DEPARTMENT OF HEALTH AND HUMAN SERVICES

National Cancer Institute (NCI)
National Eye Institute (NEI)
National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS)
National Institute of Environmental Health Sciences (NIEHS)

Principal Areas of Focus

The Department of Health and Human Services supports a broad portfolio of research related to environmental health and the health effects of global change. Included in the U.S. Climate Change Science Program is research supported by the National Institutes of Health (NIH) that focuses on exposure to ultraviolet (UV) and near-UV radiation. The principal objectives of the four NIH institutes supporting this research include an increased understanding of the effects of UV and near-UV radiation exposure on target organs (e.g., eyes, skin, immune system), the molecular changes and genetic susceptibilities that lead to these effects, and the development of strategies to prevent the initiation or promotion of disease before it is clinically defined.

In addition to UV and near-UV radiation research, HHS also supports other research related to the health effects of global change. For example, the National Institute of Environmental Health Sciences (NIEHS) supports research on the health effects of 1) air pollution and temperature, 2) agricultural chemicals, and 3) materials used in new technologies to mitigate or adapt to climate change. In addition, the Centers for Disease Control and Prevention (CDC) is engaged in a number of activities related to climate change, such as emerging and reemerging infectious diseases. Such related research is growing in importance.

Program Highlights for FY 2007

The NIEHS program supports grants and intramural projects that investigate the effects of UV exposure on the immune system, aging process, sensitive tissues such as the retina and skin, and methods to reduce these harmful effects. Examples of research include projects that will characterize the DNA-damaging and mutagenic properties of UV-A radiation, a component of the solar spectrum that has been linked to melanoma, then attempt to find a molecular link between exposure to sunlight and melanoma.

The National Toxicology Program (NTP) funded and operated by NIEHS is carrying out a systematic analysis of commercially available sunscreens to characterize several nanoscale metal oxides (e.g., titanium, zinc) currently used with regard to their dermal penetration and photocatalytic action. Careful attention is being paid to determining critical aspects of size, surface area and chemistry, crystallinity, and biopersistence in relation to both dermal penetration and potential for toxicity in the presence or absence of simulated solar light.

The National Eye Institute (NEI) supports studies on the impacts of UV radiation on the eye (retinal damage as well as corneal capacity). A major initiative is underway to determine how and why eye

cataract develops and to search for ways to prevent or slow the progression of cataract, an age-related eye disease that affects 17-20 million people globally. This project is investigating the role of UV-B radiation, which has been implicated as a specific risk factor in cataract development. Another important area of research is the understanding of certain detoxification systems in the eye and how they combat damage from UV-B radiation. The goal of this effort is to identify drugs that might have therapeutic or preventative applications. One study is investigating how corneal epithelial cells prevent damage to their DNA by reactive oxygen species generated by UV light and whether the protection against damage provided by nuclear ferritin in corneal epithelial cells can be extended to other cell types in which reactive oxygen species may have deleterious effects.

The National Cancer Institute (NCI) is supporting a wide range of studies to characterize the etiology, biology, immunology, and pathology of a variety of changes in the skin (morphological effects that might precede skin cancer), including photoaging, non-melanoma skin cancers, and melanoma caused by exposure to UV radiation. In addition, NCI is supporting studies to reduce the risk of melanoma and non-melanoma skin cancer through the development of clinically useful primary and secondary prevention strategies. One study is developing, implementing, and evaluating solar protection programs for middle school children. The interventions target school, community, recreation and beach settings, primary care practices, and parents. The interventions are based on theories that include social influence, psychological factors, and cognitive decisional factors in adolescence. Other studies are looking at the role of UV light exposure in the development of second malignant neoplasms in cancer survivors.

The National Institute of Arthritis, Musculoskeletal, and Skin Diseases (NIAMS) supports basic and clinical research on the effects of UV-A and UV-B radiation on skin. Examples of current studies include research to better understand how vitamin D3 is made and processed in the skin. These chemical reactions require ultraviolet radiation. Another study looks at the effects of UV-B radiation on the stability of cell cycle regulatory proteins and will yield insight into the mechanisms by which UV-B radiation increases the risk of non-melanoma skin cancer. A third study examines the ability of green tea polyphenols to protect against UV-B-induced skin cancers through the augmentation of the repair of UV-damaged DNA. Previous studies in this area of research have included studies on the role of overexposure to UV light in the development and exacerbation of vitiligo, a pigmentary disorder that leaves patients with disfiguring white skin patches that increase in size over time. Another patient-oriented research project studied the molecular mechanisms for the exaggerated response to UV-B of a polymorphism that is strongly associated with a photosensitive form of lupus erythematosus. Another study worked on the effect of UV-R on Langerhans cells, star-shaped cells in the germinative layer of the epidermis, and on immunity in skin. Using gene array technology, scientists identified 52 genes that are consistently up-regulated by UV-R.

Related Research

Renewed concern about emerging and reemerging infectious diseases has prompted increased attention to a variety of insect and tick-borne diseases whose incidence would be affected by environmental change. One area of research, conducted by CDC, is the use of remote sensing to study ecologic systems relevant to transmission of specific infectious diseases, especially vector-borne diseases. Examples of research by CDC using remote-sensing and other geographic/spatial technologies include studies of hantavirus, plague, and Chagas disease. Sin Nombre virus, carried by the deer mouse, causes hantavirus

pulmonary syndrome (HPS) in the Americas. Since 1994, CDC has collaborated with local academic institutions to study the effect of climatic variation, such as that associated with El Niño Southern Oscillation (ENSO), on changes in population densities of deer mice. The goal of the U.S.-based studies is to develop a model using satellite imagery to predict increases in risk of HPS at specific locations across the western United States. These studies have already helped CDC predict and post warnings of increased disease risk in the southwestern United States.

A CDC-sponsored study of plague in the four corners area of the U.S. Southwest also employs remote-sensing technology to develop a predictive model for increased plague transmission in the area. Finally, CDC is applying GIS and ecological niche analysis using GARP (Genetic Algorithm for Rule Set Prediction), a form of spatial/temporal analysis, to study the eco-epidemiology of Chagas disease in Guatemala, Mexico, Brazil, and Argentina, and to improve collaborative efforts aimed at disease surveillance and control in these regions.

CDC also sponsors broader research related to climate change and infectious diseases. CDC's Division of Vector-Borne Infectious Diseases is currently collaborating on studies of how the transmission of vector-borne diseases may be affected by the environment. Its Guatemala field station is studying the impact that adverse climatological events, such as El Niño and Hurricane Gilbert, have had on the transmission dynamics of malaria and other diseases. These catastrophic events create tremendous changes that can simultaneously create new vector habit, reduce the levels of sanitation, and overwhelm the ability of the public health system to respond. Other CDC units are collaborating on studies of the effects of climate change on dengue on the U.S.-Mexico Border.