Commentary: Effect of exercise on ocular blood flow

The widespread health benefits of physical exercise are acknowledged by all. It is a well-known fact that physical activity reduces the risk of cardiovascular mortality and morbidity. Thus, exercise forms an essential part of any cardiovascular risk prevention program. Among the various types of exercises, the high-intensity interval training (HIIT) is considered to be an efficient way to increase fitness and reduce the risk. How does exercise achieve this anti-atherogenic effect? It is believed that exercise contributes to cardiovascular wellness by virtue of various hemodynamic changes.[1] Immediately after exercise, there is an increase in the pulse rate, systolic blood pressure, cardiac output, and respiratory rate. Exercise also leads to direct changes in the vasculature by modifying blood flow, arterial pressure, luminal shear stress, and tangential wall stress. Over a period, these lead to functional as well as structural changes in the arterial wall thickness and diameter.[1] Simultaneously, increased expression of endothelial nitric oxide synthase plays an important role in the cardiovascular protection.[2]

Whether a similar effect is seen in the ocular microcirculation was explored by Karaküçük, *et al.*, in their study.[3] Optical coherence tomography angiography (OCTA) is an easy, noninvasive tool to measure the tangible benefits of the exercise regimen. Based on their study, the authors state that HIIT exercise can lead to increased blood flow to the outer retina. They documented significant increase in the central vessel density in deep capillary plexus (before: 18.7 ± 3.8%, after: 21.1 ± 4.5%) and in central choriocapillaris (before: 54.5 ± 2.8%, after 56.9 ± 2.2%) (each *P* value = 0.02). But there was no change in the superficial plexus or the foveal avascular zone. This obviously has great implications. Along with improvement in the cardiovascular fitness level, physical exercise can also be expected to improve the health of the photoreceptors.

However, this appears to be oversimplified. There are several factors at play here, autoregulation being the most important of them. Autoregulation, in simple terms, is the local regulation of blood flow within the concerned organ despite fluctuations in blood pressure. The retina has a strong autoregulatory mechanism. Recent studies have shown some autoregulation in the choroid also, although traditionally the choroid was believed to lack autoregulation.[4] A significant decrease in the parafoveal and peripapillary blood flow immediately after exercise has been reported by Alnawaiseh *et al*.[5] This decrease in the retinal blood flow and vessel density on OCTA in healthy humans is most likely due to an autoregulatory response to hyperoxia. Both Alnawaiseh *et al*.[5] and Schmitz *et al*.[6] reported decrease in the flow density in superficial macular plexus after exercise. However, they did not report flow density in choriocapillaris. Okuno *et al*.[7] have reported a slow increase in the choroidal blood flow after exercise. However, it should be noted that in retinal and optic nerve circulation, systemic factors have only a minor influence, while local factors such as nitric oxide, prostaglandins, endothelin, and the renin–angiotensin system have a more dominant role in autoregulation.[2,7]

This study analyzed the changes in young, healthy men.[3] It remains to be seen whether these observations hold true in various other populations with different systemic diseases, various age groups, and with several other external modifying factors such as medicines. The authors also noted a significant increase in the hematocrit after exercise, in the study population.[3] Hematocrit can have a significant effect on the flow density signal in capillaries.[8] Having said that, the OCTA does not offer absolute blood flow measurements. Increased flow signal in a small area does not necessarily indicate an increase in absolute blood flow. It will therefore be necessary to perform additional studies to establish the effect of exercise on the blood flow indices with careful interpretation to ascertain the protective role of exercise in maintaining photoreceptor health.

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