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Lamina Cribrosa Pore Diameter and Spaceflight-Associated Neuro-ocular Syndrome

Jessica M. Scott, PhD, **Wesley J. Tucker, PhD**, **Mark J. Haykowsky, PhD**

Memorial Sloan Kettering Cancer Center, New York, New York (Scott); Integrated Cardiovascular Exercise Physiology and Rehabilitation Laboratory, College of Nursing and Health Innovation, University of Texas at Arlington, Arlington (Tucker, Haykowsky)

In Reply We thank Shinojima and colleagues for their interest in our study[1] on exercise and swimming goggles in a model of spaceflight associated neuro-ocular syndrome (SANS). Spaceflight provokes increases in both intracranial pressure (ICP) and intraocular pressure (IOP).[2] However, there is a greater increase in ICP relative to IOP, which results in an IOP-ICP mismatch and an anteriorly directed translaminar pressure gradient across the lamina cribrosa (LC).[2] A negative translaminar pressure gradient is associated with adverse ocular changes[2]; accordingly, countermeasures that normalize this are of major importance in protecting the health of astronauts. To date, most SANS countermeasures have focused on reversing the spaceflight-associated fluid shifts to lower ICP, with tools such as a lower-body negative-pressure device.[2] Our findings[1] indicated that slightly increasing IOP with an inexpensive and convenient countermeasure, such as swimming goggles, could also normalize the translaminar pressure gradient. In addition, goggles may be a relatively safe intervention; the increase in IOP with goggles is small (approximately 3 mm Hg),[1] and goggles are worn by competitive swimmers for hours daily without an increased prevalence of glaucoma.[3]

Nevertheless, as with any novel intervention, we agree that caution is warranted during evaluation of goggles as a potential SANS countermeasure. Phase I trials are first required to determine the feasibility, safety, and appropriate dose (ie, duration and intensity) of artificially increasing IOP in SANS models prior to confirmatory phase II trials and testing in spaceflight. The lamina cribrosa and its constituent elements are sensitive to alterations in both IOP and ICP, and the lamina cribrosa is thought to be the main site of damage to retinal ganglion cell axons.[4] Thus, studies that directly assess ICP and the lamina cribrosa with tools such as swept-source[5] or spectral-domain[6] optical coherence tomography are needed. Together, these advances not only may help address SANS, a major clinical concern for astronauts, but may also enable continued long-duration human space exploration.

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Corresponding Author: Jessica M. Scott, PhD, Memorial Sloan Kettering Cancer Center, 485 Lexington Ave, New York, NY 10017 (scottj1@mskcc.org).

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