

## Fact sheet No. 22: Smoking and Eye Disease

February 2019

### INTRODUCTION

Tobacco smoke is a hazardous mixture of over 5,000 chemicals, many of which are toxic and potentially damaging to the eyes.<sup>1</sup> This fact sheet focuses on some of the major eye conditions that can be caused or exacerbated by smoking: Age-related Macular Degeneration, Cataracts, Diabetic retinopathy, Thyroid eye disease and Optic neuropathy.

### AGE-RELATED MACULAR DEGENERATION (AMD)

Age related macular degeneration (AMD) is an umbrella term for a variety of degenerative conditions affecting the macula, the small central area of the retina at the back of the eye which is responsible for clear, central vision.<sup>2</sup> When the macula is damaged, vision becomes blurred, distorted and dark in the centre (this is called a scotoma). Although peripheral vision is not affected by AMD, loss of central vision means that everyday activities such as reading, driving and watching television become difficult or impossible.

There are several potential biological mechanisms linking smoking and AMD. In short: cigarette smoke is likely to have toxic effects on the retina.<sup>3</sup> Smoking causes oxidative stress, damages the retina and reduces blood flow in the eye tissue.<sup>4</sup> This leads to oxygen deprivation in the macula which can result in tissue death.<sup>5</sup>

Smoking is the major preventable risk factor for all types of AMD.<sup>6</sup> A 2005 British study concluded that at the time, approximately 28,000 cases of AMD in older people in the United Kingdom could be attributable to smoking.<sup>7</sup> Smoking at least doubles the risk of developing AMD, which tends to develop earlier in smokers, although those that have quit smoking for 20 years or more have roughly the same risk of developing AMD as non-smokers.<sup>7 8</sup> There is a dose-response relationship that leaves heavier smokers at higher risk of developing AMD.<sup>9</sup> The risk of developing AMD is also greater for smokers with a genetic predisposition to the condition.<sup>10</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. Cataracts often develop as part of the normal ageing process. In England and Wales, it is estimated that around 2.5 million people aged 65+ have some degree of visual impairment caused by cataracts.<sup>11</sup> In the UK, over 400,000 cataract operations are performed every year.<sup>12</sup>

Smoking is a major risk factor in the development of cataracts.<sup>13</sup> Smoking leads to around a 3-fold increase in the risk of cataract development.<sup>14</sup> A smoker's risk of developing cataracts increases with the amount smoked and cataracts are more severe in heavy smokers.<sup>15</sup>

Although the exact mechanism by which smoking causes cataracts to develop is not fully understood, the destruction of antioxidant nutrients by cigarette smoke is one potential hypothesis, as antioxidants may help maintain lens transparency.<sup>16</sup> Cigarette smoking may also break down other micronutrients critical to healthy eye tissues.<sup>17</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. When these blood vessels become damaged, they can leak fluid or blood and grow scar tissue which can distort the images the retina sends to the brain. This can eventually lead to blindness.<sup>18</sup> Around 150,000 patients suffer from diabetic retinopathy in the UK.<sup>19</sup>

Smoking is a significant risk factor for developing diabetic retinopathy in type 1 and type 2 diabetes.<sup>20 21</sup> Stopping smoking, along with improved metabolic control amongst type 1 diabetics is protective against retinopathy.

The mechanisms in which smoking can lead to diabetic retinopathy are unclear. Smoking can also cause tissue hypoxia in retinal vessels which might contribute to the development of the condition.<sup>22</sup>

Smoking also increases blood pressure and raises blood sugar levels in diabetics, therefore making it more difficult to control the diabetes which can cause retinopathy in the first place. For further information about smoking and diabetes see [ASH Fact Sheet: Smoking and Diabetes](#).

## THYROID EYE DISEASE

Thyroid eye disease (TED), is an autoimmune disease in which the eye muscles and fatty tissue behind the eye become inflamed. This can cause the eyes to be pushed forward ('staring' or 'bulging' eyes) and the eyes and eyelids to become swollen and red.<sup>23</sup> TED is mainly associated with Graves' disease, where the thyroid gland becomes overactive and releases too much thyroid hormone. At least 80% of TED is associated with Graves' disease.<sup>24</sup> However, TED can also occur in people with normally functioning thyroids.<sup>25</sup> Along with protrusion of the eyes, double vision and loss of vision, sometimes causing blindness, can occur. TED is a rare condition with an incidence of 2.9 to 16 cases per 100,000 people, per year.<sup>26</sup>

There is strong evidence of an association between smoking and the development of thyroid eye disease, which is related to the number of cigarettes smoked per day<sup>27</sup>. People with Graves' disease who smoke have a four-fold increased risk of developing the condition, when compared to non-smokers.<sup>28</sup> The reason for smokers' increased risk of developing Graves disease is not fully understood but it could be partly due to the smoking-induced impairment of the immune system.<sup>29</sup> Other theories for biological mechanisms linking smoking to TED have also been proposed: smoking may have a direct irritant action on the eye, causing inflammatory changes; smoking might cause a stimulation of the autoimmune process in smokers and smoking might influence cytokine secretion in the eye.<sup>30</sup>

## OPTIC NEUROPATHY

Optic neuropathy is damage to the optic nerve (which transmits visual information from the retina to the brain) from any cause. Anterior ischaemic optic neuropathy (AION) is a type of optic neuropathy which results in sudden, painless loss of vision, often leading to permanent blindness.<sup>31</sup> Smoking might also play a role in

the development of anterior ischaemic optic neuropathy.<sup>32</sup> This is because smoking is a risk factor for the development of atherosclerosis, where plaques form within arteries, and this could lead to the optic nerve not receiving enough blood.<sup>33</sup>

Leber's hereditary optic neuropathy (LHON) is a mitochondrially inherited disease where the retinal ganglion cells are degenerated, leading to loss of central vision.<sup>34</sup> Evidence suggests that smoking increases the risk of visual failure in people genetically predisposed to developing LHON.<sup>35</sup> The increased susceptibility of smoking LHON carriers to optical neuropathy could be due to the way cigarette smoke affects mitochondrial DNA and its effects on oxidative phosphorylation.

## **PASSIVE SMOKING AND EYE DISEASE**

Non-smokers often complain of eye irritation when exposed to cigarette smoke. However, there is relatively scarce quantitative data in the literature on the direct effects of environmental cigarette smoke (otherwise known as 'second-hand smoke (SHS)') on diseases of the eye. A 2008 review article found seven studies which had looked at the possible relationship between SHS and eye-disease and found no conclusive relationships between SHS and eye conditions in any of the studies they analysed.<sup>36</sup>

## **PREGNANT SMOKERS AND EYE DISEASE**

Maternal smoking has been found to increase the risk of a number of eye defects in unborn children including: astigmatism (misshapen eyes), anophthalmia (absence of eye), microphthalmia (abnormally small eyes), strabismus (crossed eyes), esotropia (both eyes turned inwards), exotropia (eyes turned outwards) and optic nerve hypoplasia (underdeveloped or absent optic nerve).<sup>37 38 39</sup>

## **PUBLIC AWARENESS & EDUCATIONAL CAMPAIGNS**

A 2013 survey carried out in the UK found that just 15% of smokers were concerned about the impact smoking has on their eye health.<sup>40</sup> An earlier international comparison found that a low proportion of smokers in Canada (13.0%), the United States (9.5%), and the United Kingdom (9.7%) believed that smoking can cause blindness. In contrast, 47.2% of Australian smokers believed that smoking causes blindness.<sup>41 42</sup>

In the UK, there is also a lack of knowledge about eye diseases in general, for instance a 2012 survey found that 29% of people in Great Britain said they had never heard of AMD, a major eye-disease.<sup>43</sup>

British youth are similarly unclear about the link between smoking and eye-disease. A 2006 survey of UK teenagers found they were far more likely to believe that smoking 'probably' or 'definitely' causes lung cancer (81%), compared with heart disease (27%), stroke (15%) and that only 5% identified smoking as a risk for blindness.<sup>44</sup> Youth in other developed countries such as Canada and the US are similarly unaware of the impact of smoking on ocular health.<sup>45</sup>

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>46</sup> In March 2007, Australia became the first country to include a pictorial warning label on cigarette packages with the message that smoking causes blindness.

An analysis of Australia's National Tobacco Campaign showed that the advertisement conveying information about the association between smoking and blindness was more efficient in generating quit-line calls than the "tar" advertisement, which emphasised the effects of tar on a smoker's lungs.<sup>47</sup>

On October 1, 2008, the UK introduced picture warnings on cigarette packets, but these warnings originally did not include information about smoking and blindness.<sup>48</sup> In March of 2012, the European Commission formally adopted a new warning: "smoking increases the risk of blindness," which was to begin appearing on tobacco packs within two years.<sup>49</sup> The number of countries which have mandated pack warnings related to blindness is slowly increasing, currently it includes: Canada (2006), New Zealand (2008), Iran (2009), Colombia (2011), Jamaica (2013), Panama (2014) and Suriname (2014).<sup>50</sup>

## PROFESSIONAL ADVICE

The advice of the 2010 US Surgeon General's Report on smoking is that eye-care professionals should counsel patients to quit smoking.<sup>51</sup> Including training for smoking cessation counselling in ophthalmology curriculums could also help to promote smoking cessation.<sup>43</sup>

Evidence suggests that more needs to be done in the UK to get optometrists to persuade smokers to quit. As it stands, most eye care providers assess their patients' smoking status and discuss the risks of smoking on the eyes, however, not many will actively promote smoking cessation options with their patients. 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>52</sup> A 2015 survey of UK optometry training found that the majority of undergraduate optometry schools in the UK dedicate extremely limited hours (0-3) to smoking cessation, in their entire undergraduate courses.<sup>53</sup>

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