**Project Title:** Sleep Health & Behaviours: The effects of ocular circadian rhythms on eye development

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**Level:** PhD

**Background to the project:** The following study will be carried out with the School of Optometry with whom the lead investigator has previously supervised a HSC R&D funded PhD.

Disruptions to circadian rhythms have been associated with numerous health issues such as obesity and metabolic rates (Zelinski, 2014), and depression (Germain & Kupfer, 2008). More recently Stone et al. (2013) proposed that disruption of the retinal circadian rhythm (CR) is a key element in promoting dysregulation of eye growth and hence myopia. Myopia (short-sight) is a refractive error usually resulting from excessive ocular growth. Its prevalence is escalating: myopia is predicted to affect half the world’s population by 2050 (Holden et al., 2016). Both dopamine (DA) and melatonin (Mel) are intrinsically tied to Circadian Rhythms; they form a mutual inhibitory relationship whereby melatonin negatively influences dopamine release in both neural and ocular tissue, including the retina. For the first time in humans, significant differences between circulating serum levels of melatonin and dopamine in myopes and non-myopes have been found (Kearney et al., 2016). Both Mel and DA have been shown to influence eye growth in animal models of myopia (Stone et al., 2006). However, no previously published studies have examined the relationship between systemic/ocular CRs, Mel and myopia in humans. A better understanding of CR in myopic and non-myopic individuals at different stages during the development and progression of myopia is urgently needed to inform and accelerate the further development of effective and acceptable anti-myopia strategies.

Furthermore, given that effective sleep patterns lead to better general health (Strine et al. 2005) it is vital that individuals develop healthy sleep patterns and behaviours in order to regulate CR. Behaviour analytic methods have been used to successfully enhance healthy sleep patterns (Chritodulo et al. 2004), however measurement of sleep behaviours without the use of expensive lab equipment is difficult. Given the proliferation of smart technology to monitor sleep patterns (Bhat et al. 2014) this present project aims to assess if such apps can aid sleep programmes and reflect self-report scores on sleep patterns.

**Methods to be used:**
1. **Saliva Sample:** Each participant will provide a saliva sample (225µl), collected through the ‘passive drool’ method and it will be analysed for Mel content using ELISA technique.
2. **Refractive error:** Refractive error measured using the Shin-Nippon Nvision-K5001 autorefractor.
3. **Ocular biometry:** Ocular biometry (axial length and corneal curvature) measured using the Zeiss IOLMaster.
4. **Ocular structure**: Retinal structure (retinal and choroidal thickness) examined using the Spectralis Ocular Coherence Tomographer (OCT) with EDI (Enhanced Depth Imaging).

5. **Behaviour analytic procedures**: used to improve sleep behaviours. These methods could include antecedent control methods, sleep restriction, etc.

6. **Behaviour measurement**: Smart phone apps will be used to assess their efficacy in measuring sleep behaviours.

**Objectives of the research:**
1. assess if myopes and non-myopes return differing levels of melatonin (from salivary measures)
2. assess if smart phone apps can return accurate and clinically useful data to help improve sleep behaviours
3. assess if improved sleep patterns affect levels of salivary melatonin

**Skills required of applicant:**
The applicant will be required to have an undergraduate degree with BSc (Hons) 2:1 or 1st class degree. He or she will be required to work with optometrists. He or she will be required to have excellent administrative and organisational skills, good time management skills, good IT skills (data input, data management and analysis) and the ability to synthesise data and present results appropriately. They will require good interpersonal skills and manual dexterity.

**References:**


Kearney S, O'Donoghue L, Pourshahidi LK, Cobice D, Saunders KJ. Myopes have significantly higher serum melatonin concentrations than non-myopes. BMJ Open Ophthalmology (under review).


