Popular science abstract

The prevalence of myopia and high myopia is increasing worldwide. Five years ago, it was predicted that half of the global population will have myopia by 2050. Recently that estimate has been revised by WHO to 2040. Myopia genesis and its progression have been inextricably linked to near-work. Near-work vision tasks, during which accommodation is exerted are considered a major contributing factor to the myopia development, irrespective of factors such as the amount of time spent outdoors or those of genetic nature. Recently, an increased interest is shown in establishing the way the use of digital devices influence the myopia development.

When studying myopia, it is always possible to identify a group of people who are "resistant" to it despite having a genetic predisposition, and who, like their fellow myopes, exert large amount of near-work and spend little time outdoors. So what are the particular optical and anatomical characteristics of a “resistant” human eye that despite increased amount of near-work, including smart device use, does not develop myopia? There are currently no answers to this scientific question. The majority of eye parameters used in studying myopia can be cumulatively described as MACRO-parameters because they mostly concern the geometry of the eye. How eyes differ at the microscopic level is less known, but such MICRO-parameters are difficult to assess in-vivo. Recent advances in the statistical analysis of optical coherence tomography (OCT) speckle, called also OCT densitometry, show the potential of this technology to indirectly assess the eye microstructure by treating the speckle as source of information rather than noise. The team of PI is particularly active in developing corneal OCT densitometry. The main aim of this research project is to develop methods for a complete eye OCT densitometry that would indirectly assess the microstructures of cornea, the crystalline lens and retina. With this, and the development of wearable methodologies for objective, reliable and robust estimation of the amount of time spent on near-work, it is envisaged to provide answers to the myopia problem by studying two specific groups of subjects. The first group includes young adult emmetropes (18+) with genetic predisposition to myopia (one or two parents being myopes), spending large time on near-work (studying, playing computer games) and not having active interest in sports. The second age/gender/ethnicity-matched group would include myopes with similar genetic and environmental factors to those encountered in the group of emmetropes.

There are several scientific questions this project aims to answer:

1) Can the whole eye densitometry, which indirectly asses microstructure of eye tissue, increase our understanding of myopia epidemic?
2) Why some individuals DO NOT become myopic?
3) Does increased near-work in the young adulthood constitute an additional risk factor for myopia?
4) Are there any particular characteristics of the human eye (at the micro level) that are, together with the amount of near-work, contributing factors to myopia development and its progression?

The plan of the proposed research project includes several stages: (i) developing methods for whole eye OCT densitometry, (ii) developing and validating wearable techniques for objectively assessing the amount of time spent on near-work visual tasks, (iii) performing a longitudinal study (two measurement sessions within 12 months for each subjects), and (iv) developing statistical models linking the objectively estimated amount of near-work work with changes in the optical parameters of the eye (mainly densitometric ones). The developed methods for whole eye densitometry will have an added value in the assessment of other eye ailments.