

# Smoking and eye disease

## Introduction

Tobacco smoke is composed of at least 7000 active chemicals, most of them toxic and potentially damaging to the eye.<sup>1</sup> Smoking can cause or worsen several eye disorders, in particular Age-related Macular Degeneration (AMD), which may lead to blindness.<sup>2</sup> According to the RNIB, every day 100 people in the UK start to lose their sight. Yet over 50 per cent of sight loss can be avoided.<sup>3</sup>

## How smoking affects sight

Ongoing exposure to tobacco smoke generates biological changes in the eye that can lead to vision loss. Heavy exposure to secondhand smoke, such as living with a smoker for at least five years, can also cause these changes.<sup>4,5</sup>

The chemicals in tobacco smoke reduce the body's ability to protect itself by concurrently increasing the levels of oxidants and decreasing the levels of antioxidants in the body.<sup>1</sup>

High blood pressure, directly caused by smoking, is a risk factor for macular degeneration. Smoking causes blood vessels to narrow throughout the body, including the blood vessels to the eye.<sup>1</sup>

Smoking also reduces the amount of oxygen in the blood so less oxygen reaches the macula.<sup>6</sup>

Research suggests that cigarette smoke related tar triggers the formation of deposits in the retina (drusen) which mark the start of macular degeneration.<sup>7</sup>

In short, repeated exposure to tobacco smoke accelerates the body's ageing process, including that of the eyes.<sup>8</sup> The best way to avoid some of the related sight loss is by quitting smoking.

## Benefits of stopping smoking

Stopping smoking can halt or reverse damage to the eyes, depending on the severity and type of disease.<sup>9</sup> In the case of AMD, smokers are at least twice as likely to develop it<sup>9</sup> and former smokers have only a slightly increased risk compared with never smokers.<sup>10</sup> A British study of people aged 75 or older found that those who had quit smoking for 20 years or more had the same risk of developing AMD as non-smokers.<sup>9</sup> This is supported by the findings of the 2010 US Surgeon General's Report.<sup>1</sup> Since there is also a dose-response relationship between smoking and AMD,<sup>1,11,12,13,14</sup> quitting smoking early in life is important. Stopping smoking reduces the risk, over time, of developing or exacerbating AMD.<sup>11,15</sup> In the 2005 British study mentioned above, it was estimated that 28,000 older people in the United Kingdom had AMD that was most likely related to smoking.<sup>9</sup> More recent data are not available.

A US study found that, compared with men who continued to smoke, those who had quit 20 years or more before entry into the study had an approximately 21% reduced risk of cataract

extraction.<sup>16</sup> A Swedish study found that the greater the number of cigarettes smoked, the longer it took after quitting to reduce the risk of cataract development to that of a non-smoker.<sup>17</sup>

A review of AMD studies found that smoking cessation was associated with a marked, non-linear decrease of the risk of progression to AMD.<sup>18</sup>

Quitting smoking is also one of the key aspects of treatment for acute (active) thyroid eye disease (TED).<sup>19,20</sup> Smoking cessation can also reduce the rate of onset of TED and the severity of the disease.<sup>22</sup>

## Cataracts

A cataract is a clouding in the lens of the eye that causes blurred vision and, if left untreated, can lead to vision loss.<sup>21,22</sup> Cataracts often develop as part of the normal ageing process.

Smoking is a major risk factor in the development of cataracts.<sup>19,23,24</sup> A review of the evidence revealed that smoking increases the risk of a particular type of cataract – nuclear cataracts.<sup>1,23</sup> Compared with never smokers, smokers of 20 or more cigarettes per day are at least twice as likely to develop a nuclear cataract.<sup>24</sup> A smoker's risk of developing cataracts increases with the amount smoked; cataracts are more severe in heavy smokers than in light smokers.<sup>19,25</sup>

Antioxidants help maintain lens transparency. Although the exact mechanism by which smoking causes cataracts to develop is not fully understood, the destruction of antioxidant nutrients by tobacco smoke is a plausible hypothesis.<sup>26</sup> Cigarette smoking may also break down other micronutrients critical to healthy eye tissues.<sup>22</sup>

## Age-related macular degeneration (AMD)

Age related macular degeneration (AMD) is an umbrella term for a variety of degenerative changes in the macula, the small central area of the retina at the back of the eye which is responsible for clear, central vision.<sup>1</sup> When the macula is affected, vision becomes blurred, distorted and dark in the centre (this is called a scotoma).<sup>22</sup> Although peripheral vision is not affected by AMD, loss of central vision means that everyday activities such as reading, driving and watching television, cannot be performed.<sup>22</sup>

Smoking is the major preventable risk factor for AMD (both wet and dry forms).<sup>23,27</sup> Smoking at least doubles or triples the risk of developing AMD, which tends to develop earlier in smokers.<sup>14,28,29</sup> As mentioned above, there is a dose-response relationship with the number of pack-years of smoking.<sup>1,14,30,31</sup>

Smoking causes oxidative stress and damages the retina, reduces blood flow in eye tissue, and promotes ischaemia, hypoxia, and micro-infarctions.<sup>1,18</sup> It also causes cell death to retinal pigment epithelium cells,<sup>32,33</sup> likely through one of the toxic chemicals present in tobacco smoke, benzo(e)pyrene, as was found in an in vitro study.<sup>34</sup>

Smokers are more likely to suffer from all types of AMD and more likely to develop the disease ten years earlier than non-smokers.<sup>35</sup>

The risk of developing AMD is also greater for smokers with a genetic predisposition.<sup>36,37,38</sup> The interaction between genetics and smoking is also a factor to be considered.<sup>31,39,40</sup> Since scientists are just beginning to determine who is at greatest risk, based on their genetic make-up and smoking status, the best way to avoid this additional risk is to not smoke.<sup>38</sup>

It has been estimated that smoking accounts for between 40,000 and 60,000 cases of AMD with sight loss in people aged 70 and over in the UK, of whom around 17,800 are blind.<sup>9</sup>

## Diabetic retinopathy

Diabetic retinopathy is an eye complication associated with diabetes in which the blood vessels that supply the retina are damaged by high blood sugar levels.<sup>26,41</sup> When these blood vessels become damaged, they may leak fluid or blood and grow scar tissue which can distort the images the retina sends to the brain.<sup>42</sup> This can eventually lead to blindness.<sup>43,44</sup>

Smoking is a significant risk factor for developing diabetic retinopathy.<sup>45</sup> In one Brazilian study, smoking more than doubled and almost tripled the risk of developing advanced diabetic retinopathy.<sup>46</sup> Smoking may accelerate the development of this condition or, as shown in some studies, worsen it, because smoking damages blood vessels.<sup>47,48,49</sup>

A possible mechanism leading to damage of the retina is smoking-induced hypoxia.<sup>50</sup> This condition is a result of diminished oxygen in the blood, with a corresponding increase in carbon monoxide.<sup>51,52</sup> Smoking also increases blood pressure and raises blood sugar levels in diabetics, therefore making it harder to control the diabetes.<sup>53</sup> For further information about smoking and diabetes see [ASH Fact Sheet: Smoking and Diabetes](#).

## Thyroid eye disease (TED)

In Graves' disease, the thyroid gland becomes overactive, secreting too much thyroid hormone.<sup>26</sup> An eye disorder known as thyroid eye disease (TED) is a serious complication. Protrusion of the eyes, double vision, and loss of vision, sometimes causing blindness, can occur. Several years ago, the Royal College of Ophthalmologists estimated that around 400,000 people then had thyroid eye disease in the UK.<sup>54</sup>

There is strong evidence for a causal association between smoking and the development of thyroid eye disease.<sup>55,56</sup> People with Graves' disease who smoke have a four-fold increased risk of developing these eye complications compared to non-smokers.<sup>20,57</sup> Smokers also have a higher risk of the more advanced eye problems and the risk is elevated seven-fold in heavy smokers.<sup>20</sup> The reason for smokers' increased risk of eye disorders in this condition is not fully understood but it is believed to be due to a smoking-induced impairment of the immune system.<sup>24</sup> Furthermore, response to treatment can be delayed or its efficacy reduced among smokers.<sup>20</sup>

## Optic neuropathy

Anterior ischaemic optic neuropathy (AION) is an eye disease that results in a sudden, painless loss of vision, often leading to permanent blindness.<sup>24,58</sup> It occurs because of reduced blood flow in the arteries to the eyes.<sup>26</sup> Atherosclerosis – clogging of the arteries – may be responsible for AION. Smokers are at a 16-fold increased risk of developing AION compared with non-smokers.<sup>26</sup> Furthermore, smokers develop optic neuropathy at younger ages: in one study smokers were found to develop the disease at an average age of 52 and non-smokers at an average age of 64.<sup>24</sup>

## Passive smoking and eye disease

Non-smokers often complain of eye irritation when exposed to tobacco smoke, which was found to be experienced by 82% of individuals in one study.<sup>59</sup> There is currently limited evidence about the risks of passive smoking and eye disease.<sup>60</sup> One major study found that passive smoking was associated with increased risk of late AMD although the association was not statistically significant,<sup>60</sup> while a more recent study found that passive smoking almost doubled a person's risk of developing AMD.<sup>61</sup> Passive smoking is a risk for developing thyroid eye disease (TED).<sup>62</sup> Children born to women who smoke during pregnancy are prone to developing strabismus (squinting).<sup>63</sup>

More research is needed to determine which other eye diseases are caused by passive smoking. Our already extensive knowledge on the toxicology of secondhand smoke and on its potential effects on the eye suggests that passive smoking may well play a role in both the development of certain eye diseases and on treatment outcomes.<sup>60</sup>

### Public awareness

A 2013 survey carried out in the UK found that just 15% of smokers are concerned about the impact smoking has on their eye health.<sup>64</sup> This is likely because public awareness about the risk of eye diseases associated with smoking is very low.<sup>65,66,67</sup> AMD is the least well-known eye condition, with 29% of people in Great Britain in 2012 saying they had never heard of it. In another UK survey, only 49% of respondents were aware of the link between smoking and loss of sight, while the corresponding rate in Australia was 77%.<sup>69</sup>

A study of UK teenagers found that only 5% identified smoking as a cause of blindness but, even at that age, fear of blindness was a strong motivating factor in quitting smoking.<sup>70</sup> The possibility of becoming legally blind also clearly motivates adults to quit,<sup>71,72</sup> with one study showing it to be as important as fear of lung cancer, heart disease, and stroke.<sup>73</sup> Another survey of UK smokers found that seven out of ten smokers (69%) say they would stop or reduce consumption if they thought smoking could harm their eyesight.<sup>74</sup> Messages related to smoking and blindness could therefore have a significant impact on changing smoking behaviour – and consequently reducing loss of vision – but only if smokers are made aware of the risks.

### Education campaigns

Mass media campaigns in Australia and New Zealand have been very successful in raising awareness about the risk of eye diseases associated with smoking. As early as the year 2000, the Australian National Quit campaign ran an advertisement as part of a series entitled, “Every cigarette is doing you damage,” which explicitly addressed AMD.<sup>75</sup> Since 2002, the Australian government has also required that one of the mandatory pictorial pack warnings be about blindness.<sup>76,77</sup> An Australian study showed that information about the association between smoking and macular degeneration leading to blindness generated more calls to quitlines than “tar” advertisements.<sup>78</sup> Recent surveys have shown that awareness of the link between smoking and vision loss is significantly higher in Australia than in the UK, Canada or the US, where smokers had not been exposed to either tobacco pack warnings or mass media campaigns related to blindness and smoking.<sup>79,80,81</sup> Australia’s approach is clearly working.

A 2010 cross-sectional study of smokers and non-smokers in Singapore and Scotland found that over half of the respondents indicated that pack warnings about blindness would be effective in discouraging them from smoking.<sup>66</sup>

On October 1, 2008, the UK introduced picture warnings on cigarette packets,<sup>82</sup> but these warnings have not included information about smoking and blindness. In March of 2012, the European Commission formally adopted the new warning “smoking increases the risk of blindness,” which was to begin appearing on tobacco packs within two years.<sup>83</sup> Only a few other countries besides Australia – i.e., Canada (2006), Iran (2009) Singapore (2013) and Jamaica (2013) – have mandated pack warnings related to blindness or the effects of smoking on eye health.<sup>84</sup>

### Professional advice

In 2012, a survey found that only one in three optometrists in the United Kingdom regularly assessed patients’ smoking status and advised on smoking cessation.<sup>85</sup> The 2010 US Surgeon General’s Report and a number of peer-reviewed studies encourage all eye care professionals to counsel patients to quit smoking.<sup>1,38,86,87</sup> Adequate training in smoking cessation counselling and an office tracking system are required for all health professionals, including those involved in eye care, to effectively help their patients quit smoking.<sup>88</sup>

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