Fiscal Year:	FY 2008	**Task Last Updated:**	FY 02/26/2009
PI Name:	Pierson, Duane L Ph.D.		
Project Title:	Flight-Induced Changes in Immune Defenses-DSO 498		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Operational and clinical research		
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:	77058	**Congressional District:**	22
Comments:			
Project Type:	Flight	**Solicitation / Funding Source:**	96-OLMSA-01
Start Date:	04/01/1999	**End Date:**	04/01/2008
No. of Post Docs:	0	**No. of PhD Degrees:**	
No. of PhD Candidates:	0	**No. of Master' Degrees:**	
No. of Master's Candidates:	0	**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:	0	**Monitoring Center:**	NASA JSC
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Flight Program:	Pre/Post Flight		
Flight Assignment:	ISS STS-96, 95, 93, 107 In flight development phase (data collection has begun)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Kaur, Indreshpal (Enterprise Advisory Services Incorporated)		
Grant/Contract No.:	None		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Space flight may affect the delicate host-parasite relationship, thus increasing susceptibility to infectious disease. Changes in the human immune response during space flight suggest that the ability to meet infectious challenges may be attenuated. The early phases of the host response to infection depend on innate immunity in which a variety of innate resistance mechanisms recognize and respond to the presence of a pathogen. Innate immunity is present in all individuals at all times, does not increase with repeated exposure to a given pathogen, and does not discriminate between pathogens. Our hypothesis is: essential functions of neutrophils, monocytes, and natural killer (NK) cells will be altered during space flight. The constraints inherent in space flight (e.g., few subjects) mandated the use of ground-based models to supplement flight investigations. These models included a closed population in a closed environmental chamber and Antarctic expeditioners. These studies evaluated quantitative and functional data from important components of the immune response such as: neutrophils, monocytes, platelets, and natural killer cells. Our objectives are to determine the effects of space flight on: (1) neutrophil and monocyte functions such as phagocytosis, degranulation, oxidative burst capacity, and expression of surface molecules (including adhesion molecules), and (2) natural-killer cell and lymphokine-activated killer cell cytotoxicity against target cells, and cytokine production. Results from these studies provide essential data complementing other ongoing space immunology investigations. Realization of our specific aims will increase our understanding of the host-parasite relationship and the risk of infectious disease during space flight. To determine changes in the immune functions associated with space flight Astronauts live and work in a relatively crowded and stressful environment. Stresses integral to space flight, such as containment, isolation, space radiation, physical exertion, psychosocial interactions, anxiety, and sleep deprivation, can adversely affect astronaut health. Addition of microgravity to the list of stressors and one can see that space flight is a unique stress environment. Long duration exploration missions of the Moon and Mars require astronauts with fully functional and robust immune systems to reduce the development of infections and tumor cell. Successful completion of this investigation will result in a better understanding of the effects of space flight on an essential element of the human immune response. This will complete one more piece of the immunity puzzle in an effort to determine if long duration space flight results in adverse effects on the immune system. If medically significant changes occur, efforts to prevent or diminish adverse effects on the immune system will be investigated.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	The reductions in neutrophil, monocyte, and NK-cell functions are most probably the result of stress associated with space flight. We believe that space flight is a unique stress model, and new insight into the physiological effects of stress will result from these immunological studies. Perhaps, the asymptomatic changes in immune function observed in these studies may be helpful in determining clinically relevant thresholds in the human immune response.
Task Progress:	A second study investigated the ability of the shuttle crew members' monocytes to respond to Gram-negative endotoxin that they could encounter during infections. Blood specimens were collected from 20 crew members and 15 control subjects 10 days before launch, 3 to 4 h after landing, and 15 days after landing and from crew members during their annual medical examination at 6 to 12 months after landing. When challenged with Gram-negative endotoxin, the crew member's monocytes collected at all three time points produced lower levels of interleukin-6 (IL-6) and IL-1 and higher levels of IL-1ra and IL-8 compared to those of control subjects. Cytokines were assessed by measuring the number of cells positive for intracellular cytokines. These values returned to normal 6 to 12 months after landing, except for IL-1ra, which was still higher (5 to 6-fold) than in controls. This phenomenon was accompanied by an increased expression of Toll-like receptor 4 and decreased expression of CD14 on the crew members' monocytes at all time points. There were also increased levels of the lipopolysaccharide binding protein in the plasma of the crew members 3 to 4 hour and 15 days after landing. This study shows that spaceflight-associated factors (in-flight and preflight) modulate the response of monocytes to Gram-negative endotoxins.
Bibliography Type:	Description: (Last Updated: 03/24/2020)
Articles in Peer-reviewed Journals	Kaur I, Simons ER, Kapadia AS, Ott CM, Pierson DL. "Effect of spaceflight on ability of monocytes to respond to endotoxins of gram-negative bacteria." Clin Vaccine Immunol. 2008 Oct;15(10):1523-8. PMID: 18768671 , Oct-2008
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Books/Book Chapters	Pierson DL, Mehta SK, Stowe RP. "Reactivation of Latent Herpes Viruses in Astronauts." in "Psychoneuroimmunology. 4th edition." Ed. R. Ader. Amsterdam ; Boston : Elsevier/Academic Press, c2007. vol II, p. 851-868., Aug-2007
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