

## Response to Re: COVID-19, sweat, tears... and myopia?

Valentin Navel\*<sup>†</sup> MD  
 Frédéric Chiambaretta\*<sup>†</sup> MD PhD  
 Frédéric Duthéil<sup>‡§</sup> MD PhD

\*Translational Approach to Epithelial Injury and Repair, CNRS, INSERM, GReD, Université Clermont Auvergne, Clermont-Ferrand, France

<sup>†</sup>Ophthalmology, CHU Clermont-Ferrand, University Hospital of Clermont-Ferrand, Clermont-Ferrand, France

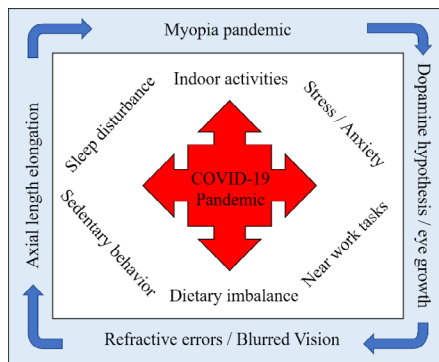
<sup>‡</sup>Physiological and Psychosocial Stress, LaPSCo, CNRS, Université Clermont Auvergne, Clermont-Ferrand, France

<sup>§</sup>Preventive and Occupational Medicine, CHU Clermont-Ferrand, University Hospital of Clermont-Ferrand, Witty Fit, Clermont-Ferrand, France  
 E-mail: valentin.navel@hotmail.fr  
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**EDITOR:** We thank Jiang et al.<sup>1</sup> for their relevant comment on the putative relation between myopia and coronavirus disease 2019 (COVID-19).<sup>2</sup> As explained by the authors, global quarantine measures could affect the lifestyle of young people by promoting near work activities, physical inactivity, dietary imbalance (that is, snacking and irregular meals) and anxiety (that is, fear of contagion).

Jiang et al.<sup>1</sup> also noted that myopic patients, who have a higher risk of ocular complications (for example, refractive errors, retinal tearing with retinal detachment), could struggle to attend regular eye examinations.

A greater amount of time indoors during extended periods of confinement could exacerbate exposure to artificial light in mesopic conditions. However, recent data suggest that time spent outdoors during childhood (that is, exposure to ultraviolet light) could protect against axial elongation of myopic eyes, therefore reducing the incidence of myopia.<sup>3</sup> Laboratory studies suggest that the effect of sunlight exposure on axial elongation could be mediated by dopamine secretion within the retina (that is, dopamine theory).<sup>4</sup> Thus, modifying environmental exposure (such as time spent outdoors) seems to be relevant to reducing myopic progression.<sup>3</sup>



**Figure 1. The complex interplay between two current pandemics: myopia and COVID-19**

Interestingly, physical activity, duration of sleep, and diet may also influence refractive error, axial length, and the incidence of myopia. Regular physical activity (more than three hours per week) is associated with a lower prevalence of myopia (odds ratio [OR] 0.46, 95% CI 0.23–0.90).<sup>5</sup> However, it is difficult to elucidate whether the beneficial role on myopic development is related to active behaviour or increased exposure to ultraviolet light.<sup>6</sup> Similarly, a recent study in a Korean population showed an inverse relationship between sleep duration and myopia, whereby sleeping more than nine hours is protective against myopic progression (OR 0.59, 95% CI 0.38–0.93).<sup>7</sup>

Given that myopia is a disease of eye development, it seems plausible that abnormalities in nutritional intake may play a role. Interestingly, trace elements (for example zinc, copper, manganese or selenium) have been detected in abnormal systemic levels in myopic subjects in different ethnicities and geographical origins.<sup>8,9</sup> Furthermore, essential nutrients and vitamins contribute to the structure and activity of many proteins and enzymes involved in eye development and visual function.<sup>10</sup> Essential nutrients are found in vegetables, seafood, numerous nuts, and more generally with a healthy and well-balanced diet.<sup>11</sup> High food intake and lack of sleep induces neuropsychological remodelling, with low-grade inflammation in the nervous system, stress-induced depression and anxiety.<sup>12</sup>

Considering the dopamine dysregulation in psychiatric disease<sup>13</sup> and the embryological origins of the retina (that is, neural crest

cells), it seems plausible that myopia is linked with a neurological abnormality in dopamine secretion. Myopic subjects, and particularly those with severe myopia, seem to be an at-risk population for depression and anxiety;<sup>14</sup> therefore, eye-care practitioners should remain vigilant in respect of the mental health of myopic patients during the SARS-CoV-2 crisis.

Thus, it is salient to consider the complex interplay between myopia and the COVID-19 pandemic, which can alter the pattern of environmental exposure (that is, indoor activities), near work tasks, sunlight exposure, sleep patterns, anxiety levels and food intake (Figure 1).

The COVID-19 pandemic may, in these ways, indirectly facilitate a better understanding of the myriad of influences upon myopic pathophysiology.

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