Fiscal Year:	FY 2013	**Task Last Updated:**	FY 09/28/2012
PI Name:	Simpson, Richard Ph.D.		
Project Title:	Effects of Long-Term Exposure to Microgravity on Salivary Markers of Innate Immunity		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	(1) **Immune**:Risk of In Mission Impacts, Adverse Health Events or Long-Term Health Impacts due to Altered Immune Response		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	85721-0001	**Congressional District:**	3
Comments:	NOTE: Formerly at University of Houston until September 2017 move to University of Arizona.		
Project Type:	Flight	**Solicitation / Funding Source:**	2010 Crew Health NNJ10ZSA003N
Start Date:	11/03/2011	**End Date:**	11/02/2015
No. of Post Docs:	1	**No. of PhD Degrees:**	
No. of PhD Candidates:	3	**No. of Master' Degrees:**	
No. of Master's Candidates:	1	**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:	1	**Monitoring Center:**	NASA JSC
Contact Monitor:	Vos, Jessica	**Contact Phone:**	
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Flight Program:	ISS		
Flight Assignment:	ISS Flight Definition phase		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Clarke, Mark Ph.D. (University of Houston) Crucian, Brian Ph.D. (Wyle Laboratories, Inc.) Lowder, Thomas Ph.D. (University of Houston) O'Connor, Dan Ph.D. (University of Houston) Pierson, Duane Ph.D. (NASA Johnson Space Center) Spielmann, Guillaume (University of Houston)		
Grant/Contract No.:	NNX12AB48G		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Immune system dysregulation has been documented during and after spaceflight, but it is not known if these changes increase infection susceptibility or pose a significant health risk to crewmembers. Inherent problems with current in-flight research are small sample sizes and the difficulty to control for the many confounding factors that impact on the immune system. As such, it is not known if changes in immunity are due to the microgravity environment per se, or to the stressors associated with landing and re-adaptation to the 1G environment. The present project proposes a Flight Definition investigation, utilizing a longitudinal repeated measures design to determine the effects of long-term exposure to microgravity on a host of salivary antimicrobial proteins (AMPs) associated with innate host immune defense, whilst also considering the impact of other acute stressors such as launch, Soyuz landing, and EVA. Saliva samples will be collected from crewmembers selected for ISS mission and ground-based controls at bi-weekly intervals for 6 months prior to flight, during the 6-month period on the ISS, and for 1 month on return to Earth. Saliva sampling was selected because it is an excellent biological fluid with which to detect broad-spectrum biomarkers of front-line host immune defense and is suitable for the spaceflight environment. Attempts will also be made to establish relationships between AMPs and other stressors associated with spaceflight (i.e. mood state disturbances, circadian desynchronization, sleep loss/disruption, stress biomarkers) using serial data. Finally, blood samples will be collected before and after the mission to determine the impact of spaceflight on cellular aspects of innate immunity. Given the potential of salivary AMPs to serve as an indicator of weakened immunity during spaceflight, this project will serve as a foundation for future countermeasure developments and technological advances to detect real time changes during subsequent lunar or Mars missions.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	This project will improve our understanding on how acute and long-term stress impacts on multiple aspects of the immune system. These research findings will be useful to determine if any immune related health problems might exist in individuals exposed to stressful environments (i.e. soldiers, caregivers).
Task Progress:	Year 1 objectives for this project were: 1. Determine the salivary antimicrobial proteins that can be accurately measured in saliva obtained using collection devices suitable for spaceflight and the microgravity environment 2. Determine the stability of all immune system biomarkers measured in both blood and saliva for up to 72h post collection Funding for this project began on November 3rd 2011. This allowed us to start the hiring process for a postdoctoral research fellow (Dr Guillaume Spielmann) who was appointed in March 2012. Objective #1 Summary Our goal was to identify a saliva collection method that would be accurate for detecting a number of key project biomarkers and would also be suitable for implementation on the International Space Station (ISS). Although whole saliva would be considered the gold standard, our attempts to collect whole saliva samples in a microgravity environment using the saliva collection aid (SCA) and a C9 parabolic flight were not successful. We therefore attempted to validate our assays with saliva collected using the Salivette and salimetrics oral swab (SOS) technologies. It became apparent that the Salivette method (which uses a cotton roll to collect saliva) would not be suitable as analyte recovery was extremely low and was not related to pair-wise concentrations determined in whole saliva. On the other hand, the SOS technology, although not resulting in complete analyte recovery, was significantly associated with concentrations determined in whole saliva and was sensitive enough to detect within-subject changes following a bout of acute physical stress. Moreover, the relative change to acute stress for all saliva biomarkers measured was not different between the passive drool and SOS collection methods. These data indicate that the SOS method, in addition to its suitability to be implemented on the ISS, is capable of accurately measuring a wide range of salivary biomarkers to detect changes within subjects over time. Dr. Pierson and Dr. Mehta's laboratory also attempted to recover viral DNA from SOS versus salivette and found that 10x more DNA could be recovered from the SOS. Objective #2 Summary Our goal was to determine the stability of the salivary and blood biomarkers and assays for up to 72h post thaw/collection to meet mission operational constraints for returning samples to Earth. Proportions of lymphocyte and monocyte subtypes appear to be stable in whole blood samples up to 48h post draw in either EDTA or ACD treated blood tubes. T-cell populations also appear to be stable up to 72h post draw. NK-cell function can be measured in both EDTA and ACD treated blood tubes and is stable for up to 48h post draw in ACD tubes. However, 48h stability was demonstrated in only 2 out of 4 samples so there is a need to increase the sample size here to determine the likelihood of NK-cell function being assessed on blood samples collected in-flight. The saliva biomarkers measured appear to be stable for up to 72h post thaw and are impervious to multiple repeat freeze-thaw cycles. Current and Future Work We are currently assessing the suitability of the SOS technology to measure additional biomarkers in saliva, including histatins, ß-defensins, lactoperoxidase, and C-reactive protein. We recently completed the analysis of 5 antimicrobial proteins in plasma samples obtained from 12 ISS astronauts from the previous "Integrated Immune" study. Analyses of these data are still ongoing. We are also in the process of optimizing assays to determine the antimicrobial capacity of saliva and neutrophil/monocyte oxidative burst and degranulation. Our first informed consent briefing to ISS crewmembers will take place in September 2012, with the first test subjects being recruited in March 2013. We anticipate that all feasibility work will be completed by January 31st 2013.
Bibliography Type:	Description: (Last Updated: 11/29/2024)

Abstracts for Journals and Proceedings	Simpson RJ, Crucian BE, Lowder TW, Clarke MS, Mehta SK, O'Connor DP, Pierson DL. "The Effects of Long-term Exposure to Microgravity on Salivary Markers of Innate Immunity." 2012 NASA Human Research Program Investigators' Workshop, Houston, TX, February 14-16, 2012. 2012 NASA Human Research Program Investigators' Workshop, Houston, TX, February 14-16, 2012. , Feb-2012