

Summary table 251 — fatty acids and cataracts

Paper no.	Reference	Type of study	Population/study information	Risk factor	Comparator	N	Level (quality)	Results	Other notes
3194	Iwig 2004	In vitro	Human epithelial cells in culture (from 177 cataract patients)	Albumin concentration in aqueous humour	NA	Samples from 177 cataract patients (in vitro)	NA	<p>Human epithelial cells are very sensitive to damage from low concentrations of unsaturated cis-configured fatty acids in vitro such as linoleic acid and oleic acid. Human epithelial cells are not as sensitive to <i>saturated</i> fatty acids.</p> <p>Various factors indicate that fatty acid binding proteins in the cytoplasm help fatty acid uptake in human lens cells, and that the uptake of fatty acids is influenced by concentrations of albumin in physiological solutions.</p> <p>This study measured the concentration of albumin in aqueous humour and showed that there was a significant age-dependent increase in albumin from approximately 2 µmol/L (≤ 40 years) to approximately 4 µmol/L (80–90 years).</p> <p>Lens cell damage caused by fatty acids was increased due to high concentrations of albumin in aqueous humour in the elderly who already have cataracts. This may mean that lens cell damage caused by free fatty acids is a possible risk factor for age-related cataracts.</p> <p>The paper’s results support the hypothesis that unsaturated fatty acids are cytotoxic to lens epithelial cells <i>in culture</i>. However, this is at a physiological level, not a clinical level.</p> <p>In normal cases, blood fatty acid:albumin molar ratios can increase up to 1 (eg after meals); however, in people with risk factors for cataracts, such as diabetes, the ratio can rise even higher because of a decrease in albumin concentration or an increase in concentrations of fatty acids in the blood.</p>	This is an in vitro experiment (looking at a mechanism of fatty acid toxicity to lens)

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								In summary, it is possible that excessive fatty acid uptake (ie in excess of the body's requirements) causes lens cell damage; however it is still unclear how or if unsaturated fatty acids cause lens damage or cataract formation in vivo.	
3196	Lu 2005	Prospective cohort	Nurses' Health Study (women in Boston area aged 53–73 years with no previously diagnosed cancer, diabetes or cataract)	Long-term dietary fat intake (10–15 years)	Long-term dietary fat intake (10–15 years)	440	II (LPS)	<p>The study looked at whether long-term dietary fat intake affected the prevalence of nuclear opacities. The 18-carbon polyunsaturated fatty acids linoleic acid and linolenic acid were significantly associated with the prevalence of nuclear opacities. The ORs for developing nuclear opacities (comparing the highest and lowest quartiles of intake) were:</p> <ul style="list-style-type: none"> • Linoleic acid: 2.2 (95%CI 1.1 to 4.6; P[trend] = 0.02). • Linolenic acid: 2.2 (95%CI, 1.1 to 4.5; P[trend] = 0.05). <p>However, there were no significant associations of other types of fat intake with cortical or posterior subcapsular opacities.</p> <p>Discussion refers to three previous studies:</p> <p>(i) in the cross-sectional phase of the Blue Mountains Study (2000) the intake of polyunsaturated fatty acids reduced the prevalence of cortical cataracts</p> <p>(ii) in the Beaver Dam cohort study (1995) there was no association between nuclear opacities and total fat intake</p> <p>(iii) in a case-control study, Tavani et al (1996) showed that total fat intake was related to a higher risk of cataract extractions.</p>	
3343	Cummings et al 2000	Cross-sectional	Blue Mountains Eye Study	Dietary fat intake in the past year calculated from a food	NA	2900	IV (LPS)	Intake of poly-unsaturated fatty acids was associated with reduced prevalence of cortical cataract. Compared with the lowest quintile, whose median intake was 6.8 g/day, the highest quintile, whose median intake was 17.4 g/day, had a slight, but	

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				frequency questionnaire, including supplements				statistically significant, reduction in risk of cortical cataract (OR 0.7; 95%CI 0.6 to 1.2). This association remained after adjustment for multiple potential confounders (<i>P</i> for trend = 0.007).	

Summary	Group
<p>Most types of dietary fat do not appear to be associated with cataract. The Nurses' Health Study found that high intakes of the 18-carbon polyunsaturated fatty acids linoleic acid and linolenic acid were significantly associated with the prevalence of nuclear opacities. This is supported by in vitro studies, which have demonstrated a potential mechanism for epithelial lens cell damage by polyunsaturated fatty acids. However, more detailed studies are required, particularly studies which separate different types of polyunsaturated fatty acids, as there is conflicting evidence from cross-sectional studies.</p>	<p><i>Group 1</i> — Clear association/causality <i>Group 2</i> — Possible association/causality (more research needed) <i>Group 3</i> — Lack of association/causality <i>Group 4</i> — Possible lack of association/causality (more research needed) <i>Group 5</i> — Conflicting results <i>Group 6</i> — Possible protection <i>Group 7</i> — No studies</p>

Summary table 254 — fatty acids and glaucoma

Paper no.	Reference	Type of study	Population/ study information	Risk factor/intervention	Comparator	N	Level (quality)	Results	Other notes
3179	Cellini 1998	Nonrandomised control trial	30 chronic simple glaucoma patients and 30 controls	DHA + vitamin E and vitamin B supplements	Vitamin B	30	III-2	Patients were treated with TROFINERV (DHA, vitamin E and vitamin B complex) for 90 days. At the end of treatment, significant improvements were found in both the perimetric indices ($P < 0.05$) and the retinal contrast sensitivity ($P < 0.05$). These improvements were not noted for the control group, which received only B vitamins.	Intervention
3180	Kang 2004	Prospective cohort	Nurses' Health Study and Health Professionals Follow-Up Study (10-year follow-up)	Higher intake of dietary fatty acids	Lower fatty acid	47	II	<p>Looked at effect of dietary fatty acid consumption on primary open-angle glaucoma.</p> <p>Found that fats were not independently associated with increased POAG risk (no statistically significant risk for any type — total fat, saturated fat, monounsaturated or polyunsaturated).</p> <p>Found that there was a tendency for high ratio of n-3-ton-6 polyunsaturated fat to increase the risk of POAG (RR=1.49; 95%CI 1.11 to 2.01; P trend = 0.10) — this was stronger for high-tension POAG.</p> <p>States that further studies are needed to examine the association.</p>	

Summary	Group
The association of fatty acids and glaucoma is unclear from this literature. Further randomised control trials would be required to support recommending fatty acids as a treatment.	<p><i>Group 1</i> — Clear association/causality</p> <p><i>Group 2</i> — Possible association/causality (more research needed)</p> <p><i>Group 3</i> — Lack of association/causality</p> <p><i>Group 4</i> — Possible lack of association/causality (more research needed)</p> <p><i>Group 5</i> — Conflicting results</p> <p><i>Group 6</i> — Possible protection</p> <p><i>Group 7</i> — No studies</p>

Summary table 255 — fatty acids and macular degeneration

Paper no.	Reference	Type of study	Population/ study information	Risk factor /intervention	Comparator	N	Level (quality)	Results	Other notes
3164	Hodge et al 2007	Systematic review (1 RCT, 1 prospective cohort study [PC])	Information on Western populations (healthy people with visual impairment, consuming typical Western diet)	Low levels of omega 3 were examined as a risk factor in the PC; omega 3 supplementation was an intervention in the RCT	Higher levels of omega 3 fatty acid consumption in the PC; controls in the RCT	NA	I (Adequate)	<p>Looked at effect of omega 3 fatty acids on progression of ARMD (ie do they slow progression/do they decrease rate of progression to advanced form?).</p> <p>RCT showed that omega 3 fatty acids slowed the progress of AMD.</p> <p>PC only looked at evidence that omega 3 fatty acids decreased the rate of progression to advanced forms of AMD.</p> <p>Study authors concluded that the research was too scanty and of too poor quality to make any firm conclusions.</p>	Intervention studies

Paper no.	Reference	Type of study	Population/ study information	Risk factor /intervention	Comparator	N	Level (quality)	Results	Other notes
3243	Hodge et al 2006	Systematic review (1 prospective cohort, 2 cross-sectional; 1 retrospective cohort; 2 case-control)	Efficacy of dietary/supplementary omega 3 fatty acids in preventing AMD	Higher omega 3 fatty acid consumption	Lower	NA	I (Adequate)	<p>Found 6 observational studies, but the studies differed so much in outcomes, exposures and covariates that no meaningful comparisons or conclusions could be made.</p> <p>One prospective cohort study found that eating canned tuna/fish more than 4 times/week did help to protect against AMD:</p> <ul style="list-style-type: none"> • canned tuna: RR 0.61; 95%CI 0.45 to 0.83 • all fish: RR 0.65; 95%CI 0.46 to 0.91 • people who ate any type of fish more than 4 times/week had a lower risk than those who ate it < 3 times/month (RR 0.65; 95%CI 0.46 to 0.91). <p>However, there were some problems with this paper (eg other oily fish failed to show similar effect; no good control group).</p> <p>Overall, the review authors concluded that, because there were only 6 low-quality and disparate studies, no clinical recommendations/conclusions about the association between omega 3 fatty acid consumption and AMD could be made.</p>	

Summary	Group
<p>Although some studies suggest that omega 3 fatty acid consumption has a protective effect against AMD, the studies that have been done on this issue are not of very good quality and the results have been inconsistent. Further research with well-designed RCTs or prospective cohort studies is required to resolve this issue.</p>	<p><i>Group 1</i> — Clear association/causality <i>Group 2</i> — Possible association/causality (more research needed) <i>Group 3</i> — Lack of association/causality <i>Group 4</i> — Possible lack of association/causality (more research needed) <i>Group 5</i> — Conflicting results <i>Group 6</i> — Possible protection <i>Group 7</i> — No studies</p>

Summary table 256 — fatty acids and retinitis pigmentosa

Paper no.	Reference	Type of study	Population/ study information	Risk factor	Comparator	N	Level (quality)	Results	Other notes
3142	Hodge et al 2006	Systematic review (3 RCTs, 3 nonrandomised or non-controlled studies)	Retinitis pigmentosa patients, mostly in the United States	Interventions using fatty acid supplements	Placebos were used in the RCTs.	NA	I (Good)	Six studies published between 1995 and 2004 investigated the value of omega 3 fatty acids in slowing the progress of retinitis pigmentosa. Although trends of improvement in some retinitis pigmentosa outcomes were found, more research is required in this area.	

Summary	Group
Although trends of improvement in some retinitis pigmentosa outcomes were found in randomised control trials, more research is required in this area before fatty acids can be recommended as a therapy for retinitis pigmentosa.	<i>Group 1</i> — Clear association/causality <i>Group 2</i> — Possible association/causality (more research needed) <i>Group 3</i> — Lack of association/causality <i>Group 4</i> — Possible lack of association/causality (more research needed) <i>Group 5</i> — Conflicting results <i>Group 6</i> — Possible protection <i>Group 7</i> — No studies

Summary table 258 — diet and cataract

Paper no.	Reference	Type of study	Population/ study information	Risk factor	Comparator	N	Level (quality)	Results	Other notes
3354	Jacques et al 2005	Prospective cohort	Nurses' Health Study	Nutrient intake	Nutrient intake	408	II (LPS)	Nutrient intake was calculated from food frequency questionnaires and nuclear density was assessed using computer-assisted image analysis. Geometric mean 5-year change in nuclear density was inversely associated with intake of riboflavin (<i>P</i> trend = 0.03) and thiamin (<i>P</i> trend = 0.04) and duration of vitamin E supplement use (<i>P</i> trend = 0.006).	
3370	Schaumberg et al 2004	Prospective cohort	Nurses' Health Study and Health Practitioners Follow-Up Study	High glycaemic load	Lower glycaemic load	4865 incident age-related cataract extractions from an original study of 111,845	II (LPS)	After adjustment for age, cigarette smoking, body mass index, total caloric intake, dietary intake of lutein and zeaxanthin and alcohol consumption, there was no significant relation of dietary glycaemic load to risk of cataract extraction (<i>P</i> trend = 0.10).	
3336	Chasan-Taber et al 1999	Prospective cohort	Nurses' Health Study	Higher intake of carotenoids and vitamin A	Lower intake	1471 cataract extractions from an original population of 77,466	II (LPS)	After controlling for age and smoking those in the highest quintile of lutein and zeaxanthin intake had a 22% decreased risk of cataract extraction compared with those in the lowest quintile (RR 0.78; 95%CI 0.63 to 0.95). Intake of other carotenoids (α -carotene, β -carotene, β -cryptoxanthin, lycopene, vitamin A and retinol) was not associated with cataract. Increasing consumption of spinach and kale, which are high in lutein, was associated with a decreased risk of cataract.	

Paper no.	Reference	Type of study	Population/ study information	Risk factor	Comparator	N	Level (quality)	Results	Other notes
3361	Lyle et al 1999	Prospective cohort	Beaver Dam Eye Study	Higher intake of antioxidant nutrients	Lower intake	246 developed nuclear cataract from 1 354 eligible participants	II (LPS)	Nutrient intake was assessed using a food frequency questionnaire administered at baseline, with questions for the previous year and 10 years in the past. People in the highest quintile for lutein intake for 10 years in the past were half as likely to have an incident nuclear cataract as persons in the lowest quintile. Overall, nuclear cataract and intake of vitamin C or E were not significantly related, but these vitamins were inversely associated with opacities for people who had other suspected risk factors for cataract, such as smoking and hypertension.	
3340	Christen et al 2005	Prospective cohort	Women's Health Study	High fruit and vegetable intake	Lower fruit and vegetable intake	2067 cataracts and 1315 cataract extractions from an eligible cohort of 35,274	II	Compared with women in the lowest quintile of fruit and vegetable intake, women with high intakes had a 10–15% reduced risk of cataract (<i>P</i> trend < 0.05). However, no significant trend was observed for cataract extraction.	

Summary	Group
<p>Fruit and vegetables These studies suggest that a diet high in fruit and vegetables has a modest protective effect on cataract. This is especially true for spinach and kale, which are naturally high in the antioxidant lutein, found to be protective against nuclear cataract.</p> <p>Other nutrients Other nutrients such as riboflavin, thiamin, vitamin C and vitamin E may protect against cataract but further studies are required.</p> <p>Glycaemic load Glycaemic load does not appear related to the incidence of cataract.</p>	<p>Group 1 — clear evidence of causality (fruit and vegetables)</p> <p>Group 2 — possible causality (more research needed) (riboflavin, thiamin, vitamin C, etc)</p> <p>Group 3 — clear evidence of no causality</p> <p>Group 4 — possible lack of causality (more research needed) (glycaemic load)</p> <p>Group 5 — conflicting results</p> <p>Group 6 — possible protection</p> <p>Group F — no studies</p>

Summary table 260 — diet and diabetic retinopathy

Paper no.	Reference	Type of study	Population/ study information	Risk factor	Comparator	N	Level (quality)	Results	Other notes
2780	Millen et al 2004	Prospective cohort	The Atherosclerosis Risk in Communities Study (subjects with type 2 diabetes)	Higher dietary vitamins C and E (or supplements)	Lower dietary vitamins C and E (or no supplements)	224 patients with retinopathy of 1353 subjects	II	No association was found between diabetic retinopathy and intake of vitamin C or E from food, or a combination of food and supplements. A decreased odds of retinopathy was found among users of vitamin C (OR 0.5; 95%CI 0.3 to 0.8), vitamin E (OR 0.5, 95%CI 0.2 to 0.8) or multisupplements (OR 0.4; 95%CI 0.2 to 0.9) compared with those who did not use supplements. Supplements may protect against retinopathy, or supplement use may be associated with lifestyle characteristics that protect against retinopathy. The authors state that only two previous studies investigated the relationship between nutrient intake and diabetic retinopathy. The San Luis Valley Diabetes Study found a direct association between intake of antioxidants and retinopathy, while the National Health and Nutrition Examination Survey found no association of serum ascorbic acid and α -tocopherol concentrations and retinopathy in people with diabetes. However, these studies were limited by cross-sectional designs and focus on short-term dietary recall.	

Summary	Group
Although in vitro and animal studies have suggested that vitamins E and C may protect against the development of retinopathy, there is insufficient evidence from epidemiological studies to confirm this protective effect.	<i>Group 1</i> — Clear association/causality <i>Group 2</i> — Possible association/causality (more research needed) <i>Group 3</i> — Lack of association/causality <i>Group 4</i> — Possible lack of association/causality (more research needed) <i>Group 5</i> — Conflicting results <i>Group 6</i> — Possible protection <i>Group 7</i> — No studies

Summary table 261 — diet and glaucoma

Paper no.	Reference	Type of study	Population/ study information	Risk factor	Comparator	N	Level (quality)	Results	Other notes
3180	Kang et al 2004	Prospective cohort	Nurses' Health Study and Health Professionals Follow-Up Study	Higher dietary fatty acids	Lower dietary fatty acids	474 confirmed cases of POAG from a total study of 116 505	II (LPS)	Major fats and fat subtypes were not independently associated with risk of developing primary open-angle glaucoma (POAG). There was positive association between a higher ratio of n-3 to n-6 polyunsaturated fat and risk of POAG (RR 1.49; 95%CI 1.11 to 2.0, <i>P</i> = 0.10), a relationship which was stronger for high tension POAG (RR 1.68; 95%CI 1.18 to 2.39, <i>P</i> = 0.009).	
2774	Kang et al 2003	Prospective cohort	Nurses' Health Study and Health Professionals Follow-Up Study	Higher dietary antioxidants	Lower dietary antioxidants	474 confirmed cases of POAG from a total study of 116 505	II (LPS)	There were no strong associations between consumption of antioxidants (α -carotene, β -carotene, β -cryptoxanthin, lycopene, lutein/zeaxanthin, vitamin C, vitamin E and vitamin A) and POAG.	

Summary	Group
These prospective studies suggest that diet, specifically fatty acids and antioxidants, is neither a causative nor a protective factor for primary open-angle glaucoma.	<p><i>Group 1</i> — Clear association/causality</p> <p><i>Group 2</i> — Possible association/causality (more research needed)</p> <p><i>Group 3</i> — Lack of association/causality</p> <p><i>Group 4</i> — Possible lack of association/causality (more research needed)</p> <p><i>Group 5</i> — Conflicting results</p> <p><i>Group 6</i> — Possible protection</p> <p><i>Group 7</i> — No studies</p>

Summary table 262 — diet and macular degeneration

Paper no.	Reference	Type of study	Population/ study information	Risk factor	Comparator	N	Level (quality)	Results	Other notes
3275	Tomany et al 2001	Prospective cohort	The Beaver Dam Eye Study	Higher coffee and caffeine intake	Lower coffee and caffeine intake	3435	II	Coffee and caffeine consumption were not associated with the 5-year incidence of early age-related maculopathy, soft indistinct drusen or pigmentary abnormalities.	
3266	Seddon et al 2003	Prospective cohort	Patients attending a hospital-based clinic specialising in macular degeneration	Higher dietary fat intake	Lower dietary fat intake	261	II	After controlling for other factors, people in the highest quintile of total fat intake had an increased risk of progression to advanced AMD relative to the lowest quintile (RR 2.90; 95%CI 1.15 to 7.32). An increased risk was found for animal, vegetable, saturated, monounsaturated, polyunsaturated and transunsaturated fats. In contrast, fish and nuts were protective against AMD.	
3225	Cho et al 2004	Prospective cohort	Nurses' Health Study and Health Professionals Follow-Up Study	≥ 3 servings of fruit	< 1.5 servings of fruit	464 cases of early ARM and 316 cases of neovascular ARM from 118,428 original participants	II	Participants who had consumed 3 or more servings of fruit per day had a lower risk of neovascular ARM compared with those who consumed fewer than 1.5 servings of fruit per day (RR 0.64; 95%CI 0.44 to 0.93). Significant results for either early or neovascular ARM were not found for vegetables, antioxidant vitamins or carotenoids.	
3222	Chiu et al 2006	Prospective cohort	Nurses' Health Study	Higher carbohydrate quantity or quality (high quality defined as low glycaemic index)	Lower carbohydrate quantity or quality	1036 eyes without previous ARM diagnosis	II	Those in the highest tertile of dietary glycaemic index (≥ 77) were more likely to develop ARM (OR 2.71; 95%CI 1.24 to 5.93) than those in the lowest tertile (< 74.6). This relationship was found for retinal pigmentary abnormalities but not for drusen. Total carbohydrate intake was not related to ARM.	

Paper no.	Reference	Type of study	Population/ study information	Risk factor	Comparator	N	Level (quality)	Results	Other notes
2792	Cho et al 2001	Prospective cohort	Nurses' Health Study and Health Professionals Follow-Up Study	Higher zinc	Lower zinc	384 cases of AMD from 104,208 participants	II	Moderate zinc intake, in food or from supplements, was not associated with a reduced risk of AMD.	
2798	Flood et al 2002	Prospective cohort	Blue Mountains Eye Study	Higher antioxidant vitamins and zinc	Lower antioxidant vitamins and zinc	159 eligible participants developed ARM from 2335 people	II	After adjusting for age, sex, family history and smoking, no evidence was found for a protective effect of dietary antioxidant or zinc intake from ARM. However, compared with the lowest quintile, increased intakes of vitamin C were associated with an increased risk of early ARM (OR 1.7; 95%CI 1.0 to 3.0 and OR 2.3; 95%CI 1.3 to 4.0 for the fourth and fifth quintiles). The authors could not explain this association, but suggested that it could be a chance finding.	

Summary	Group
A low-fat, low-glycaemic diet high in fruit, fish and nuts may be protective against the onset of age-related macular degeneration. Other factors, such as zinc, coffee or carbohydrate intake, were not related to AMD. Further research is required before any supplements could be recommended.	<p><i>Group 1</i> — Clear association/causality</p> <p><i>Group 2</i> — Possible association/causality (more research needed)</p> <p><i>Group 3</i> — Lack of association/causality</p> <p><i>Group 4</i> — Possible lack of association/causality (more research needed)</p> <p><i>Group 5</i> — Conflicting results</p> <p><i>Group 6</i> — Possible protection</p> <p><i>Group 7</i> — No studies</p>

Summary table 264 — diet and trachoma

Paper no.	Reference	Type of study	Population/ study information	Risk factor	Comparator	N	Quality	Results	Other notes
1962	Fine and West 1997	Cross-sectional	Children under 5 years of age in Tanzania	Malnutrition	NA	189	IV	No association was found between malnutrition (defined by a mid-arm circumference less than 12.5 cm or a value one standard deviation below the age-specific mean) and trachoma.	

Summary	Group
Numerous studies have shown that malnutrition predisposes an individual to infections, due to immunological deficits. Although they share risk factors such as poor hygiene and low socioeconomic status, this study did not find an association between malnutrition and trachoma.	<i>Group 1</i> — Clear association/causality <i>Group 2</i> — Possible association/causality (more research needed) <i>Group 3</i> — Lack of association/causality <i>Group 4</i> — Possible lack of association/causality (more research needed) <i>Group 5</i> — Conflicting results <i>Group 6</i> — Possible protection <i>Group 7</i> — No studies

