

The Global Fruit & Veg Newsletter



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Nutrition and Eye Health

Despite being an extremely active field of research, ocular nutrition remains relatively unknown to both health professionals and patients. Downie *et al.* have shown that patients have high expectations when it comes to getting advice on their diet. Opticians appear to be good people to talk to on the topic.

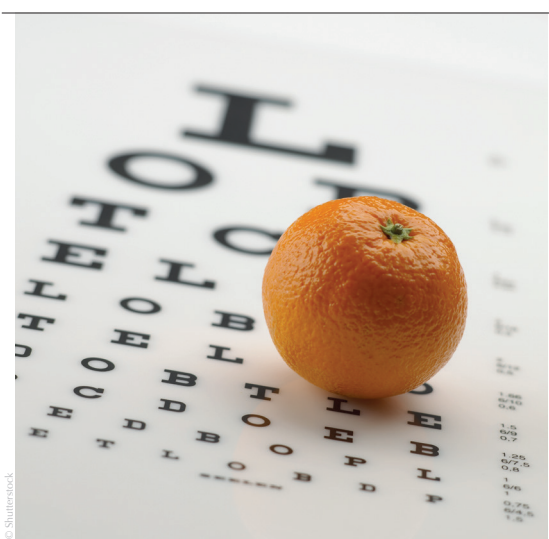
Physiopathological and epidemiological data has been accumulating for some twenty years or so. Lens opacification can lead to the development of cataracts. Incidentally, this organ contains 50 times more vitamin C than plasma. Similarly, the macular pigment of the retina contains two carotenoids, lutein and zeaxanthin, which act as both blue light filters and in situ antioxidants. Eisenhauer *et al.* have produced an overview of dietary sources of lutein and zeaxanthin and their bioavailability. The foods with the highest levels are leafy vegetables, with spinach and kale leading the field followed by cabbage, lettuce, parsley - and pistachio nuts. Meanwhile, the bioavailability of the lutein and zeaxanthin in eggs is remarkable, despite the low levels contained.

Epidemiological studies have confirmed the relationship between lifestyle and the appearance of a number of eye diseases. One such is the Nurses' Health Study, which has been reviewed by Kang *et al.* As well as smoking, which creates harmful oxidative stress, they have demonstrated an inverse relationship between cataracts and carotenoids and other antioxidant nutrients, and between age-related macular degeneration and carotenoids, in addition to other factors like low glycaemic load in interaction with genetic factors.

So, to be on the safe side, let's make sure we eat healthily.

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What the Nurses' Health Study has to tell us about maintaining eye health

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Loss of sight is a major cause of disability in the USA and greatly affects quality of life. By 2050, the number of Americans aged over 65 will have doubled, and the prevalence of the main causes of age-related vision changes (cataracts, AMD – age-related macular degeneration, glaucoma) will increase significantly. Not only has considerable progress been made in treating such diseases, but we have also significantly increased our understanding of what mechanisms are involved, what the important risk factors are and what may help for prevention.

The Nurses' Health Study (NHS) data was used in order to better understand how genetic factors and lifestyle might influence the occurrence of age-related disorders; the studies using these data from the period 1976 – 2016 are reviewed. This extensive and substantial long-term prospective study offered an incredible opportunity for epidemiological research into eye diseases. To use this large cohort's data, we used methods that would enable a valid assessment of the risk factor relationships involved in these sight disorders.

First, we initially relied on nurses' self-report of having reported receiving a medical diagnosis (of eye disease) in the first step of identifying cases; given their medical training as health professionals, the self-reports of being diagnosed with eye diseases by a physician were considered reliable. Second, for each eye disease, we developed precise definitions that maximised data specificity, thus avoiding bias, and for some diseases confirmed the self-reports using medical records with those definitions. Lastly, we included only those reporting having had eye examinations, in order to be able to perform sufficiently sensitive, valid statistical analyses.

Cataract

If left untreated, cataracts are the leading cause of blindness worldwide. Cataracts represent an opacification of the crystalline lens (the eye's main lens, which performs one of sight's primary functions, known as accommodation; without this, objects would appear blurred). The only treatment is surgery (removal of the opacified crystalline lens and its replacement with an intraocular implant to restore clarity). The mechanisms underlying cataract formation are not clear. Crystalline lenses are normally transparent, but they become opaque as a result of protein aggregation and precipitation. There are three types of cataract, depending on the location of the opacity—nuclear, cortical, and posterior subcapsular—each of which could have a different cause. We conducted two types of studies for cataract; one by survey and one by in-person eye exams in a subset of participants. For the survey based studies, we defined cataract as the report of cataract surgery among those over 45 years of age, and in the in-person exam study, cataract was defined as the gradual opacification of the lens, confirmed by an eye examination in Boston, for subjects over 50 years of age.

• Smoking

Age, cumulative ultraviolet light exposure, and smoking are now considered established risk factors for cataracts: 20% are thought to be due to smoking, which induces oxidative stress and is associated with lower levels of antioxidants in the blood. In the NHS study, we observed that smoking 65 or more packs-years was associated with a 1.5 to 1.8 times greater risk of cataract extraction and that there was a dose/response effect in smokers. Furthermore, we observed an inverse relationship with stopping smoking: former smokers who had stopped smoking for 25 years or more had a 20% lower risk of cataract extraction, especially for those who had smoked two or more packs per day, although the risk did not fall to the same level as that of never smokers. In prevention terms, this provides support for the importance of never

smoking or stopping smoking.

• Role of antioxidants and fruit and vegetables

Antioxidants, such as vitamins C and E, are natural defences against oxidative stress. Vitamin C is present in the lens at more than 50 times the concentration found in plasma, and in the NHS study, vitamin C and E supplements used for 10 years or more, especially among non-smokers and women under 60 years old, was associated with a 20 to 30% lower risk of lens surgery.

We evaluated the influence of carotenoids on the development of cataracts. High intake of vitamin A, lutein or zeaxanthin (in which spinach and kale are particularly rich) were associated with a 20 to 30% lower risk of cataract extraction. However, trials using supplements of various vitamins have not demonstrated convincing protective effects. Nonetheless, the US National Eye Institute recommends eating "green leafy vegetables, fruit, and other foods with antioxidants" as part of a lifestyle that may help to lower cataract risk. We were also able to confirm that type 2 diabetes and obesity were risk factors.

Age-related Macula Degeneration (AMD):

AMD is a deterioration of part of the retina (macula), which can result in loss of central vision whilst the peripheral vision is maintained. It is of multifactorial origin and affects people aged over 50, with 15% of 85-year-olds being affected in the USA. It has a number of stages, starting with the accumulation of drusen (whitish deposits that can be seen at the back of the eye) in the macula (age-related maculopathy, or ARM, 'dry' type) before developing into the late degenerative type (atrophic or 'wet' AMD) which results in loss of central vision.

Age, family history, and smoking are all risk factors for AMD. In addition to genetic factors, our study confirmed an association with smoking.

As for dietary factors, we observed that higher consumption of F&V containing significant amounts of lutein or zeaxanthin was associated with 25 to 35% lower AMD risk. We also found that the consumption of carbohydrates with a high glycaemic index was strongly associated with higher risk of AMD.

Glaucoma

The most common type This eye disease primarily affects people aged 40 or over, owing to an increase in intraocular pressure causing damage to the optic nerve (which sends visual information to the brain) and thereby diminishing the field of vision. Intraocular pressure is the currently the only known modifiable factor. The NHS study supported the role of type 2 diabetes in increasing intraocular pressure (82% higher risk). The relationship between antioxidants and glaucoma is not well known, and the NHS study did not reveal a relationship with smoking or the consumption of fats or antioxidants. However, we were able to demonstrate an association between consuming large amounts of nitrates (a source of nitric oxide, NO, itself a powerful vasodilator), which abound in leafy green vegetables, and around a 20% lower risk of primary open-angle glaucoma.

In conclusion, as well as regular eye exams, our study has made a major contribution to our understanding of what approaches may be important to prevent age-related eye disease for age-related eye diseases, namely:

- refraining from cigarette smoking or stop smoking
- keeping a healthy diet a weight and lifestyle to avoid diabetes
- eating a diet containing plenty of fruit and vegetables (particularly those high in carotenoids and green leafy vegetables).

based on: Jae H. Kang et al. Contribution of the Nurses' Health Study to the Epidemiology of Cataract, Age-Related Macular Degeneration, and Glaucoma . Am J Public Health. 2016 September; 106(9): 1684–1689.

Lifestyle factors and the role of optometrists: patients' perceptions and experiences

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Tobacco smoking, nutrition and ocular health

Tobacco smoking and nutrition are key lifestyle factors that are established to have long-term effects on ocular health. Tobacco smoking is the most important modifiable risk factor for age-related macular degeneration (AMD)¹, with current smokers having an at least two-fold increased risk of developing AMD compared with individuals who have never smoked^{2,3}. In addition, there is epidemiological evidence that diets rich in certain nutrients, in particular the macular carotenoids (lutein and zeaxanthin) and omega-3 fatty acids, are associated with a decreased risk of late-stage AMD⁴.

However, little is known about patients' perceptions and experiences in these areas in relation to the care provided by optometrists, being major providers of primary eye care in the community. The major aim of this study was to survey patients' perceptions and prior experience regarding the role of optometrists in enquiring and providing advice about tobacco smoking and nutrition.

The perceptions and experiences of 220 patients with respect to optometric care

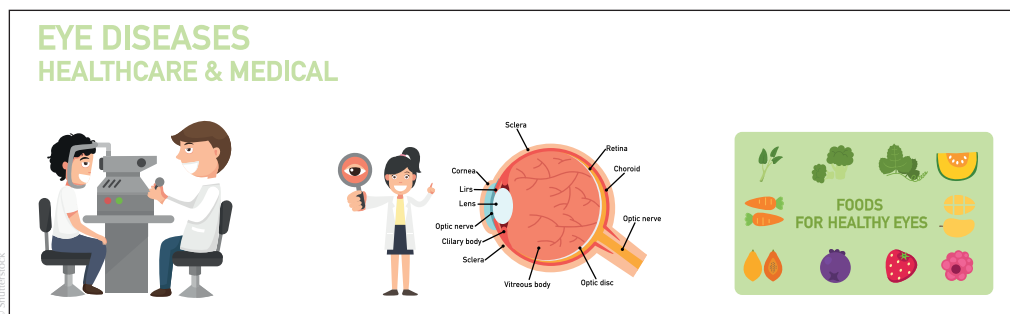
An anonymous survey was distributed to adults who were attending an eye test, with an optometrist at, the University of Melbourne eye care clinic, Parkville, Victoria, Australia. Survey respondents provided demographic and other relevant information (e.g., age, gender, length of time since last eye examination, country of most recent eye examination, smoking status and nutritional supplement intake) and indicated their level of agreement, on a five-step Likert scale, with several statements relating to the care provided by optometrists in the areas of general health, smoking and nutrition. The statements assessed the perceived scope of optometric practice and the extent to which the survey respondents expected, and felt comfortable, discussing these topics with their optometric care provider. A total of 220 completed surveys were included in the analysis.

For one in three respondents, their optometrist had questioned them about their diet

More than 80 percent of survey respondents agreed that they visit their optometrist to measure their refractive error and to assess the health of their eyes. Two out of three survey respondents indicated that they expect their optometrist to ask about their general health, with almost half expecting their optometrist to communicate with their general medical practitioner. About one-third of respondents indicated that their optometrist had routinely questioned them about their smoking status, diet and nutritional supplement intake. This was despite about half of respondents expecting their optometrist to question them about these factors and almost three out of four respondents indicating that they felt comfortable talking with their optometrist about these lifestyle behaviours.

This study provides the first insight into patients' perceptions and experience with Australian optometric practice, in the areas of tobacco smoking and nutrition. We find that most people attending an eye examination in Australia expect their optometrist to examine their eye health, ask them about their smoking and diet habits, and are comfortable discussing these topics with their primary eye care provider. These findings demonstrate that patients recognize the expertise of optometrists in providing care that includes the evaluation of eye health. Our study findings also highlight that brief advice interventions relating to tobacco use and diet are likely to be acceptable to deliver in optometry consultations.

Concerning nutrition counselling, optometrists are well positioned to provide simple advice on healthy dietary behaviours to their patients. The Macular Disease Foundation of Australia encourages a healthy, balanced diet including the intake of coloured vegetables daily. More complex, nutrition-focussed healthcare could then be achieved through appropriate co-management with general practitioners and/or other health professionals, such as dieticians, to achieve desirable lifestyle changes.



Based upon : Downie LE, Douglass A, Guest D, Keller PR. What do patients think about the role of optometrists in providing advice about smoking and nutrition? *Ophthalmic Physiol Opt.* 2017 Mar;37(2):202-211.

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Lutein and Zeaxanthin intake & Age-Related Macular Degeneration Protection

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The objectives of our recent work were to examine the literature and evaluate the link between L/Z intake and AMD risk and describe food sources and factors that increase the bioavailability of L/Z, to inform dietary models.

Eyes & carotenoids: importance of lutein and zeaxanthin

Among thirty carotenoids identified in human blood and tissues, only lutein and zeaxanthin (L/Z) are found in the eye. L/Z are the major constituents of macular pigment, a compound concentrated in the macula region of the retina that is responsible for fine-feature vision. Age-Related Macular Degeneration (AMD) is one of the leading causes of blindness in older adults in the developed world. US research has forecast that the number of patients with AMD is likely to double between 2010 and 2050, and this disease is becoming a crucial public health issue¹.

Cohort studies and clinical trials showed that L/Z may prevent and/or slow the progression of this disease. A 2012 systematic review and meta-analysis of six longitudinal cohort studies found a 32% risk reduction of neovascular AMD among those people who consumed the highest category of L/Z compared to those who consumed the lowest².

Recommended intake for Lutein and Zeaxanthin

Nowadays, there are no official recommended dietary intake levels for L/Z. A study published in 1994 showed that an intake of 6 mg/d of L/Z could reduce the risk of AMD³. However, 2 recent studies (AREDS2 and the BMES) consider that a level of L/Z intake less than 6 mg/d is associated with a decreased likelihood of AMD⁴.

Data on population L/Z intake is limited and varies depending on countries:

- In Europe, the average daily intake of major carotenoids (including retinol, alpha-tocopherol, beta-carotene, alpha-carotene, beta-cryptoxanthin, lutein, zeaxanthin, and lycopene) ranges from 3.5 mg/d in the Spanish population to 5.33 mg/d in the German population⁵.
- In an American study of older adults, L/Z consumption was 2.7 mg/d for men and 3.09 mg/d for women⁶. Another study estimated that American adults consume approximately 1–2 mg/d of lutein⁷.
- In an Australian study of older adults, the average L/Z intake was 0.9 mg (slightly higher for women)⁸.

In US and Australia, we have also seen that the national intakes of lutein may be declining due to the decrease of fruit and vegetable consumption^{9,10}.

Dark green leafy vegetables, eggs and fruits: source of lutein and zeaxanthin

Dark green leafy vegetables, like kale and spinach, are the most important source of lutein and zeaxanthin. It's important to note that the cooking method may change the content of lutein and zeaxanthin: for example, raw spinach contains 12 197 µg/100g of lutein and zeaxanthin while cooked spinach contains 11 308 µg/100g¹¹.

Eggs are also an important source of lutein and zeaxanthin. Nevertheless, the amount is more important in the raw egg yolk (1094 µg/100g), and when the whole egg is raw (504 µg/100g)¹¹.

Avocado and orange are the fruits that contain the most lutein and zeaxanthin, with amounts of 270 µg/100g and 129 µg/100g, respectively¹¹.

The original article presents two examples of menus providing a certain amount of lutein and zeaxanthin, proving that effective levels of L/Z can be achieved through diet alone, with values of 5 mg or 10 mg per day. These diet models show the availability of L/Z from different types of foods: dark green leafy vegetables, pistachio nuts and eggs, and must be adapted according to the country.

Factors affecting absorption and bioavailability of dietary carotenoids

The absorption of certain carotenoids is shown to be increased effectively by the addition of fat to the meal containing carotenoid; for example, we can add olive oil to the salad, or cooking oil like extra virgin olive oil, or even a whole egg.

However, when consumed within the same meal, there's a competition for absorption between carotenoids. This competition may decrease the bioavailability of carotenoids.

Moreover, it has been shown that carotenoid absorption is reduced by dietary fiber from plant sources (e.g. pectin and guar gum), and carotenoids bioavailability may be decreased if they are located within the chloroplasts and chromoplasts of plants.

Despite the fact that eggs contain a lower amount of L/Z than most containing vegetables, the bioavailability of these compounds from eggs is higher, most likely due to the fat content.

Current evidence suggests that we can be protected against AMD by consuming foods that contain high amounts of lutein and zeaxanthin. In order to achieve adequate dietary levels of L/Z, it's important to have a diet high in a variety of foods, including plenty of leafy green vegetables.

Based on: Eisenhauer, B.; Natoli, S.; Liew, G.; Flood, V.M. Lutein and zeaxanthin-food sources, bioavailability and dietary variety in age-related macular degeneration protection. *Nutrients* 2017, 9, 120.

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