Beta Carotene and Eye Health

Public Health Nutr. 2002 Apr;5(2):347-52.

The intake of carotenoids in an older Australian population: The Blue Mountains Eye Study.

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OBJECTIVE: To describe the distribution of carotenoid intakes and important food sources of carotenoids in the diet of a representative population of older Australians. DESIGN: Population-based cohort study. SETTING: Two post-code areas in the Blue Mountains, west of Sydney, Australia. SUBJECTS: We studied 2012 (86%) of the 2334 participants aged 55+ years attending the 5-year follow-up of the cross-sectional Blue Mountains Eye Study (BMES), who completed a detailed semi-quantitative food-frequency questionnaire. The intakes for five carotenoids were studied: alpha-carotene, beta-carotene, beta-cryptoxanthin, lutein and zeaxanthin combined, and lycopene. RESULTS: The mean intake per day for each carotenoid was: alpha-carotene, 2675 microg; beta carotene equivalents, 7301 microg; beta-cryptoxanthin, 299 microg; lutein and zeaxanthin, 914 microg; lycopene, 3741 microg; retinol, 653 microg; total vitamin A, 1872 microg retinol equivalents. beta-Carotene equivalents contribute a substantial proportion of total vitamin A intake (65%) in this population. Women had slightly higher intakes than men for alpha-carotene, beta-carotene equivalents, and lutein and zeaxanthin ($P < 0.05$). Carrots and pumpkin were the main contributors to alpha-carotene and beta-carotene equivalent intakes. Orange juice, oranges and papaw were the main contributors to beta-cryptoxanthin intake. Broccoli, green beans and oranges contributed substantially to lutein and zeaxanthin intake. The main contributors to lycopene intake were tomatoes and bolognaise sauce. CONCLUSIONS: Vitamin A intake in this population is high relative to the Australian Recommended Dietary Intake. Carotenoid intakes, particularly beta-carotene, make a substantial contribution, particularly from fruit and vegetables. This study provides important information as a basis for examining associations between dietary carotenoid intake and eye disease in the BMES.

PMID: 12020387 [PubMed - indexed for MEDLINE]

Am J Clin Nutr. 2008 Jun;87(6):1899-905.

Antioxidant nutrient intake and the long-term incidence of age-related cataract: the Blue Mountains Eye Study.

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BACKGROUND: Oxidative stress has been implicated in cataractogenesis. Long-term intake of antioxidants may offer protection against cataract. OBJECTIVE: We investigated relations between antioxidant nutrient intakes measured at baseline and the 10-y incidence of age-related cataract. DESIGN: During 1992-1994, 3654 persons aged >or=49 y attended baseline examinations of the Blue Mountains Eye Study (82.4% response). Of these persons, 2464 (67.4%) participants were followed >or=1 time after the baseline examinations (at either 5 or 10 y). At each examination, lens photography was performed and questionnaires were administered, including a 145-item semiquantitative food-frequency questionnaire. Antioxidants, including beta-carotene, zinc, and vitamins A, C, and E, were assessed. Cataract was assessed at each examination from lens photographs with the use of the Wisconsin Cataract Grading System. Nuclear cataract was defined for opacity greater than standard 3. Cortical cataract was defined as cortical opacity >or= 5% of the total lens area, and posterior subcapsular (PSC) cataract was defined as the presence of any such opacity. RESULTS: Participants with the highest quintile of total intake (diet + supplements) of vitamin C had a reduced risk of incident nuclear cataract [adjusted odds ratio (OR): 0.55; 95% CI: 0.36, 0.86]. An above-median intake of combined antioxidants (vitamins C and E, beta-carotene, and zinc) was associated with a reduced risk of incident nuclear cataract (OR: 0.51; 95% CI: 0.34, 0.76). Antioxidant intake was not associated with incident cortical or PSC cataract. CONCLUSION: Higher intakes of vitamin C or the combined intake of antioxidants had long-term protective associations against development of nuclear cataract in this older population.

PMID: 18541583 [PubMed - indexed for MEDLINE]

Eye. 2008 Jun;22(6):751-60. Epub 2008 Apr 18.

Antioxidant supplements to prevent or slow down the progression of AMD: a systematic review and meta-analysis.

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INTRODUCTION: The aim of this review was to examine the evidence as to whether antioxidant vitamin or mineral supplements prevent the development of AMD or slow down its progression. METHODS: Randomised trials comparing antioxidant vitamin and/or mineral supplement to control were identified by systematic electronic searches (updated August 2007) and contact with investigators. Data were pooled after investigating clinical and statistical heterogeneity. RESULTS: There was no evidence that antioxidant (vitamin E or beta-carotene) supplementation prevented AMD. A total of 23 099 people were randomised in three trials with treatment duration of 4-12 years; pooled risk ratio=1.03 (95% CI, 0.74-1.43). There was evidence that antioxidant (beta-carotene, vitamin C, and vitamin E) and zinc supplementation slowed down the progression to advanced AMD and visual acuity loss in people with signs of the disease (adjusted odds ratio=0.68, 95% CI, 0.53-0.87 and 0.77, 95% CI, 0.62-0.96, respectively). The majority of people were randomised in one trial (AREDS, 3640 people randomised). There were seven other small trials (total randomised 525). CONCLUSIONS: Current evidence does not support the use of antioxidant vitamin supplements to prevent AMD. People with AMD, or early signs of the disease, may experience some benefit from taking supplements as used in the AREDS trial. Potential harms of high-dose antioxidant supplementation must be considered. These may include an increased risk of lung cancer in smokers (beta-carotene), heart failure in people with vascular disease or diabetes (vitamin E) and hospitalisation for genitourinary conditions (zinc).

Publication Types:

- Meta-Analysis
- Review

PMID: 18425071 [PubMed - indexed for MEDLINE]

Invest Ophthalmol Vis Sci. 2008 Aug;49(8):3328-35. Epub 2008 Apr 17.

Blood levels of vitamin C, carotenoids and retinol are inversely associated with cataract in a North Indian population.

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PURPOSE: To examine the association of blood antioxidants with cataract. METHODS: Cross-sectional study of people aged >or=50 years identified from a household enumeration of 11 randomly sampled villages in North India. Participants were interviewed for putative risk factors (tobacco, alcohol, biomass fuel use, sunlight exposure, and socioeconomic status) and underwent lens photography and blood sampling. Lens photographs (nuclear, cortical, and posterior subcapsular) were graded according to the Lens Opacities Classification System (LOCS II). Cataract was defined as LOCS II grade >or=2 for any opacity or ungradable, because of dense opacification or history of cataract surgery. People without cataract were defined as LOCS II <2 on all three types of opacity, with absence of previous surgery. RESULTS: Of 1443 people aged >or=50 years, 94% were interviewed, 87% attended an eye examination, and 78% gave a blood sample; 1112 (77%) were included in the analyses. Compared with levels in Western populations, antioxidants were low, especially vitamin C. Vitamin C was inversely associated with cataract. Odds ratios (OR) for the highest (>or=15 micromol/L) compared with the lowest (<or=6.3 micromol/L) tertile were 0.64, (95% confidence interval [CI] 0.48-0.85; P < 0.01). Tertiles of zeaxanthin (P < 0.03), alpha-carotene (P < 0.05), and retinol (P < 0.02) were associated with decreased odds of cataract. In analysis of continuous data, significant inverse associations were found for vitamin C, zeaxanthin, lutein, lycopene, alpha- and beta-carotene, and beta-cryptoxanthin, but not for alpha- or gamma-tocopherol. CONCLUSIONS: Inverse associations were found between cataract and blood antioxidants in an antioxidant-depleted study sample.

Publication Types:

- Multicenter Study
- Randomized Controlled Trial
- Research Support, Non-U.S. Gov't

PMID: 18421094 [PubMed - indexed for MEDLINE]

Clin Nutr. 2008 Jun;27(3):464-72. Epub 2008 Mar 14.

Dietary and nutritional biomarkers of lens degeneration, oxidative stress and micronutrient inadequacies in Indian cataract patients.

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BACKGROUND & AIMS: Habitual food and nutrient intakes of 140 Indian cataract patients and 100 age- and sex-matched controls (50-75 years), from high income group and low income groups, were assessed. METHODS: Food intake was recorded by food frequency questionnaire and data were examined for linkages with blood/lens parameters of oxidative stress through a case-control study. RESULTS: Intake of animal foods and fried snacks was significantly higher while vegetables, green leafy vegetables, fruit, tea and micronutrient intakes were lower in patients than in controls ($p<0.001$). Lens oxidative stress and opacity showed a significant negative association with fruit intake ($p<0.05$). Multiple regression analysis indicated association of intakes of iron, beta-carotene, ascorbic acid, tannic acid and inositol pentaphosphate with plasma oxidative stress ($p<0.01$) and association of intakes of iron, ascorbic acid and inositol triphosphate with lens oxidative stress ($p<0.01$). Weighted least square regression for lens opacity revealed that intakes of ascorbic acid, folic acid and inositol pentaphosphate explained 59.7% of the total variation ($p<0.01$). CONCLUSIONS: Dietary deficiency of antioxidant micronutrients was greater for patients than controls. Deficiency of beta-carotene, ascorbic acid, folic acid, iron, phytate and polyphenols increased oxidative stress in blood and lens.

Publication Types:

- Research Support, Non-U.S. Gov't

PMID: 18342406 [PubMed - indexed for MEDLINE]

Orv Hetil. 2007 Dec 2;148(48):2259-68.

[Metabolic therapy for early treatment of age-related macular degeneration]

[Article in Hungarian]

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Currently, age-related macular degeneration is one of the most common eye diseases causing severe and permanent loss of vision. This disease is estimated to affect approximately 300-500 thousand Hungarians. While earlier no treatment was available, in the recent decade an antioxidant therapy became very popular using combinations of high dosage antioxidant vitamins C, E, beta carotene and zinc. Based on theoretical concepts and mostly in vitro experiences, this combination was thought to be effective through neutralizing reactive oxygen species. According to a large clinical trial (AREDS) it reduced progression of intermediate state disease to advanced state, but did not influence early disease. This original combination, due to potential severe side effects, is not on the market anymore. However, the efficacy of modified formulas has not been proved yet. Recently, the metabolic therapy, a combination of omega-3 fatty acids, coenzyme Q10 and acetyl-L-carnitine has been introduced for treating early age-related macular degeneration through improving mitochondrial dysfunction, specifically improving lipid metabolism and ATP production in the retinal pigment epithelium, improving photoreceptor turnover and reducing generation of reactive oxygen species. According to a pilot study and a randomized, placebo-controlled, double blind clinical trial, both central visual field and visual acuity slightly improved after 3-6 months of treatment and they remained unchanged by the end of the study. The difference was statistically significant as compared to the base line or to controls. These functional changes were accompanied by an improvement in fundus alterations: drusen covered area decreased significantly as compared to the base line or to control. Characteristically, all these changes were more marked in less affected eyes. A prospective case study on long-term treatment confirmed these observations. With an exception that after slight improvement, visual functions remained stable, drusen regression continued for years. Sometimes significant regression of drusen was found even in intermediate and advanced cases. All these findings strongly suggested that the metabolic therapy may be the first choice for treating age-related macular degeneration. Currently, this is the only combination of ingredients corresponding to the recommended daily allowance, and at the same time, which showed clinically proved efficacy.

PMID: 18039616 [PubMed - indexed for MEDLINE]

Ophthalmic Epidemiol. 2007 Sep-Oct;14(5):288-98.

Intake of zinc and antioxidant micronutrients and early age-related maculopathy lesions.

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BACKGROUND: Macular degeneration, the end stage of age-related maculopathy (ARM), is the leading cause of legal blindness worldwide, and few modifiable risk factors are known. The high concentration of carotenoids in the macula, plus evidence linking oxidative stress to ARM and carotenoids to antioxidation, generated the hypothesis that higher antioxidant intakes can prevent ARM. Results of observational and intervention studies have been inconsistent. OBJECTIVE: To evaluate associations between intakes of zinc and antioxidant micronutrients and early ARM. METHODS: Between 1993 and 1995, ARM was assessed in 398 Boston-area women aged 53-74 y using the Wisconsin Age-related Maculopathy System of grading retinal fundus photographs. The women were a subset of the Nurses' Health Study cohort. Micronutrient intake was assessed by semi-quantitative food frequency questionnaires administered four times between 1980 and the baseline eye examinations. RESULTS: After multivariate adjustment for potential confounders, 1980 energy-adjusted intakes of alpha-carotene, beta-carotene, lycopene, total retinol, total vitamin A, and total vitamin E were significantly inversely related to the prevalence of pigmentary abnormalities (PA). Furthermore, increasing frequency of consuming foods high in alpha-or beta-carotene was associated with lower odds of PA; compared to women consuming these foods < 5 times/wk, odds ratios (95% CI) were 0.7 (0.3-1.6) for 5-6 times/wk, 0.6 (0.2-1.3) for 7-9.5 times/wk, and 0.3 (0.1-0.7)for > or =10 times/wk. Lutein/zeaxanthin intakes and more recent intakes of most carotenoids were unrelated to PA, and intakes of zinc and antioxidant micronutrients were unrelated to having large or intermediate drusen alone.

Publication Types:

- Research Support, N.I.H., Extramural
- Research Support, Non-U.S. Gov't
- Research Support, U.S. Gov't, Non-P.H.S.

PMID: 17994438 [PubMed - indexed for MEDLINE]

Mol Biotechnol. 2007 Sep;37(1):26-30.

Carotenoids and flavonoids contribute to nutritional protection against skin damage from sunlight.

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The concept of photoprotection by dietary means is gaining momentum. Plant constituents such as carotenoids and flavonoids are involved in protection against excess light in plants and contribute to the prevention of UV damage in humans. As micronutrients, they are ingested with the diet and are distributed into light-exposed tissues, such as skin or the eye where they provide systemic photoprotection. beta-Carotene and lycopene prevent UV-induced erythema formation. Likewise, dietary flavanols exhibit photoprotection. After about 10-12 weeks of dietary intervention, a decrease in the sensitivity toward UV-induced erythema was observed in volunteers. Dietary micronutrients may contribute to life-long protection against harmful UV radiation.

Publication Types:

- Research Support, Non-U.S. Gov't
- Review

PMID: 17914160 [PubMed - indexed for MEDLINE]

Curr Opin Ophthalmol. 2007 May;18(3):220-3.

Nutritional supplementation in age-related macular degeneration.

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PURPOSE OF REVIEW: This review assesses the current status of the knowledge of the role of nutrition in age-related macular degeneration - a leading cause of vision loss in the persons with European ancestry. RECENT FINDINGS: We will evaluate the different nutritional factors and both observational and interventional studies used to assess the association of nutrition with age-related macular degeneration. Persons with intermediate risk of age-related macular degeneration or advanced age-related macular degeneration in one eye are recommended to take the formulation proven in the Age-Related Eye Disease Study (AREDS) to be successful in preventing the development of advanced age-related macular degeneration by 25%. The formulation consists of vitamins C, E, beta-carotene and zinc. In addition, observational data suggest that high dietary intake of macular xanthophylls lutein and zeaxanthin are associated with a lower risk of advanced age-related macular degeneration. Similarly, long-chain polyunsaturated fatty acids derived from fish consumption are also associated with a decreased risk of advanced age-related macular degeneration. SUMMARY: Persons with intermediate age-related macular degeneration or advanced age-related macular degeneration (neovascular or central geographic atrophy) in one eye should consider taking the AREDS-type supplements. Further evaluation of nutritional factors, specifically, lutein/zeaxanthin and omega-3 fatty acids will be tested in a multicenter controlled, randomized trial - the Age-Related Eye Disease Study 2 (AREDS2).

Publication Types:

- Review

PMID: 17435429 [PubMed - indexed for MEDLINE]

Vitam Horm. 2007;75:117-30.

Conversion of beta-carotene to retinal pigment.

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Vitamin A and its active metabolite retinoic acid (RA)(1) play a major role in development, differentiation, and support of various tissues and organs of numerous species. To assure the supply of target tissues with vitamin A, long-lasting stores are built in the liver from which retinol can be transported by a specific protein to the peripheral tissues to be metabolized to either RA or reesterified to form intracellular stores. Vitamin A cannot be synthesized de novo by animals and thus has to be taken up from animal food sources or as provitamin A carotenoids, the latter being converted by central cleavage of the molecule to retinal in the intestine. The recent demonstration that the responsible beta-carotene cleaving enzyme beta,beta-carotene 15,15'-monooxygenase (Bcmo1) is also present in other tissues led to numerous investigations on the molecular structure and function of this enzyme in several species, including the fruit fly, chicken, mouse, and also human. Also a second enzyme, beta,beta-carotene-9',10'-monooxygenase (Bcmo2), which cleaves beta-carotene eccentrically to apo-carotenals has been described. Retinal pigment epithelial cells were shown to contain Bcmo1 and to be able to cleave beta-carotene into retinal in vitro, offering a new pathway for vitamin A production in another tissue than the intestine, possibly explaining the more mild vitamin A deficiency symptoms of two human siblings lacking the retinol-binding protein for the transport of hepatic vitamin A to the target tissues. In addition, alternative ways to combat vitamin A deficiency of specific targets by the supplementation with beta-carotene or even molecular therapies seem to be the future.

Publication Types:

- Review

PMID: 17368314 [PubMed - indexed for MEDLINE]

Br J Nutr. 2006 Oct;96(4):643-9.

Protective effects of tomato extract with elevated beta-carotene levels on oxidative stress in ARPE-19 cells.

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Epidemiological studies show that dietary products rich in carotenoids delay the progression of age-related macular degeneration. Experimental evidence from cellular studies on the antioxidant actions of carotenoids in the retinal pigment epithelium is still, however, fragmentary. The present study examined the uptake and protective potential of dietary carotenoids from tomato on the human retinal pigment epithelial cell line ARPE-19. ARPE-19 cells were incubated in medium supplemented with tomato extract containing high levels of beta-carotene, lycopene and traces of lutein. The cellular uptake of carotenoids was analysed by reverse-phase HPLC. Oxidative stress was induced by treatment with 1 mm-H2O2. Nitrotyrosine was detected by immunocytochemistry, and oxidised proteins (protein carbonyls) were measured by a quantitative ELISA method. Lipid peroxidation was assessed by quantifying thiobarbituric acid reactive substances. ARPE-19 cells preferentially accumulated lutein and beta-carotene rather than lycopene. Nitrotyrosine formation was considerably reduced in cells incubated with tomato extract compared with controls after H2O2 treatment. Protein carbonyls were reduced by 30 % (P = 0.015), and the formation of thiobarbituric acid-reactive substances was reduced by 140 % (P = 0.003) in cells incubated with tomato extract. The present study provides the experimental evidence for protective effects of dietary tomatoes rich in carotenoids on oxidative stress in the retinal pigment epithelium.

Publication Types:

- Research Support, Non-U.S. Gov't

PMID: 17010222 [PubMed - indexed for MEDLINE]

Invest Ophthalmol Vis Sci. 2005 Oct;46(10):3562-9.

beta-Carotene conversion into vitamin A in human retinal pigment epithelial cells.

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PURPOSE: Vitamin A is essential for vision. The key step in the vitamin A biosynthetic pathway is the oxidative cleavage of beta-carotene into retinal by the enzyme beta,beta-carotene-15,15'-monooxygenase (BCO). The purpose of the study was to investigate beta-carotene metabolism and its effects on BCO expression in the human retinal pigment epithelial (RPE) cell line D407. METHODS: BCO mRNA and protein expression were analyzed by real-time quantitative PCR and Western blot analysis, respectively. BCO activity was assayed in protein extracts isolated from D407 cells. The conversion of beta-carotene to retinoids was determined by measuring retinol levels in D407 cells on beta-carotene supplementation. RESULTS: By RT-PCR, BCO mRNA was detected in D407 cells, bovine RPE, and retina. Western blot analyses revealed the presence of BCO at the protein level in D407 cells. Exogenous beta-carotene application to D407 cells resulted in a concentration (75% at 0.5 microM and 96% at 5 microM; $P < 0.05$)- and time (127% at 2 hours and 97% at 4 hours in 5 microM beta-carotene, $P < 0.05$)-dependent upregulation of BCO mRNA expression. Application of exogenous retinoic acid downregulated BCO mRNA levels at higher concentrations (1 microM; -96%, $P < 0.0005$) and upregulated it at a lower concentration (0.01 microM; 399%, $P < 0.005$). The RAR-a-specific antagonist upregulated BCO expression by sixfold ($P < 0.005$). Tests for enzymatic activity demonstrated that the mRNA upregulation resulted in enzymatically active BCO protein (7.3 ng all-trans-retinal/h per milligram of protein). Furthermore, D407 cells took up beta-carotene in a time-dependent manner and converted it to retinol. CONCLUSIONS: The results suggest that BCO is expressed in the RPE and that beta-carotene can be metabolized into retinol. beta-Carotene cleavage in the RPE may be an alternative pathway that would ensure the retinoid supply of photoreceptor cells.

Publication Types:

- Research Support, Non-U.S. Gov't

PMID: 16186334 [PubMed - indexed for MEDLINE]

J Histochem Cytochem. 2005 Nov;53(11):1403-12. Epub 2005 Jun 27.

Cell type-specific expression of beta-carotene 9',10'-monooxygenase in human tissues.

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The symmetrically cleaving beta-carotene 15,15'-monooxygenase (BCO1) catalyzes the first step in the conversion of provitamin A carotenoids to vitamin A in the mucosa of the small intestine. This enzyme is also expressed in epithelia in a variety of extraintestinal tissues. The newly discovered beta-carotene 9',10'-monooxygenase (BCO2) catalyzes asymmetric cleavage of carotenoids. To gain some insight into the physiological role of BCO2, we determined the expression pattern of BCO2 mRNA and protein in human tissues. By immunohistochemical analysis it was revealed that BCO2 was detected in cell types that are known to express BCO1, such as epithelial cells in the mucosa of small intestine and stomach, parenchymal cells in liver, Leydig and Sertoli cells in testis, kidney tubules, adrenal gland, exocrine pancreas, and retinal pigment epithelium and ciliary body pigment epithelia in the eye. BCO2 was uniquely detected in cardiac and skeletal muscle cells, prostate and endometrial connective tissue, and endocrine pancreas. The finding that the BCO2 enzyme was expressed in some tissues and cell types that are not sensitive to vitamin A deficiency and where no BCO1 has been detected suggests that BCO2 may also be involved in biological processes other than vitamin A synthesis.

Publication Types:

- Comparative Study
- Research Support, N.I.H., Extramural

PMID: 15983114 [PubMed - indexed for MEDLINE]

Eur J Neurosci. 2005 Jan;21(1):59-68.

Photoreceptor morphology is severely affected in the beta,beta-carotene-15,15'-oxygenase (bcox) zebrafish morphant.

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The retinoic acid molecule, a vitamin A derivative, is of key importance for eye and photoreceptor development in vertebrates. Several studies have provided evidence that the ventral part of the retina is particularly susceptible to impairment in retinoid signalling during the period of its development. In zebrafish, targeted gene knockdown of beta,beta-carotene-15,15'-oxygenase (bcox), the key enzyme for vitamin A formation, provokes a loss of retinoid signalling during early eye development that results in microphthalmia at larval stages. Using this model, we analysed the consequences of this for the retinal morphology of the fish larvae in structural details. Our analyses revealed that rods and cones do not express photoreceptor specific proteins (rhodopsin, peanut agglutinin, zpr1) in the peripheral retina. The photoreceptors in the central retina showed shortened outer segments, and electron dense debris in their intermembranal space. The number of phagosomes was increased, and cell death was frequently observed in the outer nuclear layer. Furthermore, the number of Muller cells was significantly reduced in the inner nuclear layer. Thus, we found that the lack of retinoid signalling strongly effects photoreceptor development in the ventral and dorsal retina. In addition, shortened outer segments and cell death of the remaining photoreceptors in the central retina indicate that there is an ongoing need for retinoid signalling for photoreceptor integrity and survival at later developmental stages.

Publication Types:

- Comparative Study
- Research Support, Non-U.S. Gov't

PMID: 15654843 [PubMed - indexed for MEDLINE]

Am J Epidemiol. 2003 Aug 15;158(4):337-46.

Antioxidant intake and primary open-angle glaucoma: a prospective study.

Kang JH, **Pasquale LR**, **Willett W**, **Rosner B**, **Egan KM**, **Faberowski N**, **Hankinson SE**.

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The relation between dietary antioxidant intake and primary open-angle glaucoma risk was examined in participants aged over 40 years in the Nurses' Health Study (n = 76,200) and the Health Professionals Follow-up Study (n = 40,284). They were followed biennially from 1980 and 1986, respectively, to 1996, during periods when they received an eye examination. Dietary intakes were measured repeatedly from 1980 in the Nurses' Health Study and from 1986 in the Health Professionals Follow-up Study using validated food frequency questionnaires. The authors analyzed 474 self-reported glaucoma cases confirmed by medical chart review to have primary open-angle glaucoma with visual field loss. The authors used Cox proportional hazards models for cohort-specific multivariate analyses, and results were pooled using random effects models. The pooled multivariate rate ratios for primary open-angle glaucoma comparing the highest versus lowest quintile of cumulative updated intake were 1.17 (95% confidence interval (CI): 0.87, 1.58) for alpha-carotene, 1.10 (95% CI: 0.82, 1.48) for beta-carotene, 0.95 (95% CI: 0.70, 1.29) for beta-cryptoxanthin, 0.82 (95% CI: 0.60, 1.12) for lycopene, 0.92 (95% CI: 0.69, 1.24) for lutein/zeaxanthin, 1.05 (95% CI: 0.59, 1.89) for vitamin C, 0.97 (95% CI: 0.62, 1.52) for vitamin E, and 1.11 (95% CI: 0.82, 1.51) for vitamin A. In conclusion, the authors did not observe any strong associations between antioxidant consumption and the risk of primary open-angle glaucoma.

Publication Types:

- Research Support, Non-U.S. Gov't
- Research Support, U.S. Gov't, Non-P.H.S.
- Research Support, U.S. Gov't, P.H.S.

PMID: 12915499 [PubMed - indexed for MEDLINE]

Ophthalmologe. 2003 Mar;100(3):181-9.

- **[Antioxidant micronutrients and cataract.Review and comparison of the AREDS and REACT cataract studies]**
  [Article in German]

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  Age-related cataract remains the major cause of preventable blindness throughout the world. It has long been realized that one of the important etiological factors for this disease is oxidative and in particular photooxidative damage to the lens.Therefore, the antioxidant micronutrients, vitamins C and E and the carotenoids, in particular beta-carotene, have been discussed as factors that could reduce the risk for this disease. The present article reviews what is known about the transport of these substances to the lens, their accumulation, and their concentrations in the lens. Furthermore, the available epidemiological literature is briefly mentioned, but more emphasis has been placed on a description and discussion of major clinical intervention studies. Finally, the design and results of two of those trials using antioxidant micronutrients, the Age-Related Eye Disease Study (AREDS) and the Roche European American Cataract Trial (REACT), are compared.The AREDS trial did show a positive effect only for age-related macular degeneration but not for cataract, while the REACT trial demonstrated a small but statistically significant deceleration of cataract progression.The techniques for following the course of a cataract in the REACT study were more sensitive to subtle changes than those used in the AREDS study, and this may have been one important factor accounting for the differences.The authors' detailed comparison of these studies, however, suggests that even more important may have been the fact that in the REACT study intervention started earlier in the disease process,with higher doses of vitamins C and E and beta-carotene and consequently with larger plasma concentrations of these antioxidant micronutrients.The REACT trial results support the early complementation of a diversified diet with supplements containing vitamins C and E and beta-carotene as well as other carotenoids.The authors also believe that it is reasonable to include these micronutrients in the therapeutic armamentarium of general ophthalmological practice.

  PMID: 12640546 [PubMed - indexed for MEDLINE]

Am J Clin Nutr. 2002 Mar;75(3):540-9.

- **Long-term intake of vitamins and carotenoids and odds of early age-related cortical and posterior subcapsular lens opacities.**

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BACKGROUND: Proper nutrition appears to protect against cataracts. Few studies have related nutrition to the odds of developing cortical or posterior subcapsular (PSC) cataracts. OBJECTIVE: We assessed the relation between usual nutrient intakes and age-related cortical and PSC lens opacities. DESIGN: We studied 492 nondiabetic women aged 53-73 y from the Nurses' Health Study cohort who were without previously diagnosed cataracts. Usual nutrient intake was calculated as the average intake from 5 food-frequency questionnaires collected over a 13-15-y period before the eye examination. Duration of vitamin supplement use was determined from 7 questionnaires collected during this same period. We defined cortical opacities as grade > or = 0.5 and subcapsular opacities as grade > or =0.3 of the Lens Opacities Classification System III. RESULTS: Some lenses had more than one opacity. No nutrient measure was related to prevalence of opacities in the full sample, but significant interactions were seen between age and vitamin C intake (P = 0.02) for odds of cortical opacities and between smoking status and folate (P = 0.02), alpha-carotene (P = 0.02), beta-carotene (P = 0.005), and total carotenoids (P = 0.02) for odds of PSC opacities. For women aged <60 y, a vitamin C intake > or = 362 mg/d was associated with a 57% lower odds ratio (0.43; 95% CI: 0.2, 0.93) of developing a cortical cataract than was an intake <140 mg/d, and use of vitamin C supplements for > or = 10 y was associated with a 60% lower odds ratio (0.40; 0.18, 0.87) than was no vitamin C supplement use. Prevalence of PSC opacities was related to total carotenoid intake in women who never smoked (P = 0.02). CONCLUSIONS: Our results support a role for vitamin C in diminishing the risk of cortical cataracts in women aged <60 y and for carotenoids in diminishing the risk of PSC cataracts in women who have never smoked.

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