

<b>Fiscal Year:</b>	FY 2020	<b>Task Last Updated:</b>	FY 12/09/2019
<b>PI Name:</b>	Macias, Brandon Ph.D.		
<b>Project Title:</b>	Prospective Observational Study of Ocular Health in ISS Crews		
<b>Division Name:</b>	Human Research		
<b>Program/Discipline:</b>			
<b>Program/Discipline--Element/Subdiscipline:</b>	HUMAN RESEARCH--Biomedical countermeasures		
<b>Joint Agency Name:</b>	<b>TechPort:</b>	No	
<b>Human Research Program Elements:</b>	(1) <b>HHC:</b> Human Health Countermeasures		
<b>Human Research Program Risks:</b>	(1) <b>SANS:</b> Risk of Spaceflight Associated Neuro-ocular Syndrome (SANS)		
<b>Space Biology Element:</b>	None		
<b>Space Biology Cross-Element Discipline:</b>	None		
<b>Space Biology Special Category:</b>	None		
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<b>PI Organization Type:</b>	NASA CENTER	<b>Phone:</b>	281-483-2026
<b>Organization Name:</b>	NASA Johnson Space Center		
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<b>City:</b>	Houston	<b>State:</b>	TX
<b>Zip Code:</b>	77058	<b>Congressional District:</b>	36
<b>Comments:</b>	NOTE: Became civil servant fall 2020; previously KBR/NASA Johnson Space Center. Prior to that until 2016, was at the University of California, San Diego.		
<b>Project Type:</b>	FLIGHT	<b>Solicitation / Funding Source:</b>	Directed Research
<b>Start Date:</b>	01/06/2017	<b>End Date:</b>	10/01/2019
<b>No. of Post Docs:</b>		<b>No. of PhD Degrees:</b>	1
<b>No. of PhD Candidates:</b>		<b>No. of Master' Degrees:</b>	1
<b>No. of Master's Candidates:</b>	4	<b>No. of Bachelor's Degrees:</b>	
<b>No. of Bachelor's Candidates:</b>		<b>Monitoring Center:</b>	NASA JSC
<b>Contact Monitor:</b>	Norsk, Peter	<b>Contact Phone:</b>	
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<b>Flight Program:</b>	ISS		
<b>Flight Assignment:</b>	NOTE: Used 10/1/2019 as end date for reporting purposes (Ed., 12/11/2019) NOTE: End date changed to 9/30/2019 (original end date was 11/16/2017) per PI (Ed., 10/9/18) NOTE: End date changed to 9/30/2018 (original end date was 11/16/2017) per A. Allcorn and PI (Ed., 10/11/17)		
<b>Key Personnel Changes/Previous PI:</b>	Current PI: Brandon R. Macias; Former PI: Christian Otto.		
<b>COI Name (Institution):</b>	Gibson, C. Robert O.D. ( Coastal Eye Associates--Texas ) Sargsyan, Ashot M.D. ( KBRwyle, Houston, TX ) Alexander, David M.D. ( NASA Johnson Space Center ) Ploutz-Snyder, Robert Ph.D. ( University of Michigan ) Riascos-Castaneda, Roy M.D. ( University of Texas Medical Branch ) Patel, Nimish O.D., Ph.D. ( University of Houston ) Samuels, Brian M.D., Ph.D. ( University of Alabama at Birmingham ) Kramer, Larry M.D. ( The University of Texas ) Lee, Stuart Ph.D. ( KBR/NASA Johnson Space Center ) Stenger, Michael ( NASA Johnson Space Center )		
<b>Grant/Contract No.:</b>	Directed Research		

<b>Performance Goal No.:</b>	
<b>Performance Goal Text:</b>	<p>NOTE: Continuation of "Prospective Observational Study of Ocular Health in ISS Crews" with Dr. Brandon Macias as new Principal Investigator (PI). Former PI was Dr. Christian Otto, who moved in January 2017.</p> <p>Spaceflight-associated neuro-ocular syndrome (SANS) is characterized by changes in astronauts' vision (hyperopic shifts) and eye structure (optic disc edema, choroidal folds, globe flattening, and cotton wool spots). This risk is termed Spaceflight Associated Neuro-ocular Syndrome (SANS), formally called Visual Impairment/Intracranial Pressure (VIIP), by NASA. The purpose of this study is to characterize and quantify the ocular, neurological, and cardiovascular changes associated with the development of SANS before, during, and after long-duration International Space Station (ISS) missions. The data collected will augment Medical Requirements Integration Documents (MRID) requirements and testing performed during scheduled exams. In addition, the frequency of in-flight and postflight testing will be increased to quantify the temporal profile of our outcome measures. In short, preflight, in-flight, and postflight measures include: tonometry, ocular ultrasound, brain blood flow, funduscopy, visual acuity, OCT; while brain and ocular magnetic resonance imaging (MRI), and eye exams including fundus exams and cycloplegic refraction will be conducted preflight and postflight. Moreover, blood pressure and cardiac output will be collected preflight, in-flight, and postflight to assess systemic vascular compliance.</p> <p><b>Task Description:</b></p> <p>Expected Outcomes</p> <ol style="list-style-type: none"> <li>1. Significant in-flight change in at least one or more of the following variables will occur: visual acuity, intraocular pressure, optic disc edema (papilledema), chorioretinal folds, optic nerve sheath distention, optic nerve tortuosity, optic nerve-to-sheath ratio, globe flattening, and retinal "cotton-wool spots." In addition, these variables will return to pre-flight values during the postflight recovery period.</li> <li>2. It is expected that if an in-flight or postflight measure deviates from preflight baseline measures, it may have a prolonged recovery to baseline (preflight values) that is positively associated with severity.</li> </ol> <p>Specific Aims</p> <p>Characterize the temporal profile of ocular, neurological, and cardiovascular variables associated with the development of SANS before, during, and after long-duration ISS missions.</p> <p>See also: <a href="https://">https://</a></p> <p><b>Rationale for HRP Directed Research:</b></p> <p>This research is directed because it contains highly constrained research and there is insufficient time. This research is highly constrained because it is proposing additional data collections of MRID measures pre-, in-, and postflight. Since the co-investigative team collects the MRID data, they are the best source to collect this data as well. Due to the visibility of this risk, there is pressure to characterize the visual changes associated with spaceflight in order to begin to identify the underlying cause. The results of this study will help define and frame the new Risk of Microgravity-Induced Visual Impairment/Intracranial Pressure.</p> <p><b>Research Impact/Earth Benefits:</b></p> <p>Terrestrial Benefits:</p> <ol style="list-style-type: none"> <li>1. Advances in the tools and techniques as part of this SANS research will benefit terrestrial clinical populations.</li> <li>2. Identifying the cause(s) and risk factors for the SANS syndrome will also inform the cause(s) and risk factors for these terrestrial conditions.</li> </ol> <p><b>Task Progress:</b></p> <p>We have made significant progress over the review period. We have updated and maintained our "Ocular Health" NASA IRB (Institutional Review Board) documents. Thirteen ISS crewmembers participated in the inflight medical surveillance exams and the additional testing specific to this experiment, including the One-Year mission crewmembers. All data collection is complete. Pre- and postflight evaluations included functional eye measures (cycloplegic refraction and visual fields); structural eye measures (funduscopy, optical coherence tomography [OCT], ocular ultrasound, and optical biometry); intraocular pressure (IOP, tonometry); cardiovascular function (via ultrasound with concurrent ECG and blood pressure); blood flow velocity in the middle cerebral artery (MCA) (including an estimate of noninvasive intracranial pressure measured with transcranial Doppler); and magnetic resonance imaging (MRI) to assess eye and optic nerve structure and cerebrospinal fluid flow. In-flight measures included visual acuity, amsler grid, IOP, OCT imaging of the posterior eye, funduscopy, ocular ultrasound, cardiovascular function, and blood flow velocity in the MCA. The primary data analysis is complete.</p> <p>Detailed analysis of key variables that demonstrate significant spaceflight induced changes is complete. Currently, we have two manuscripts in review, and two others in submission for peer-reviewed journals. Preliminary results were recently reported by Dr. Macias at the 2019 Human Research Program (HRP) Workshop.</p> <p><b>Bibliography Type:</b></p> <p>Description: (Last Updated: 04/04/2024)</p> <p><b>Abstracts for Journals and Proceedings</b></p> <p>Macias B, Otto C, Ploutz-Snyder R, Sargsyan A, Alexander D, Kramer L, Riascos R, Samuels B, Gibson C, Patel N, Lee S, Laurie S, Stenger M. "Prospective Observational Study of Ocular Health in ISS Crews – The Ocular Health Study." 2019 NASA Human Research Program Investigators' Workshop, Galveston, TX, January 22-25, 2019. Abstracts. 2019 NASA Human Research Program Investigators' Workshop, Galveston, TX, January 22-25, 2019. , Jan-2019</p> <p><b>Abstracts for Journals and Proceedings</b></p> <p>Macias BR, Laurie S, Lee SMC, Marshall-Goebel K, Ploutz-Snyder R, Martin D, Hargens A, Dulchavsky S, Stenger MB. "Spaceflight Associated Neuro-ocular Syndrome: ISS vs Analog." 40th International Society for Gravitational Physiology (ISGP) Meeting, Nagoya, Japan, May 26-31, 2019. Abstracts. 40th International Society for Gravitational Physiology (ISGP) Meeting, Nagoya, Japan, May 26-31, 2019. , May-2019</p>

Abstracts for Journals and Proceedings	Kramer LA, Hasan KM, Stenger MB, Otto C, Ploutz-Snyder RJ, Riascos RF, Macias BR. "Longitudinal study of microgravity-induced changes in brain volumetry, pituitary morphology and cerebral spinal fluid hydrodynamics: relationship to spaceflight associated neuro-ocular syndrome." International Society for Magnetic Resonance in Medicine ISMRM 27th Annual Meeting, Montreal, Canada, May 11-16, 2019. Abstracts. International Society for Magnetic Resonance in Medicine ISMRM 27th Annual Meeting, Montreal, Canada, May 11-16, 2019. , May-2019
Articles in Peer-reviewed Journals	Macias BR, Patel NB, Gibson CR, Samuels BC, Laurie SS, Otto C, Ferguson CR, Lee SMC, Ploutz-Snyder R, Kramer LA, Mader TH, Brunstetter T, Stenger MB. "Association of long-duration spaceflight with anterior and posterior ocular structure changes in astronauts and their recovery." JAMA Ophthalmol. 2020 May;138(5):553-9. <a href="https://doi.org/10.1001/jamaophthalmol.2020.0673">https://doi.org/10.1001/jamaophthalmol.2020.0673</a> ; PMID: 32239198; PMCID: PMC7118682 , May-2020
Articles in Peer-reviewed Journals	Kramer LA, Hasan KM, Stenger MB, Sargsyan A, Laurie SS, Otto C, Ploutz-Snyder RJ, Marshall-Goebel K, Riascos RF, Macias BR. "Intracranial effects of microgravity: A prospective longitudinal MRI study." Radiology. 2020 Jun;295(3):640-8. <a href="https://doi.org/10.1148/radiol.2020191413">https://doi.org/10.1148/radiol.2020191413</a> ; PMID: 32286194 , Jun-2020
Articles in Peer-reviewed Journals	Rohr JJ, Sater S, Sass AM, Marshall-Goebel K, Ploutz-Snyder RJ, Ethier CR, Stenger MB, Martin BA, Macias BR. "Quantitative magnetic resonance image assessment of the optic nerve and surrounding sheath after spaceflight." npj Microgravity. 2020 Oct 8;6(1):30. <a href="https://doi.org/10.1038/s41526-020-00119-3">https://doi.org/10.1038/s41526-020-00119-3</a> ; PMID: 33083526; PMCID: PMC7545196 , Oct-2020
Articles in Peer-reviewed Journals	Sater SH, Sass AM, Rohr JJ, Marshall-Goebel K, Ploutz-Snyder RJ, Ethier CR, Stenger MB, Kramer LA, Martin BA, Macias BR. "Automated MRI-based quantification of posterior ocular globe flattening and recovery after long-duration spaceflight." Eye (Lond). Published: 29 January 2021. <a href="https://doi.org/10.1038/s41433-021-01408-1">https://doi.org/10.1038/s41433-021-01408-1</a> ; PMID: 33514895 , Jan-2021
Articles in Peer-reviewed Journals	Macias BR, Ferguson CR, Patel N, Gibson C, Samuels BC, Laurie SS, Lee SMC, Ploutz-Snyder R, Kramer L, Mader TH, Brunstetter T, Alferova IV, Hargens AR, Ebert DJ, Dulchavsky SA, Stenger MB. "Changes in the optic nerve head and choroid over 1 year of spaceflight." JAMA Ophthalmol. 2021 Jun;139(6):663-7. <a href="https://doi.org/10.1001/jamaophthalmol.2021.0931">https://doi.org/10.1001/jamaophthalmol.2021.0931</a> ; PMID: 33914020; PMCID: PMC8085766 , Jun-2021
Articles in Peer-reviewed Journals	Marshall-Goebel K, Macias BR, Kramer LA, Hasan KM, Ferguson C, Patel N, Ploutz-Snyder RJ, Lee SMC, Ebert D, Sargsyan A, Dulchavsky S, Hargens AR, Stenger MB, Laurie S. "Association of structural changes in the brain and retina after long-duration spaceflight." JAMA Ophthalmol. 2021 Jul 1;139(7):781-4. <a href="https://doi.org/10.1001/jamaophthalmol.2021.1400">https://doi.org/10.1001/jamaophthalmol.2021.1400</a> ; PMID: 34014272; PMCID: PMC8138750 , Jul-2021
Articles in Peer-reviewed Journals	Pardon LP, Greenwald SH, Ferguson CR, Patel NB, Young M, Laurie SS, Macias BR. "Identification of factors associated with the development of optic disc edema during spaceflight." JAMA Ophthalmol. 2022 Oct 27;140(12):1193-1200. <a href="http://dx.doi.org/10.1001/jamaophthalmol.2022.4396">http://dx.doi.org/10.1001/jamaophthalmol.2022.4396</a> ; PMID: 36301519; PMCID: PMC9614681 , Oct-2022
Articles in Peer-reviewed Journals	Sibony PA, Laurie SS, Ferguson CR, Pardon LP, Young M, Rohlf FJ, Macias BR. "Ocular deformations in spaceflight-associated neuro-ocular syndrome and idiopathic intracranial hypertension." Invest Ophthalmol Vis Sci. 2023 Mar;64(3):32. <a href="https://doi.org/10.1167/iovs.64.3.32">https://doi.org/10.1167/iovs.64.3.32</a> ; PMID: 36988950; PMCID: PMC10064934 , Mar-2023