

Fiscal Year:	FY 2005	Task Last Updated:	FY 03/03/2006
PI Name:	Chylack, Leo M.D.		
Project Title:	Precise Assessment of Prevalence and Progression of Lens Opacities in Astronauts as a Function of Radiation Exposure During Space Flight and Development of Improved Routine Clinical Assessment of Ocular Lens Status		
Division Name:	Human Research		
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Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Radiation health		
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Human Research Program Risks:	(1) Cardiovascular: Risk of Cardiovascular Adaptations Contributing to Adverse Mission Performance and Health Outcomes		
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No. of PhD Candidates:	1	No. of Master' Degrees:	0
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No. of Bachelor's Candidates:	0	Monitoring Center:	NASA JSC
Contact Monitor:	Contact Phone:		
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Flight Program:			
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Key Personnel Changes/Previous PI:	0		
COI Name (Institution):	Cucinotta, Francis (NASA Johnson Space Center) Feiveson, Al (NASA) Wear, Mary (Wyle Labs, NASA) Manuel, F Keith (Space Center Eye Associates)		
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Task Description:

The NASA Study of Cataract in Astronauts (NASCA) is a cross-sectional and longitudinal five-year epidemiological study of the risk factors associated with cataract incidence and progression in the whole population of American astronauts and two control populations – pilots with military aviation experience and participants in the Longitudinal Study of Astronaut Health (LSAH). The study of risk factors focuses on the types and doses of radiation exposure in space flight, measures of nutrition, and general health. The assessment of cataract will use digital images of the lens and validated measures of severity. The study will measure the prevalence, incidence, and progression rates of cortical, nuclear, posterior subcapsular, and mixed cataracts, and it will relate these measures to measures of radiation, nutrition, and general health. A secondary goal of this project will be to improve the routine annual clinical assessment of the ocular lens by including Nidek EAS 1000 digital imaging of the lens in the annual ocular examination. NASCA contains an initial cross-sectional assessment of prevalence, and a follow-on assessment of progression rates of lens opacification in the populations of astronauts, military pilots, and ground based comparison participants in the Longitudinal Study of Astronaut Health (LSAH). Main goal of cross-sectional study: To determine the prevalence of the three main classes of age-related lens opacification in the complete sample of astronauts and in two control populations: military pilots and ground-based subjects in the LSAH. We will determine the risk of each class of cataract associated with exposure to various components and dosages of radiation during space flight. A secondary goal of the cross-sectional study is to estimate the prevalence of the three main classes of age-related lens opacification and determine the risk of each class of cataract associated with various factors (nutrition, general health, UV radiation, and others) encountered non-space flight. A tertiary goal of the cross-sectional study is to modify the ocular assessment protocol in the astronauts' regular annual medical examination to improve the assessment of the status of the crystalline lens. The main goal of the five-year longitudinal study is to determine the progression rates of the three main types of lens opacification in the complete sample of astronauts, the control populations of pilots and ground-based subjects in the LSAH, and then determine the risk factors associated with cataract progression with a specific focus on the components and doses of radiation exposure during space flight. Specifically, total radiation lens dose, space radiation lens dose, and individual contributions from space galactic cosmic ray and trapped proton lens dose will be assessed. NASA is concerned about identifying and ultimately mitigating the risks to astronaut health of exposure to radiation in space. Several avenues of research now suggest that increased risk of lens opacification may be one of these adverse health effects. In order to address this issue, NASA has approved and funded this five-year, multi-centered research proposal entitled "The Precise Assessment of Prevalence and Progression of Lens Opacities in Astronauts as a Function of Radiation Exposure During Space Flight." The Brigham and Women's Hospital (BWH), the Johnson Space Center (JSC), the Department of Medicine at Baylor College of Medicine (BCM), Wyle Laboratories, and Space Center Eye Associates are the five centers cooperating in the execution of this study. The epidemiologic team at BCM will recruit astronauts and control subjects. Members of the Flight Medicine Clinic at the JSC will perform ocular and general medical examinations and will obtain blood samples for analysis. They will obtain specialized digital images of the crystalline ocular lens that will enable investigators at The Center for Ophthalmic Research at the BWH to derive measures of the severity for each class of cataract. Wyle Laboratories personnel at JSC will create and maintain the main data set of this project, and members of the Radiation Safety Office and the Statistical Branch of the JSC will work with Dr. Chylack, the PI of this project, and the other Co-Investigators to analyze of the data from this project and prepare regular reports and manuscripts. Leo T. Chylack, Jr., M.D. (BWH) originally submitted the proposal as a Supplemental Medical Objective (SMO). The goal of the proposal was to supplement the current annual ocular examination with new measurements that would allow an objective and more quantitative routine assessment of the status of the crystalline lens in astronauts. This supplementary methodology would enable NASA to obtain objective assessments of the clarity of the lens, quantitative, continuous measures of the severity of lens opacification, and, over time, cataract type-specific progression rates. The SMO has undergone review by several intramural boards and a non-advocate peer review (NAR) panel. As a result of this review, the NAR recommended 1) a major expansion of the project to enable measures of the prevalence and progression rates of various forms of lens opacification, and 2) modifications of the number and composition of the control groups to provide comparisons of prevalence and progressions rates of lens opacification in astronauts to those in pilots exposed to the cataractogenic risks of high altitude (but not space) flight and to those in LSAH subjects, who presumably are not exposed to high altitude or space radiation.

Rationale for HRP Directed Research:**Research Impact/Earth Benefits:**

Expanding our understanding of the mechanisms of space-radiation-induced cataract may suggest means of reducing the risk of radiation-induced cataract on earth among individuals employed in jobs in which radiation constitutes an occupational hazard. Also, it may suggest improved means of shielding the eyes of patients undergoing radiation therapy. Information about the mechanisms of cataracts in astronauts may suggest additional research into the causes of age-related cataract, the world's leading cause of blindness. Lastly, the longitudinal phase of the study which links nutritional data to the risk of cataract progression may suggest nutritional means of ameliorating the risk of cataract.

Task Progress:

Harvard Food Frequency Questionnaires: We have completed an analysis of those nutrients that have been identified as risk factors for age-related cataract (ARC), and we will look first at the relevance of these nutrients to the risk of cataract in the NASCA cohorts. Due to the relatively small size of our NASCA cohorts, we will not be able to include more than 1-2 of these nutrients in regression models in which age, lens-specific radiation dose, and gender will be included as independent variables. We will be able to test each of the nutrient values of interest and which have relevance to ARC. From these data we hope to find nutritional factors that ameliorate the risk of radiation-induced cataract. Such findings might form the basis for an interventional study of efficacy of one or more nutrients as anti-cataract treatments.

Ocular examination and LogMAR acuity measurement: We are grading nuclear color as a means of decreasing the variability of our measurements of nuclear opacification.

Nidek EAS 1000 Lens Imaging Analysis: We have completed the image analyses of 250 subjects who have been through the ocular examination protocol to date. We have encountered no unanticipated difficulties in the image analyses. The images have been of unusually high quality. We expect to receive another 90 subjects-worth of image data on 05/01 and we will have all of these image analyses completed before the end of July 2005 when we will begin the cross-sectional analyses of the NASCA data.

Bibliography Type:

Description: (Last Updated: 08/21/2012)

Abstracts for Journals and Proceedings	Chylack LT Jr. "The NASCA Study – The NASA Study of Cataract in Astronauts." 2005 Bioastronautics Workshop in Galveston, TX, January 10-12, 2005. Abstracts, 2005 Bioastronautics Workshop in Galveston, TX, January 10-12, 2005. , Jan-2005
Abstracts for Journals and Proceedings	Cucinotta FA, Manuel FK, Iszard G, Feiveson A, Peterson LE, Hardy D, Marak LJ, Tung W, Wear ML, Chylack LT Jr. "Historical study of radiation exposures and the incidence of cataracts in astronauts." 9th Biennial Meeting of the International Society of Toxicology (ISOT), Ft. Worth, TX October 21, 2004. Abstracts, 9th Biennial Meeting of the International Society of Toxicology (ISOT), Ft. Worth, TX October 21, 2004. , Oct-2004