



# Optometry in Practice

Literature review

## COVID-19 and its impact on eye care: a review

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## Abstract

SARS-CoV-2, which causes COVID-19, has led to a global pandemic. Although primarily thought of as a respiratory illness, ocular manifestations have also been reported with other symptoms. The pandemic has led to many challenges for both patients and eye care practitioners (ECPs). During the early stages of the pandemic, access to healthcare was limited, and many routine appointments were either postponed or cancelled unless urgent eye care was required. ECPs have shown agility, flexibility and innovation in adapting to cope with the challenges imposed, adapting environments and eye care management in both primary and secondary care. Infection control safeguards were put in place in line with government guidance.

The World Health Organization declared conjunctivitis a 'less common' symptom of COVID-19 in early 2020. There is now more evidence of the type and duration of ocular symptoms linked to COVID-19. There is also evidence of changes in the behaviour of patients, including the use of contact lenses (CLs) and seeking help for eye problems, as this might have potentially increased their exposure to COVID-19 if hospital attendance was required. The pandemic also led to increased use of remote consultations, which has been positively received by patients and ECPs alike.

This article reviews the literature surrounding eye care and the impact of the COVID-19 pandemic on patients and ECPs. It is to be appreciated that this is a fast-changing field, and more research and data will likely be available after the publication of this paper.

## Background

Coronavirus disease-2019 (COVID-19), caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is primarily a respiratory illness, with symptoms such as dry cough and fever, and it was declared a global pandemic on 11 March 2020 by the World Health Organization (WHO).<sup>1</sup> Countries around the world have enforced local and national restrictions to reduce the spread of the virus, which has affected healthcare and eye care access and provision across the globe. Although a fair amount of current research has been dedicated to understanding transmission of the coronavirus and the impact of COVID-19, many questions are still unanswered. In the early stages of the pandemic, little was known about the transmission and impact of COVID-19, leading to uncertainty and anxiety for both patients and eye care practitioners (ECPs). With time, research and evidence-based guidance have emerged, with ECPs adapting innovatively to ensure ongoing patient care whilst complying with health and safety guidance for patients and staff, informed by national guidelines.<sup>2-6</sup>

## Methodology

Using a systematic approach, the PubMed database was searched from 1 December 2019 to 4 February 2021 using the following search terms: (SARS-CoV-2 OR 2019-nCoV OR COVID-19 OR coronavirus OR "Wuhan Coronavirus") AND (2019 or 2020) AND (eye OR ophthalmology OR eyecare OR optometrist\* OR ocular), yielding a total of 1,754 studies, of which 137 were deemed most relevant. The most relevant literature to date is reviewed below.

## Transmission of COVID-19 via the eyes

COVID-19 is transmitted via direct patient-to-patient contact through respiratory and other droplets<sup>7</sup> that contain water, mucus and infectious particles. These droplets can potentially be spread via exhaled breath by people when talking, coughing or sneezing.<sup>7,8</sup> It is also known that people not displaying any COVID-19 symptoms can transmit the SARS-CoV-2 virus which is responsible for COVID-19, as peak transmissibility can occur on or before their first symptom appears.<sup>9,10</sup> In addition, reports suggest that up to a third of COVID-19 cases are asymptomatic but are capable of transmitting the virus.<sup>11</sup> The SARS-CoV-2 virus has been found in tears<sup>12-15</sup> even in patients not showing any symptoms.<sup>12,16</sup> It is, therefore, reasonable to expect

that the eye is a potential entry route for the virus.<sup>17,18</sup> The exact mechanism, however, is still under debate. The SARS-CoV-2 virus is reliant on the host receptor angiotensin-converting enzyme II (ACE2) to cause infection. ACE2 is an enzyme attached to the cell membranes located in many cell tissues, including the lungs, arteries, heart, kidney and intestines.<sup>19</sup> While some reports suggest ACE2 expression is present on the ocular surface,<sup>20-23</sup> others suggest that this expression may be negligible.<sup>24,25</sup>

## Ocular signs and symptoms

It is known that the eye can be affected by respiratory viruses,<sup>26,27</sup> and therefore, it is not surprising that ocular manifestations have been reported with the SARS-CoV-2 virus.<sup>23,28,29</sup> While the WHO has declared conjunctivitis as a 'less common' symptom,<sup>1,30</sup> ECPs are all too aware that conjunctivitis is a very broad term that can include other symptoms, such as mucopurulent discharge that is not generally associated with virus infection. Various ocular signs and symptoms have been reported in the literature, including hyperaemia (red eyes), nodular episcleritis, floaters and eye discomfort ranging from sore eyes and foreign-body sensation to itching, eye pain or non-specified 'conjunctivitis'.<sup>16,31-36</sup> In one report, ocular symptom was the sole symptom of COVID-19.<sup>37</sup>

To try to provide clarity, a study from our laboratory sought to ascertain which ocular manifestations were reported significantly more during COVID-19 compared to the pre-COVID-19 state. Our data show that sore eyes were found to be the most significant eye symptom that differed from the pre-COVID-19 state.<sup>18</sup> Other frequently reported symptoms were photophobia and watery eyes (also manifestations of viral infection), although these were not significantly different from the pre-COVID-19 state. Other ocular signs, such as retinal vascular abnormalities – in particular, decreased vessel density compared to people not previously infected with COVID-19 – have also been observed.<sup>38,39</sup>

### Prevalence and timing of ocular signs and symptoms

The reported prevalence of ocular manifestations in people infected with COVID-19 varies widely (4–32%).<sup>40–43</sup> A recent systematic review and meta-analysis reported the prevalence of ocular manifestations at 11.03%, and it was shown to be more common in people with more severe cases of the virus.<sup>44</sup> It is possible that ocular manifestations may not have been documented in the presence of other more life-threatening symptoms, especially in people needing hospitalisation, resulting in a lower reported prevalence.<sup>40,41</sup>

The timing of ocular signs and symptoms reported in the literature also varies. Ocular symptoms have been reported up to 8 days prior, at the same time, and even up to 2 weeks after other COVID-19 symptoms, such as dry cough and fever.<sup>16,18,32–34,45</sup> Late onset of ocular manifestations is rare, although one case outlined that pseudomembranous and haemorrhagic conjunctivitis occurred over 2 weeks after a patient had been diagnosed with COVID-19.<sup>45</sup>

### Reducing the risk of COVID-19

Hand-to-face touches are an established route of transmission, particularly as human coronaviruses can exist on surfaces at room temperature for up to 9 days,<sup>46</sup> and up to 28 days in laboratory conditions.<sup>47</sup> In order to reduce the risk

of virus transmission, infection control measures such as regular hand washing, reminders to refrain from touching the face and regular disinfection of surfaces have been advocated.<sup>48</sup> Chemical disinfection, such as with 0.1% sodium hypochlorite or 62–71% ethanol,<sup>46</sup> has been shown to be effective at inactivating the SARS-CoV-2 virus on surfaces,<sup>48</sup> thereby disrupting the virus's ability to infect.<sup>49</sup>

ECPs and patients have adopted the use of appropriate personal protective equipment (PPE), slit-lamp breath shields and eye protectors. The use of face coverings helps prevent droplet transmission,<sup>50,51</sup> but there is some concern that they may be incorrectly worn.<sup>52</sup> Face coverings or masks, which are now mandatory indoors in the UK,<sup>53</sup> have been reported to have their own shortcomings if incorrectly worn.<sup>54</sup> Additionally, it has been shown that face coverings do not prevent hand-to-face touching, with reports suggesting that adjusting the mask on the face can occur up to five times per hour and touching the eye can occur once every 2 hours.<sup>55</sup> In addition, face masks have been shown to aggravate or induce dry-eye symptoms, termed mask-associated dry eye (MADE).<sup>56</sup> This may be because, with exhalation, instead of the wide dispersion of air that occurs when not wearing a face covering, the air is expelled via gaps in the facial covering which can be directed upwards towards the eyes.<sup>57,58</sup> This stream of air can disrupt the tear film, leading to dry-eye symptoms. A study of self-reported symptoms suggests that up to 27% of people wearing face masks have been affected by these dry-eye symptoms.<sup>59</sup>

Eye protectors, in particular eye goggles, have been reported to be linked to a lower rate of COVID-19 infection.<sup>60–62</sup> In addition, a study has shown that conventional spectacle wear (>8 hours/day) has been associated with lower COVID-19 rates compared to non-spectacle wearers,<sup>63</sup> possibly due to a physical barrier being offered between the hand and the eyes. However, this is only one observational study and it has significant limitations which must be taken into consideration. The study had a small number of patients with myopia

(5.8%), which is not a representative sample of myopia in Hubei province, where this study was conducted (31.5%). In addition, the study cohort with a median age of 51 years was compared to a younger student population.<sup>63</sup> Until further evidence is provided, it would be very wise to continue with eye protection in the form of airtight eye goggles. Customised face shields that combine a face mask with eye protection are being developed specifically for such purposes.<sup>64,65</sup>

Reassuringly, evidence suggests that ECPs<sup>66</sup> and patients are compliant with PPE and other infection control measures as advised by professional bodies,<sup>3,67–69</sup> and are likely to carry on with these practices beyond the current pandemic.<sup>70,71</sup>

### Use of non-contact tonometry (NCT)

As SARS-CoV-2 can potentially be transmitted via aerosols,<sup>72</sup> the use of NCT has been discouraged.<sup>2,3,60,73–77</sup> Recent reports, however, suggest that facepiece masks and N95 respirators worn by patients may lead to inaccurate measurements of intraocular pressure using Goldmann applanation tonometry (GAT)<sup>78</sup> and that it may be possible to consider NCT in certain limited circumstances.<sup>79</sup> However, unless further evidence is forthcoming, it is advisable to comply with the advice offered by professional bodies.

### Impact of the COVID-19 pandemic on patients

#### Access to eye care

During the initial national restrictions, lack of information and PPE meant that many optometry practices in the UK were closed. Access to hospital eye services (HES) was also restricted in the USA and worldwide, with skeleton services offered to patients.<sup>80,81</sup> Studies also suggest that confusion and anxiety around COVID-19 led to patients in Thailand and the USA being reluctant to seek help when needed.<sup>82,83</sup> In some cases in the UK, patients made their own decisions about whether to seek advice

for what may have been potentially sight-threatening conditions or attend already overburdened emergency departments and risk exposure.<sup>84</sup>

It is vital that access to primary eye care services is maintained, as delayed treatment can increase the prevalence of irreversible blindness, such as for wet age-related macular degeneration and retinal detachment.<sup>85</sup> Reports on the presentation of people to hospitals vary. Various studies have reported that attendance at emergency HES reduced to nearly half during the pandemic compared to the same period in 2019, with many elective surgeries, such as cataract operations, being postponed or cancelled in the UK and worldwide.<sup>86–90</sup>

A decrease in the presentation of retinal tears and a rise in macula-off retinal detachments have been reported in some areas of the UK and internationally,<sup>87,88,91–93</sup> potentially increasing the risk of blindness.<sup>94</sup> It is unknown whether this increase in macula-off retinal detachments is due to patients delaying consultation due to fear of COVID-19 infection or the inaccessibility of community optometric practices. On the other hand, a study from Southend in the UK reported a 292% increase in patients presenting with retinal detachments during the COVID-19 pandemic compared to the same time in the previous year.<sup>95</sup> The authors suggest that this may be due to more referrals from nearby units which may previously have referred their patients to other units.

#### Contact lens care and usage

CL hygiene is paramount at all times, but especially during the COVID-19 pandemic as the eye can be an entry route for the virus.<sup>23,28</sup> Maintenance of routine appointments for CL wearers is important as reports suggest that over half of asymptomatic CL wearers may have at least one undiagnosed ocular complication.<sup>96</sup> The ceasing of routine optometry appointments in the UK<sup>4</sup> in the early stages of the pandemic meant that CL wearers, who would ideally be seen at regular intervals,<sup>97</sup> were not seen in the early phases of the lockdown, although later adoption of remote consultation then mitigated this to an extent.<sup>98–100</sup>

A behaviour change relating to CL wear has also been reported during the pandemic, with patients wearing their CLs for 50% less time than before the COVID-19 pandemic.<sup>101,102</sup> A number of reasons may contribute to this, including the fact that working from home meant fewer social interactions,<sup>103</sup> possible concerns about viral infection and increased screen time.<sup>104</sup> Wearers of soft reusable lenses have been less compliant with their lenses than their daily disposable counterparts during the COVID-19 pandemic.<sup>101</sup>

#### Digital eye strain and the risk of myopia

The move from in-person meetings and schooling to virtual working as a result of the COVID-19 pandemic has increased screen time significantly.<sup>104–106</sup> Unsurprisingly, digital eye strain has increased as a result.<sup>106–108</sup> Patients should be reminded to take regular breaks from their screen by looking at a point in the distance 20 foot away for 20 seconds every 20 minutes (20-20-20 rule).<sup>109</sup> In addition to digital screen time, remote schooling and reduced outdoor time for children have been reported as significant risk factors for myopia,<sup>106,110,111</sup> suggesting the need for parents to encourage outdoor activities in compliance with lockdown guidance.

#### Advice to patients

As a lack of information about access to eye care can increase the risk of irreversible blindness,<sup>85</sup> it is vital that information about how to seek help is disseminated to patients. Patients with eye care concerns during the pandemic should seek attention from their ECP without delay.<sup>112</sup> For CL wearers, advice about the risk of infection and management (i.e. advice to cease CL wear) should be offered if experiencing any symptoms.<sup>113</sup> In the early stages of the lockdown, 80% of CL wearers reported not having any professional advice about CL wear and COVID-19.<sup>102</sup> It is important that guidance and information reach patients even when CL wearers do not seek out the information by themselves.<sup>102</sup> Recommendations for visually impaired patients include other important information such as tailored physical activity.<sup>114</sup>

Guidance on spectacle fogging as a potential barrier for face-covering compliance has been produced. This includes correct mask fitting, fitting pliable wire strips within masks, taping mask to skin, creating vents at the side to allow exhaled breath an exit and lens coatings.<sup>115–117</sup>

#### Impact of the COVID-19 pandemic on ECPs

Eye care has dramatically changed due to the COVID-19 pandemic, and ECPs have been forced to adapt their working conditions. A number of infection control measures have been adopted, including increased ventilation, temperature checks on entry,<sup>118</sup> reducing the number of people in a clinic, social distancing, using protective screens at reception and dispensing desks and slit-lamp breath shields.<sup>2</sup> During the first wave, face-to-face appointments with some community ECPs were limited to emergencies, via the minor eye condition service (in the UK) or the temporary COVID-19 Urgent Eyecare Service (CUES).<sup>119–121</sup>

The decreased footfall and possible decreased presentations of eye emergencies have led to some ECPs, particularly ophthalmologists and orthoptists, being deployed to different departments<sup>122,123</sup> to work with the high influx of COVID-19 patients. Advice regarding deployment has been produced by NHS England<sup>124</sup> and the General Medical Council,<sup>125</sup> outlining best practice and highlighting the importance of working within one's own competence and seeking advice when needed.<sup>126</sup>

#### Telemedicine during COVID-19

Remote consultations by ECPs in the form of telemedicine have been recommended<sup>3,123,127,128</sup> and widely adopted throughout the pandemic to limit contact time and risk to ECPs and patients. These remote consultations have been positively received by patients in the UK and Germany.<sup>129,130</sup>

There is great potential for further growth within teleophthalmology for triaging and treatment.<sup>98–100</sup> Whilst not routinely practised before the pandemic,<sup>66,80</sup> numerous smartphone apps to aid teleophthalmology exist,

from visual acuity tests and posterior and anterior imaging to disease assessment, home monitoring and management.<sup>131</sup> However, a number of these apps are not regulated or validated, leading to them being underutilised.<sup>99,131</sup> Care must be taken with smartphone eye imaging, as inadequate calibration can produce variations in image quality, which could lead to inaccurate diagnosis. However, despite this limitation, reports suggest that, for suitably qualified ECPs, subjective evaluation of images did not differ significantly<sup>132</sup> and that agreement between remote and in-person consultations for anterior eye disease and postsurgery follow-ups were comparable.<sup>133</sup> While it is unlikely that telemedicine will replace face-to-face consultations entirely, it is likely that confidence and willingness to use telemedicine in ophthalmology will be sustained postpandemic,<sup>134,135</sup> in particular in low-vision and glaucoma services.<sup>136,137</sup>

## Conclusions

In conclusion, the COVID-19 pandemic has produced new challenges around eye care. Evidence shows that ocular manifestations, in particular sore eyes, were shown to be the most frequent ocular symptom, along with photophobia and watery eyes, and these manifestations typically occur before or during the other known COVID-19 symptoms. While many CL wearers have reduced their wear time, it is important to stress the importance of CL hygiene compliance, as evidence suggests that this information has not always reached patients. In general, more eye care information around COVID-19 needs to be disseminated to patients, especially urging them how and where to seek advice when suffering from an eye complaint. An increase in telemedicine uptake has been shown, and overall, patients appear to be satisfied with receiving eye care remotely from their ECP. Infection control safeguards have been introduced. Indeed, the pandemic has produced many challenges for both patients and ECPs, which we, as a profession, have shown great agility, flexibility and capability in overcoming.

## Relevance to practice

This article:

- Outlines the potential route of transmission of the SARS-CoV-2 virus via the ocular surface
- Describes the prevalence, type and timing of ocular manifestations of COVID-19
- Explains the impact of the COVID-19 pandemic on patients, including their access to ECPs, management of CLs, ocular symptoms associated with face masks and increased screen time as a result of the COVID-19 pandemic
- Describes the impact of the COVID-19 pandemic on ECP delivery of care and the increased use of telemedicine

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### CET multiple choice questions

This article has been approved for one non-interactive point under the GOC's Enhanced CET Scheme. The reference and relevant competencies are stated at the head of the article. To gain your point visit the College's website [www.college-optometrists.org/oip](http://www.college-optometrists.org/oip) and complete the multiple choice questions online. The deadline for completion is 30 April 2022. Please note that the answers that you will find online are not presented in the same order as in the questions below, to comply with GOC requirements.

**1. The reported prevalence of ocular manifestations in people infected with COVID-19 is:**

- Less than 4%
- 4–32%
- 33–56%
- 57–72%

**2. Which chemical disinfection method has been shown to be effective at inactivating the SARS-CoV-2 virus on surfaces?**

- 0.1% sodium hypochlorite
- 0.05% sodium hypochlorite
- 26% ethanol
- 60% ethanol

**3. Which symptom was found to be reported significantly more in COVID-19 compared to the pre-COVID-19 state?**

- Photophobia
- Watery eyes
- Sore eyes
- Itching

**4. Up to 27% of people wearing face masks have been affected by which symptom?**

- Dry eye
- Sore eyes
- Photophobia
- Itching

**5. How many times an hour has mask adjusting been shown to occur?**

- Up to five
- 10
- 15
- 20

**6. What percentage of CL wearers reported not having any professional advice about CL wear and COVID-19 in the early stages of the lockdown?**

- 20%
- 40%
- 60%
- 80%

#### CPD exercise

After reading this article, can you identify areas in which your knowledge of COVID-19 and its impact on eye care has been enhanced?

How do you feel you can use this knowledge to offer better patient advice?

Are there any areas you still feel you need to study and how might you do this?

Which areas outlined in this article would you benefit from reading in more depth, and why?