Task Book Report Generated on: 03/28/2024

Pixame:	Fiscal Year:	FY 2019	Task Last Undated	FY 10/30/2018
Project Title: Mobile Gravity Suit (an Integrative Countermeasure Device) Image: Ima				
Program/Discipline: Program/Discipline: Program/Discipline: Program/Discipline: Program/Discipline: Program/Discipline: Diani Agency Name: TechPort: Yes Diani Agency Name: (1) HIC-Human Health Countermeasure: Human Research Program Elements: (1) HIC-Human Health Countermeasure: Human Research Program Risks: (1) ASANSRisk of Spaceflight Associated Neuro-ocular Syndrome (SANS) Space Biology Special Category: None				
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Program/Discipline- Element/Subdiscipline- Element/Subdiscipline- Program Progr	Division Name:	Human Research		
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Human Research Program Elements (I) HIRC-Human Health Countermeasures Human Research Program Risks: (I) SANS-Risk of Spaceflight Associated Neuro-ocular Syndrome (SANS) Space Biology Cross-Element None Space Biology Cross-Element None Space Biology Special Category: None PI Email: Rectreen@used.edu Fax: FY PI Organization Type: University of California, San Diego PI Address 1: University of California, San Diego PI Address 2: History History Home: S58-263-6365 Organization Name: University of California, San Diego PI Address 2: History History History History History History PI Web Page: City: La Jolla State: CA Zip Code: Q3037-1337 Congressional District: 5 Comments: Project Type: GROUND Solicitation Funding American Medical Center Dr. Li 2 West 417 Project Type: GROUND Solicitation Funding American Application Applic				
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Space Biology Element: None Space Biology Cross-Element Discipline: None PI Email: Resetrent/aucst edu Fax: FY PI Organization Type: UNIVERSITY Phone: 858-263-6365 Organization Name: University of California, San Diego PI Address I: Clinical Physiology Laboratory, Department of Orthopedic Surgery PI Address S: 9452 Medical Center Dr. LL2 West 417 PI Web Page: City: La Jolla State: CA Zip Code: 92037-1337 Congressional District: 52 Comments: Project Type: GROUD Solicitation / Funding and Performance (FLAGSIIP), Appendix B-Omnibus Start Date: 10:04/2018 End Date: 10:03/2020 No. of Post Does: No. of PhD Degrees: No. of Post Does: No. of Master' Degrees: No. of Master's Candidates: No. of Master' Degrees: No. of Master's Candidates: No. of Master' Degrees: No. of Bachelor's Candidates: No. of Rachelor's Degrees: No. of Bachelor's Candidates: No. of Master' Degrees: No. of Master' Degrees: No. of Master' Degrees: No. of Master' Degrees: No. of Master' Degrees: No. of Bachelor's Candidates: No. of Master' Degrees: No. of Bachelor's Candidates: No. of Master' Degrees: No. of Bachelor's Candidates: No. of Master' Degrees: No. of Master' Degrees: No. of Bachelor's Candidates: No. of Master' Degrees: No. of Master' Degrees: No. of Master's Candidates: No. of Master' Degrees: No. of Master	Human Research Program Elements:	(1) HHC :Human Health Countermeasures		
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Because all parts of human physiology are affected by microgravity, an integrative countermeasure strategy is needed. Loss of muscle and bone mass along with deconditioning of the heart and vessels are well described effects of microgravity. More recently structural and functional changes of the eye, experienced by some astronauts during long-term missions, have been described and summarized in the Spaceflight Associated Neuro-ocular Syndrome (SANS). While the exact etiology of SANS remains unknown, the microgravity induced headward fluid shift is likely part of the pathophysiology and countermeasures that can reverse this fluid shift are prioritized. Based on our experimental data from short-term microgravity by parabolic flights and 24-hour simulated microgravity, we suggest that fluid redistribution in space may not give rise to a pathological increase in intracranial pressure, but rather the lack of diurnal fluctuations in intracranial volume and pressures may be responsible for the remodeling of the eye. In ambulatory neurosurgical patients with pressure sensors inserted in the brain tissue, we therefore demonstrated the feasibility of lower body negative pressure to reduce intracranial pressure as means of re-introducing diurnal pressure variability. Extending on this, in a recent 3-day, 6° head-down tilt bedrest trial we applied lower body negative pressure (LBNP) for 8 hours every day, to demonstrate safety and efficacy to significantly reduce long-term swelling at the back of the eye believed to be early symptoms of SANS.

At the University of California San Diego we have developed and tested a fully mobile "Gravity Suit" comprised of pressurized-trousers and attached vest. The suit simulates the effects of gravitational stress by application of low-levels lower body negative pressure to re-introduce an Earth-like fluid shift while at the same time inducing a ground reaction force at the bottom of the feet and a mechanical load along the entire body axis. Preliminary tests involving healthy human subjects in simulated microgravity have demonstrated the efficacy of 20 mmHg lower body negative pressure within the suit to reduce internal jugular vein cross-sectional area by some 45% and induce mechanical load of 57% bodyweight.

The intravehicular suit is comfortable enough to wear 8-10 hours a day and flexible enough to be combined with daily activity and even exercise with the overall aim to provide an integrative countermeasure. As an overall long-term aim, we suggest that use of the Gravity Suit will 1) re-introduce the diurnal variability of intracranial pressure and volume to help prevent development of SANS; 2) stimulate the cardiovascular system to maintain cardiac muscle mass and vascular compliance; 3) counteract loss of postural muscle mass and bone density; 4) finally, the axial loading will preserve curvature of the spine, paraspinal muscle, and disc morphology to both ameliorate in-flight back pain, and reduce risk of post-flight disc herniation.

Within the scope of this proposal, we will finalize and further test our prototype by integrating vacuum- and monitoring systems within the waist-belt to increase safety and allow for free and un-tethered movement. Comfort, range of motion, and gait will be assessed during relevant activities simulating daily work tasks on the International Space Station and in combination with resistive exercise device relevant for cislunar and deep space missions. High levels and/or prolonged exposure to lower body negative pressure can potentially compromise blood flow to the brain; however, activity and use of the muscle pump increases orthostatic tolerance. To establish a safe range and optimize the user scenario, we will test cardiovascular responses and cerebral perfusion during graded lower body negative pressure with and without a combined ground reaction force and in combination with rowing exercise. Successful funding of this proposal will bring our Gravity Suit to Countermeasure Readiness Level 7.

Rationale for HRP Directed Research:

Research Impact/Earth Benefits:

Task Progress:

Task Description:

New project for FY2019.

Bibliography Type:

Description: (Last Updated: 01/24/2024)