**830**	**1290**	**2395**
OR	1.0	0.66	0.68	0.65	0.66
95% CI	-	0.50,0.88	0.51,0.91	0.48,0.87	0.48,0.92
P=0.02					
Zeaxan (μg)	**43**	**91**	**135**	**194**	**301**
OR	1.0	0.68	0.83	0.85	0.83
95% CI		0.51,0.89	0.63,1.09	0.63,1.14	0.60,1.15
P=0.75					

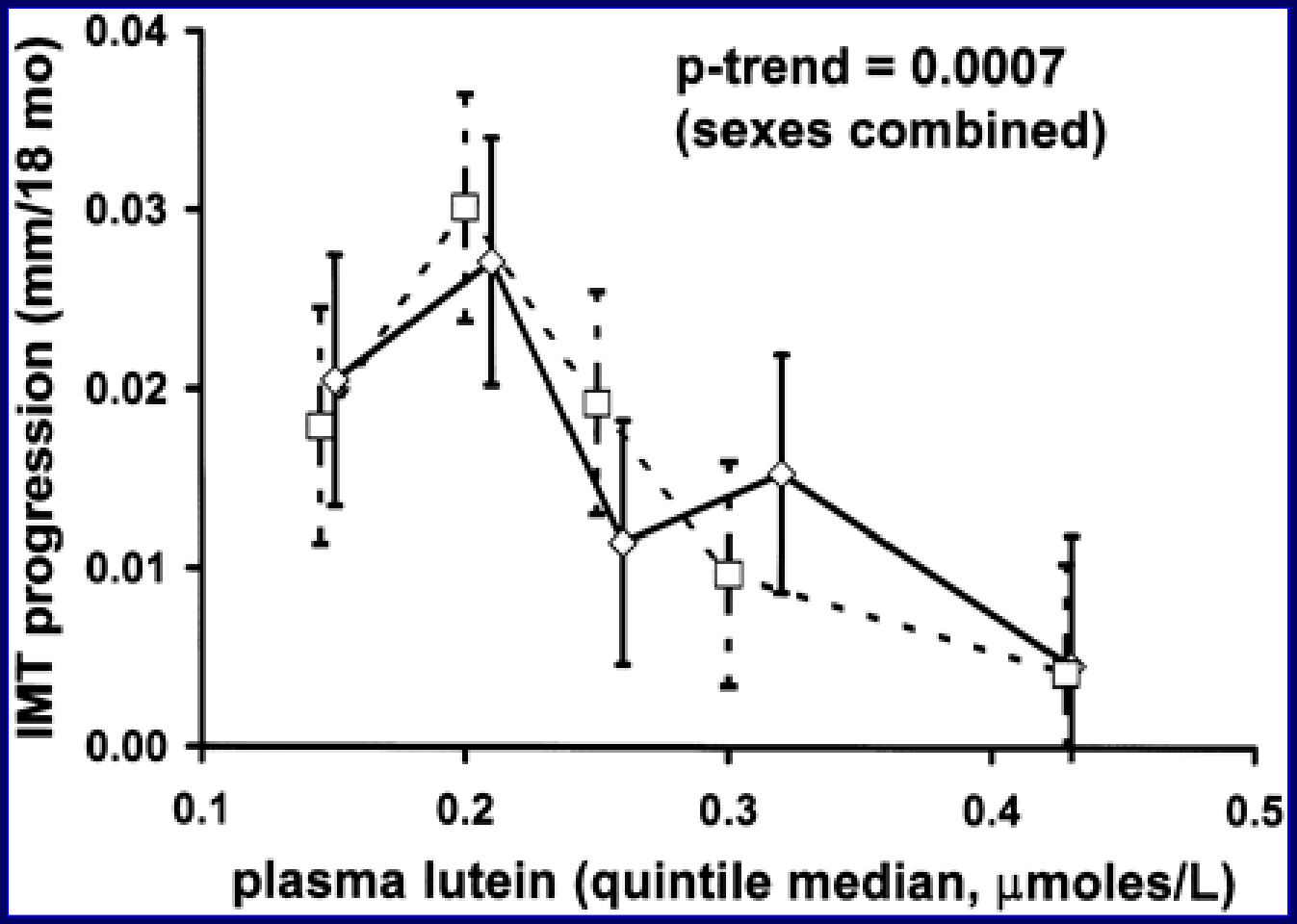
Slattery et al. AJCN 2000

Serum Lutein and Zeaxanthin and Risk for Breast Cancer

	Lutein		Zeaxanthin	
Quartile	**OR**	**95% CI**	**OR**	**95% CI**
4 (high)	1.0	-	1.0	-
3	1.43	0.85 - 2.41	1.05	0.54 - 2.04
2	1.22	0.76 - 1.97	0.88	0.47 - 1.66
1 (low)	2.08	1.11 - 3.90	1.12	0.59 - 2.13
P (trend)	0.01		0.54	

Toniolo et al. ***Am J Epidemiol*** 2001

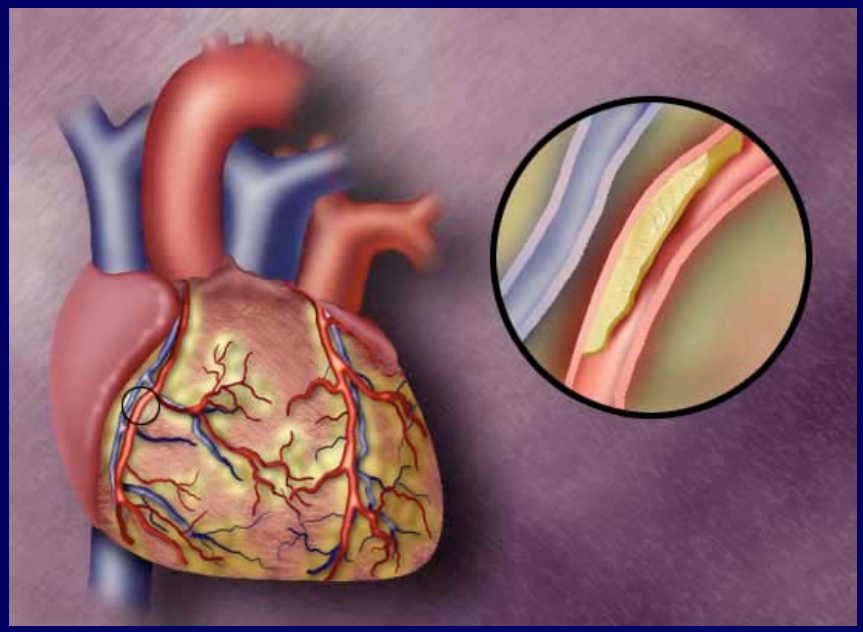
Change in IMT and Plasma Lutein: Los Angeles Atherosclerosis Study



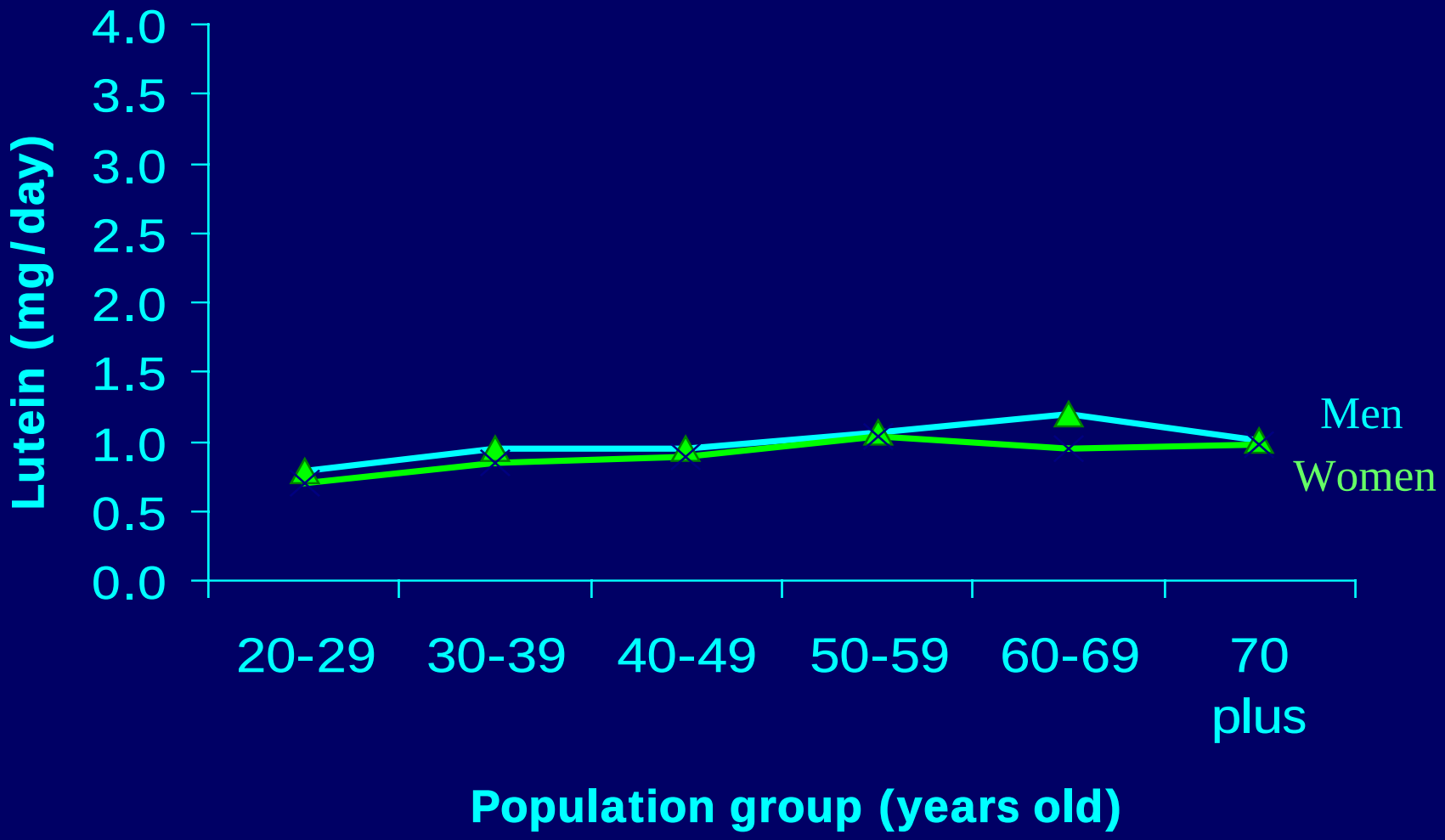
Dwyer et al. *Circulation* 2001

LUTEIN & ATHEROSCLEROSIS

- Lutein as an antioxidant/anti-inflammatory
- IMT progression low in those with high plasma lutein
- High lutein intake decreased atherosclerosis in animal model
- Lutein effects on inflammatory responses



LUTEIN INTAKE (1994-96)



Source: Environ International Corporation. Experimental Biology 1999.

DIETARY LUTEIN/ZEAXANTHIN

KHQ

Carotenoid Content of Chicken Egg Yolk

	µg/yolk	µg/mg C	µg/100 g
Lutein	292 ± 117	1.19 ± 0.32	723 ± 690
Zeaxanthin	213 ± 85	0.87 ± 0.23	1257 ± 502
Total	505	2.06	2980

Handelman et al. *Am J Clin Nutr* 1999

Beaver Dam Eye Study: Nuclear Cataracts Risk

Entire Cohort (43-84 y)		
Food	**OR**	**95% CI**
vegetables	0.7	0.4 - 1.2
spinach/greens	0.6	0.4 - 0.9
eggs	0.7	0.5 - 1.2
Younger sub-cohort (43 - 64 y)		
spinach	0.6	0.3 - 1.0
eggs	0.4	0.2 - 0.9

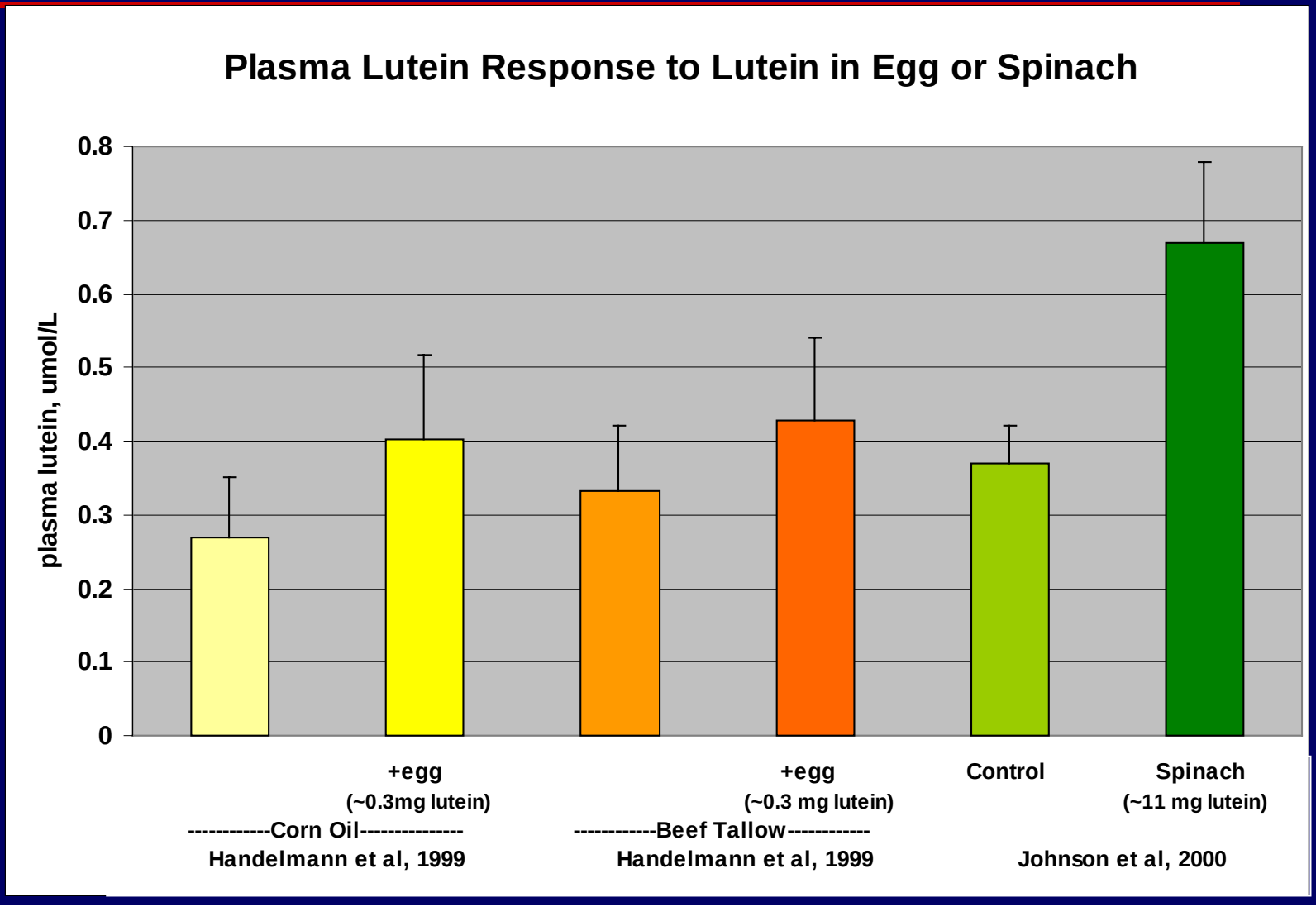
Lyle et al. *Am J. Epidemiol* 1999

EGG FEEDING STUDIES

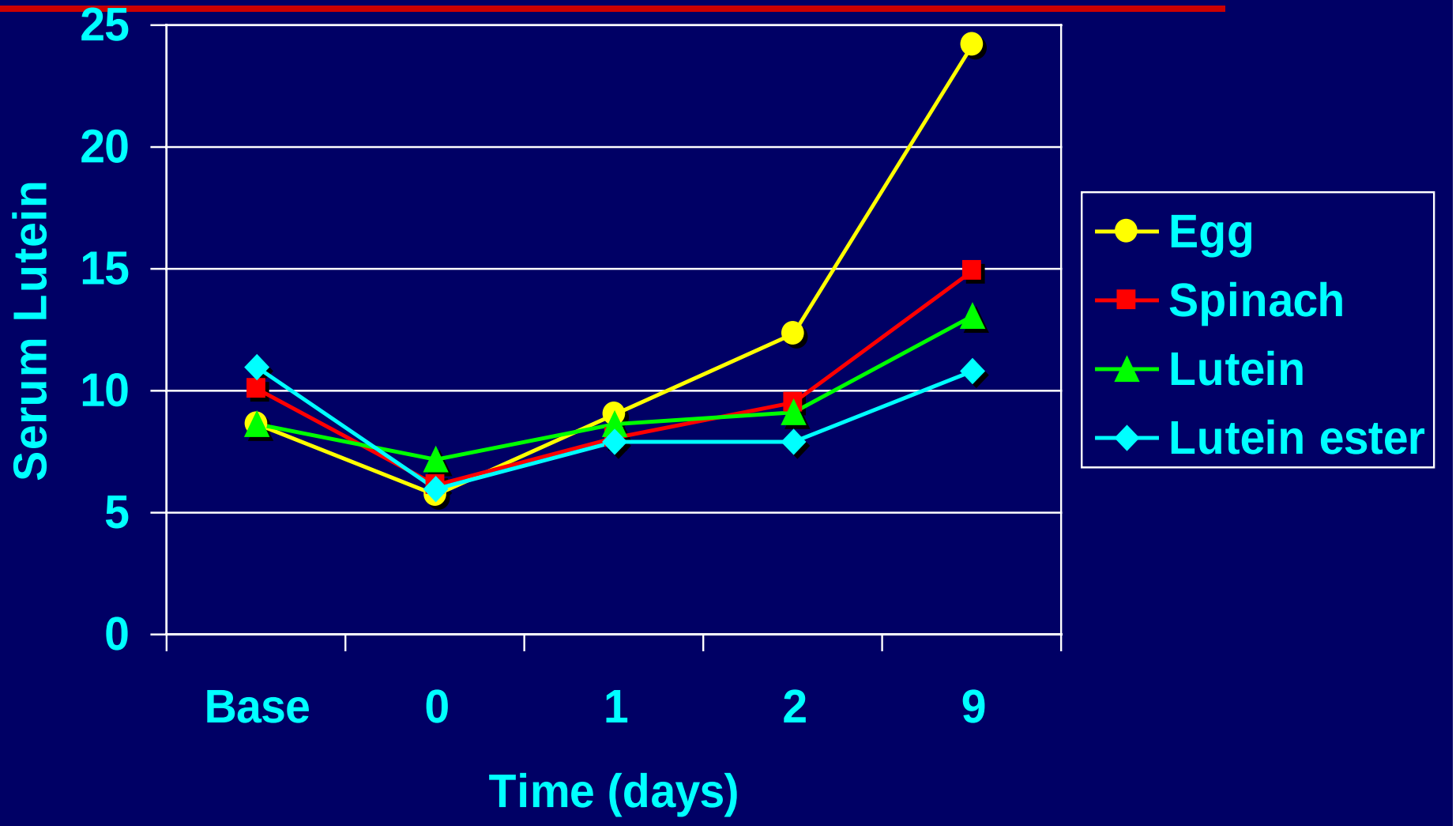
	Control	+ Egg	% Change
Lutein	0.30	0.42	+ 40%
Zeaxanthin	0.05	0.12	+ 140%
<u>Lutein</u>			
Control egg	0.21	0.21	-
Enriched egg	0.24	0.45	+ 88%

Handelman et al. AJCN 1999; Suria et al. EJCN 2000

EGG LUTEIN & PLASMA



LUTEIN BIOAVAILABILITY



EGGS AND MPOD

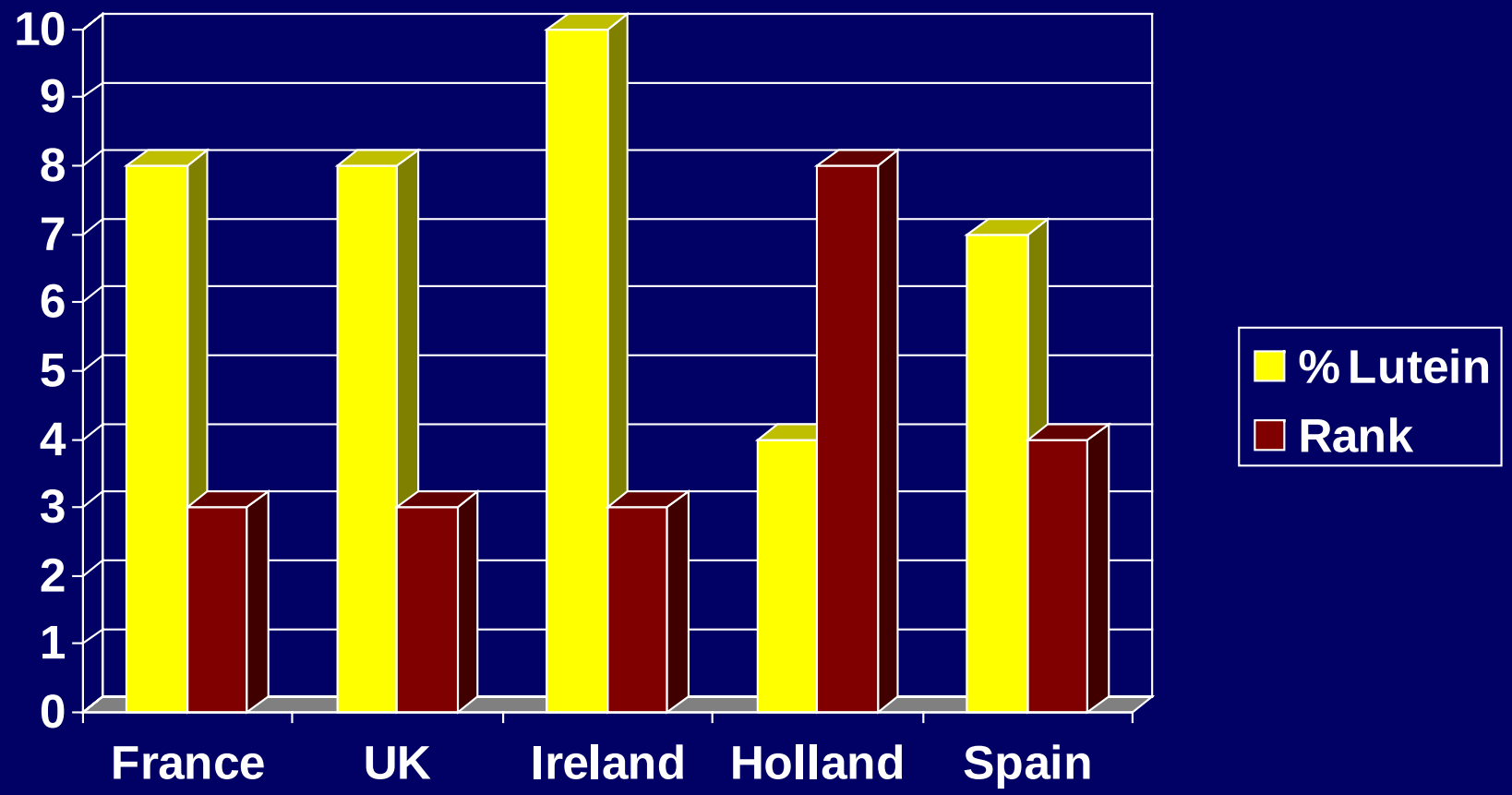
	Controls (8)	6 Eggs/wk for 3 months (9)
Baseline MPOD	*0.173*	*0.181*
Final MPOD	*0.195*	***0.300****

While the average level of lutein and zeaxanthin in one egg is modest (L=250 μg and Z=200 μg, for the eggs used in these studies) the bioavailability appears high. Consuming 6 eggs/week resulted in a significant increase in MPOD without increasing cholesterol risk.

EGG XANTHOPHYLLS

- Pre-extracted source
- High bioavailability
- Variable levels with ability to increase
- Increase plasma levels
- Increase MPOD
- Important source of zeaxanthin

EGGS AND DIETARY L+Z

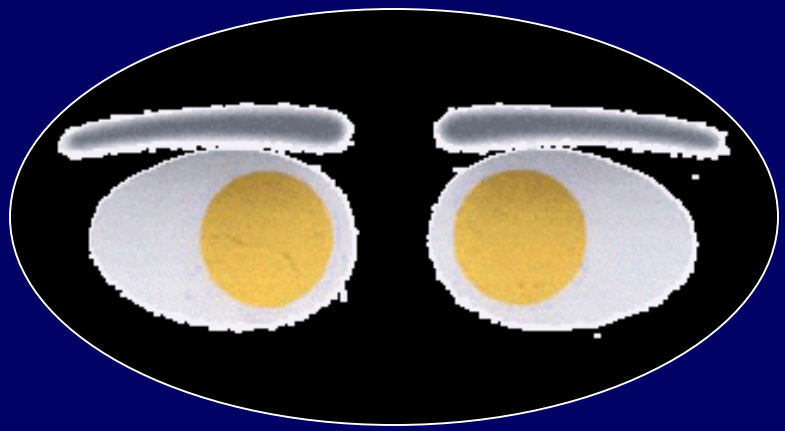


COMPLICATIONS

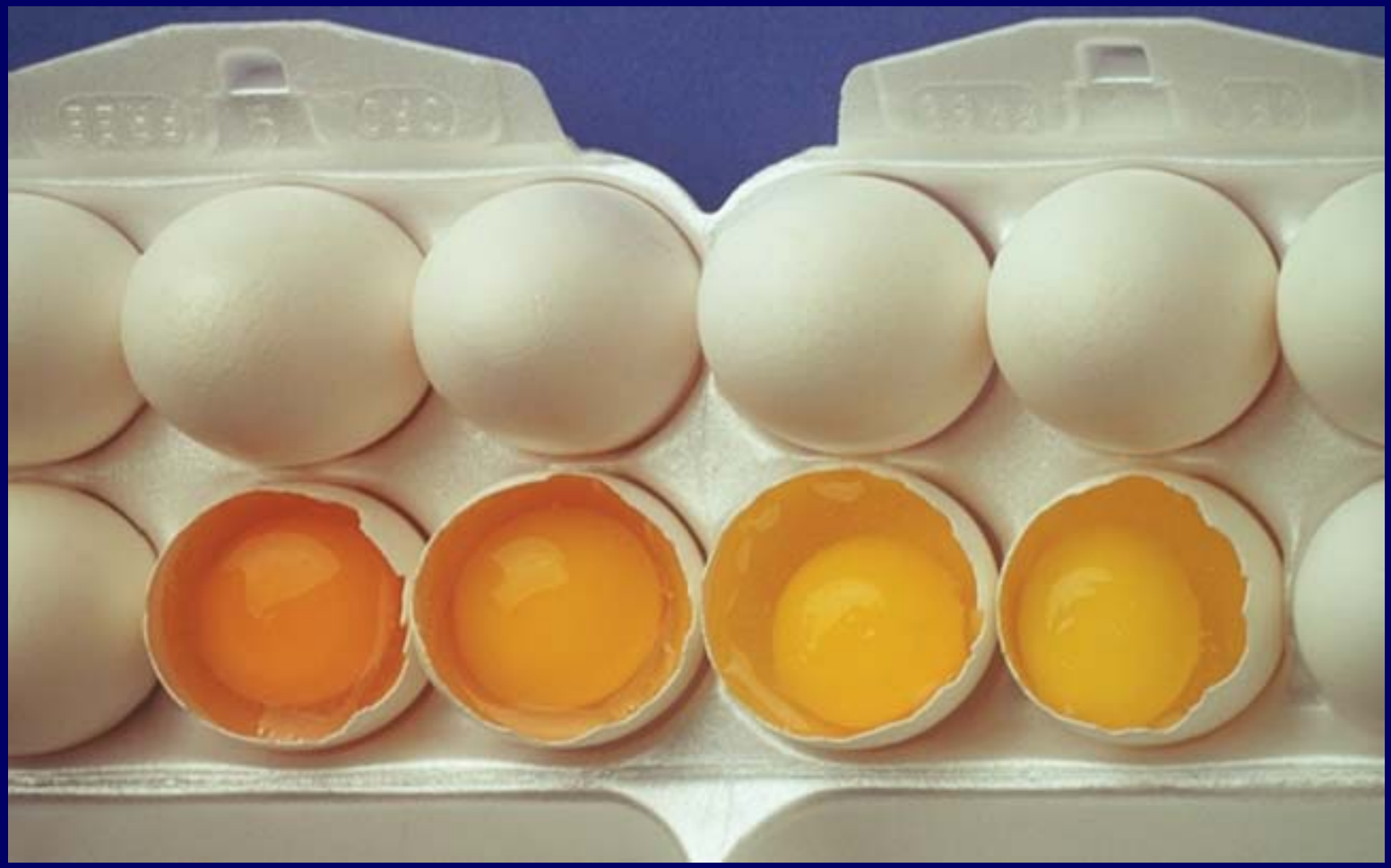
- Intake mass not the same as bioavailable xanthophylls
- Competitive tissue deposition differs between men and women
- Lutein and zeaxanthin appear to have different effects on risk:
  - Lutein - Cataracts, CHD and cancer
  - Zeaxanthin – AMD

EGGS & XANTHOPHYLLS

- Egg xanthophylls in phospholipid matrix
- Higher bio-availability than green, leafy vegetables or supplements
- Xanthophyll levels in eggs can be increased by alterations in feed
- Multiple potential health benefits from xanthophyll enriched eggs



FUNCTIONAL EGG LUTEIN



PROCESSING LOSS

Sample	mg lutein per 50 g		
	Raw	Pasteurized	Scrambled
Control	0.13[a]	0.13	0.12
Lutein added	2.56	2.65	2.40

THE RETURN OF THE GOOD EGG