Breakup Of The Ward Ice Shelf
Antarctica 2004

Medical Ecology Of
Stratospheric Ozone Depletion:
Impacts on the Human Condition

Some 20 million people worldwide are currently blind as a result of cataracts. Of these, WHO estimates that as many as 20% may be due to UV exposure. Experts believe that each 1% sustained decrease in stratospheric ozone would result in an increase of 0.1% in the number of cataracts caused by solar UV.

Photo Aging
UVB Solar Radiation And Skin Cancer Risk

UVB - 290 to 320 nm
UVC - 100 to 290 nm
UVA - 320 to 400 nm

Absorption spectra for a few selected compounds

Examples of Non-melanoma Skin cancer

Incidence of Skin Cancers
INCIDENCE

- Excluding carcinoma in situ (noninvasive cancer) of any site except urinary bladder or basal and squamous cell skin cancers
- In 2002 ~ 1,284,900 new cancer cases are expected
  - Men 637,500
  - Women 647,400
- More than 1 million cases of basal and squamous cell skin cancers are expected to be diagnosed this year
- Since 1990, nearly 16 million new cancer cases have been diagnosed
Molecular Mechanisms

Latitude and Skin Cancer

Photolyase substrate

<table>
<thead>
<tr>
<th>Tumor</th>
<th>Mutation</th>
<th>Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCC</td>
<td>G → T (Arg &gt; Ser) at codon 249</td>
<td>HBV, Aflatoxin</td>
</tr>
<tr>
<td>Melanoma (skin cancer)</td>
<td>GG → TT</td>
<td>UV radiations</td>
</tr>
<tr>
<td>Lung cancer</td>
<td>G → T (codons 157, 159, 245, 266, 249, 273)</td>
<td>Tobacco smoke (Kras, p53)</td>
</tr>
<tr>
<td>Bladder cancer</td>
<td>G → C</td>
<td>Aromatic (Tobacco smoke, phenolic dyes)</td>
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</tbody>
</table>
Topical application of photolyase reversed CBDs by 50 - 60%

Cellular functions of p53:

1. Suppresses progression through the cell cycle in response to DNA damage, thereby allowing DNA repair to occur before replicating the genome; hence, p53 prevents the transmission of damaged genetic information from one cell generation to the next.

2. Initiates apoptosis if the damage to the cell is severe (this protects the organism from the growth of damaged cells, and so loss of p53 function is a key step in the neoplastic cascade).

3. Often as a tumor suppressor: Mutations in p53 can cause cells to become oncogenically transformed, and mutation studies have shown that p53 acts as a potent suppressor of tumor suppression, able to restore some level of normal growth to cancerous cells in vitro.

4. p53 is a potent transcription factor and once activated, it represses transcription of one set of genes (several of which are involved in stimulating cell growth) while stimulating expression of other genes involved in cell cycle control.

5. The p53 pathway (picture summarizing the cellular functions of p53, 996, by Hall PA et al.)

   http://bioinformatics.weizmann.ac.il/hotmolecbase/entries/p53.htm

Structure of p53 Protein

<table>
<thead>
<tr>
<th>Domain</th>
<th>1-90</th>
<th>63-92</th>
<th>100-200</th>
<th>305-345</th>
<th>360-395</th>
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<tr>
<td>N-terminal domain</td>
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<tr>
<td>Central domain</td>
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<td></td>
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<tr>
<td>C-terminal domain</td>
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<tr>
<td>Transcription factor</td>
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<tr>
<td>Transcriptional</td>
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<td></td>
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<tr>
<td>Negative regulation</td>
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<tr>
<td>Promoter domain</td>
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<tr>
<td>Ternary complex</td>
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<tr>
<td>Sequence-specific DNA-binding</td>
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</table>
Figure 2. Comparison of the p53-53BP2 and p53-DNA (15) complexes in two orthogonal views (rotated by 90° about the z-axis). The six most frequently mutated amino acids of p53, highlighted in yellow, are at or near both the 53BP2 and DNA interfaces. (A and B) The 53BP2 SH3 domain (red) binds the L3 loop, while the fourth ankyrin repeat (magenta) binds the L2 loop of the p53 core domain (cyan). The zinc atom of p53 is shown as a green sphere. (C and D) Comparison with the p53-DNA (blue) complex (15) in the same p53 orientations as (A and B). Abbreviations for the amino acid residues are: A, Ala; C, Cys; D, Asp; E, Glu; F, Phe; G, Gly; H, His; I, Ile; K, Lys; L, Leu; M, Met; N, Asn; P, Pro; Q, Gln; R, Arg; S, Ser; T, Thr; V, Val; W, Trp; Y, Tyr.
The Ras (Raus-associated Sarcoma) Oncogene

In about 30% of human cancers, Ras is mutated so that it is permanently switched on, telling the cell to grow regardless of whether receptors on the cell surface are activated or not.

Akt = serine-threonine kinase

Selected References


Medical Ecology Of Stratospheric Ozone Depletion:

The Rest Of Life On Earth

Large losses of total ozone in Antarctica reveal seasonal Cl0x/NOx interaction


J. C. Farman, B. G. Gardiner & J. D. Shanklin*

* First article to document ozone hole over Antarctica
Species: Antarctic krill (Euphausia superba)

Classification:
- Phylum: Arthropoda
- Class: Copepodida
- Order: Euphausiacea
- Genus: Euphausia

**Photoinhibition in Antarctic phytoplankton by ultraviolet-B radiation in relation to column ozone values**

Oceana Hoh-Hansen, Virginia E. Villafañe, and E. Walter Helbling,
Polar Research Program, Scripps Institution of Oceanography,
University of California, San Diego, La Jolla, California 92037-0202

**Negative effects of UVB-irradiated phytoplankton on life history traits and fitness of Daphnia magna**

MEINDRIK J. DELANGE AND PAUL C. VAN ZEVENWEG
Aquatic Ecology and Water-Quality Management Group, Department of Environmental Sciences, Wageningen University, Wageningen, The Netherlands

**SUMMARY**

1. We tested the effect of ultraviolet-B (UVB)-irradiated phytoplankton on life history characteristics of Daphnia magna. Two phytoplankton species were used: Chlamydomonas reinhardtii and Cryptomonas parvula. The phytoplankton species were cultured under photobiologically active radiation (PAR) conditions and subjected to UVB supplementation with ultraviolet-A and ultraviolet-B radiation, and fed to Daphnia.

2. Life history traits of Daphnia were negatively affected when fed an UVB-irradiated Cryptomonas. Survivorship at nauplii and lower juveniles with lower fitness were produced in the UVB treatments. In the Chlamydomonas experiment, no significant effect was observed.

3. The cause of the observed UVB effects is likely to be contaminant levels in food quality. Ultraviolet-B radiation has the potential of inhibiting energy transfer from the first to the second trophic level.

**Ecological effects of ultraviolet solar radiation**


Minimal effects of UVB radiation on Antarctic diatoms over the past 20 years

A. McMillan¹, H. Heijnis² & D. Hodgson³

Minimal compositional changes in 20-year sequences of diatom assemblages from the Vestfold Hills suggest that the enhanced UVB levels resulting from the 'ozone hole' has had little effect on the diatom component of the phytoplankton community. In coastal areas such as this one, the presence of an

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Amphibians in a Very Bad Light

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³Frank B. Nestor Chair in Natural Science, Natural Science Division, Pepperdine University, Malibu, CA 90263

Amphibian defenses against ultraviolet-B radiation

Andre N. Bierwagen* & Lara K. Bodie³

INTEGRATED RESEARCH CHALLENGES IN ENVIRONMENTAL BIOLOGY

The Global Decline of Amphibians

HOST-PATHOGEN BIOLOGY AND THE GLOBAL DECLINE OF AMPHIBIANS

Evaluation of Solar Ultraviolet Radiation as a Factor in Amphibian Declines in Montana Habitats

Duration: February 1996 - September 2005

Principal Contact: Dr. Edward E. Little, USGS Columbia Environmental Research Center