Abstract

The low reported prevalence of myopia in Norway and other Scandinavian countries deviates from the increasing global prevalence, with a particularly high prevalence in South-East Asia. Increased outdoor time, potentially linked with daylight exposure, has been reported to have a protective effect against myopia incidence and progression. The low prevalence of myopia in Norway, despite the dark winters (6 hours of available daylight vs. ≈19 hours in the summer), raises the question of whether seasonal adaptation and the difference in daylight availability can have a role in protecting against myopia. The aim of this thesis was therefore to assess biological and environmental factors related to physiological ocular growth — ocular growth occurring during the stages of emmetropization and maintaining emmetropia — in order to comprehend refractive error development.

This thesis consists of three papers that explore the environmental and biological factors, specifically circannual (papers I and III) and circadian rhythms (papers I and II) and their implications for physiological ocular growth. The project was conducted in Norway and involved 17–24-year-olds (paper I), 19–25-year-olds (paper II), and 7–11-year-olds (paper III). Physiological ocular growth (by AL) exhibited a seasonal variation for 7–24-year-olds, with a faster rate during the winter compared to summer (papers I and III), but with an overall slower rate than seasonal changes during myopia development. AL and SER for the 7–8-year-olds were comparable to Chinese children of the same age, but the differences increased at ages 10–11-years, and more so at ages 17–25 years. The choroid for all age-groups (papers I–III) was thicker compared with Chinese individuals in each respective age-group, even at ages 7–8 years. The association between ΔAL and AL phase shift from winter to summer (paper I) indicates a seasonal adaptation, which provides support for the involvement of ocular diurnal rhythms in physiological ocular growth. Further support is shown in the differential alterations of the AL and ChT phase relationship during winter when there was more ocular growth than during summer (paper I), and when influenced by 1% topical atropine (paper II). These alterations in paper I and II held resemblance to those reported in chick studies during accelerated and slowed ocular growth, respectively. The potential involvement of the crystalline lens and its diurnal rhythm with physiological ocular growth warrants more research.

The findings of this thesis contribute to the understanding of environmental and biological factors involved with physiological ocular growth. This has potential implications for myopia control therapy that needs to have a person-centred health-care approach.

Keywords: Myopia, refractive errors, physiological ocular growth, axial length, choroidalthickness, crystalline lens, circadian rhythm, circannual rhythms, person-centred healthcare