


**Light Quality and Health:
Are we at risk from poor quality “junk” light?**



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Disclosures

- Consultant, Functional Formularies
- Chief of Clinical Innovation at Novolux Lighting Technologies

Educational Objectives

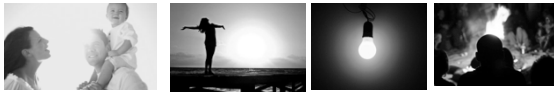
- Review the historical importance of the relationship between natural light exposure and health-performance.
- Review the importance of circadian rhythm disruption as a key driver of chronic, complex disease.
- Consider lifestyle interventions to enhance circadian entrainment-synchronization.

Key Considerations

- Acute-chronic disruption of circadian entrainment are drivers of acute care outcomes and perhaps all chronic, complex disease.
- We are living in a modern environment more disconnected from our evolved, entrained biologic systems.
- Greater attention to alignment between light quality, timing and exposure are accessible interventions for current-future consideration.

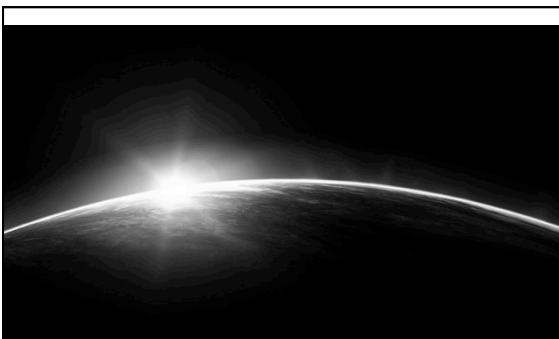
zeitgeber | a cue given by the environment, such as a change in light or temperature, to reset the internal body clock.
from German Zeitgeber, from Zeit 'time' + Geber 'giver'.

Too little of this:



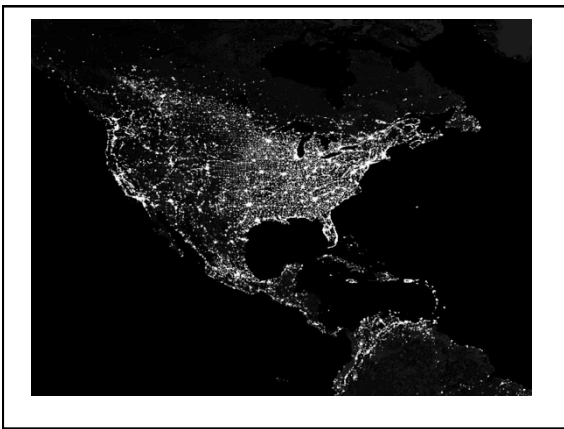
Too much of this:

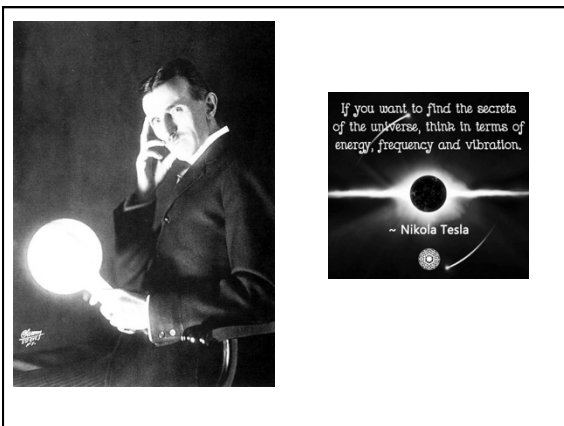


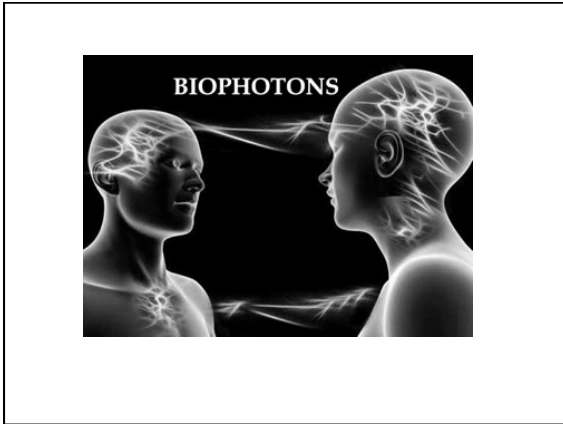


- Earth, at the equator is spinning approximately 1,000 miles/hour around its axis
- Earth is orbiting the sun, moving approximately 66,600 miles/hour
- Diurnal rhythm is central to the existence of all life on our planet





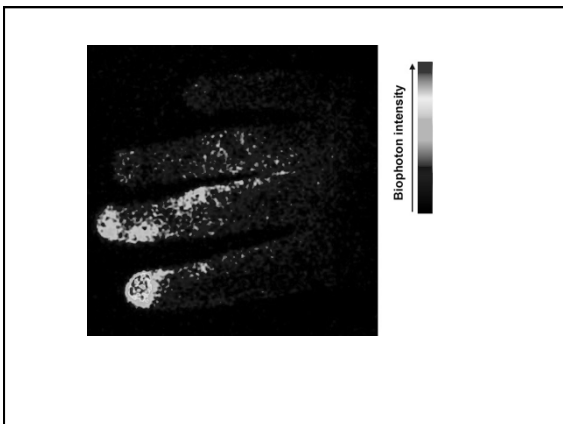


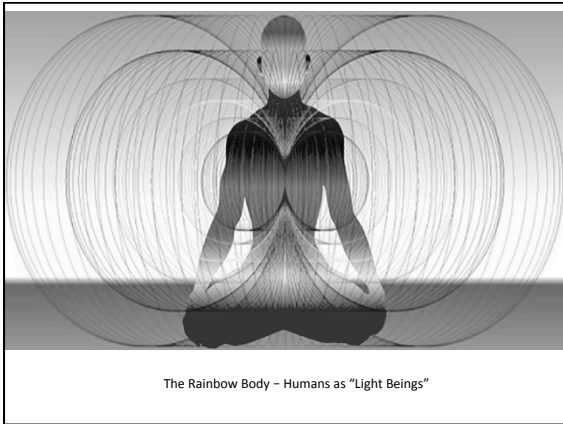


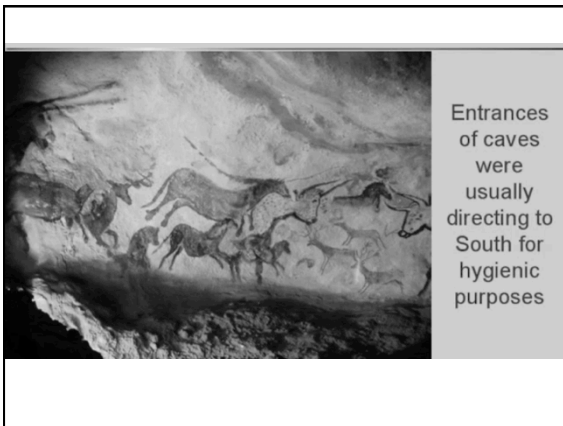
Via Biophoton Light Energy Field

Drs Fritz Albert Popp, Peter Gariev and Vladimir Proponin

- Every animal and plant cell has biophoton emissions that orchestrate function.
- Energetic architecture
- Semi-crystalline matrix
- Resonant frequency and vibration
- Phantom DNA







Heliotherapy

Hippocrates prescribed heliotherapy (sunbathing) for **both medical and psychological** purposes.

Philostratus claimed that all of the Olympian athletes took sunbaths in order to strengthen their muscles and bones.


Hippocrates
460 B.C. - 377 B.C.

Philostratus
c.170 - c.247
Beneficial effects of UV radiation on diseases other than cancer!
Asta Juzeniene

Bikini Mosaic in the Villa Romana del Casale, 4th century

1903
 NIELS RYBERG FINSEN (1860-1904)

Danish physician. Nationality - Denmark




o The 1903 Nobel prize in Physiology or Medicine was awarded to Niels Ryberg Finsen "in recognition of his contribution to the treatment of diseases, especially lupus vulgaris, with concentrated light radiation, whereby he has opened a new avenue for medical science."

Princess of Wales donates Finsen lamp to the London Hospital **1900**

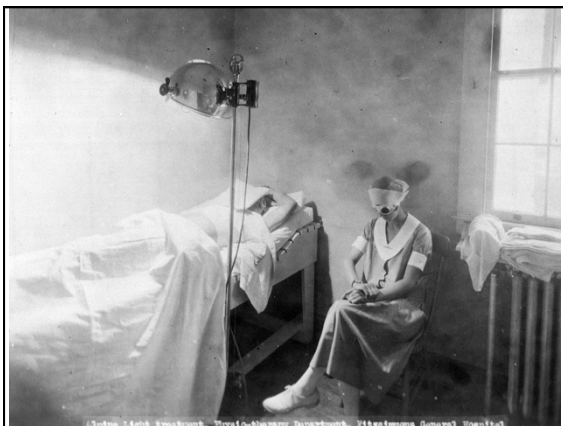
■ **Tuberculosis - the Lamps of Hope**

During the 1890s, Niels Ryberg Finsen (1860-1904), a Danish physician, investigated the bactericidal effects of light which he found was more effective at the ultra-violet end of the spectrum. He constructed a powerful carbon arc electric lamp with four tubes down which light was passed.

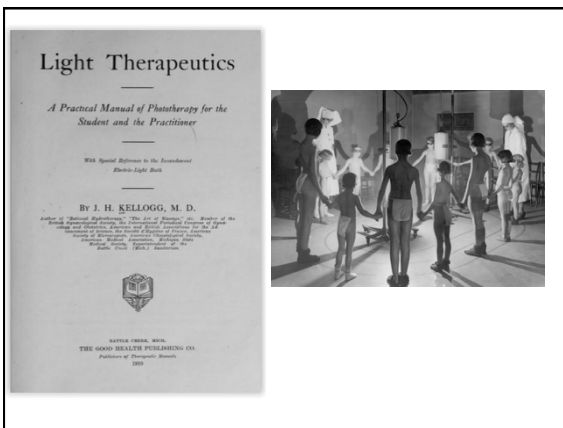


■ Patients undergoing treatment for lupus vulgaris.

■ Finsen's results at treating lupus were so successful that in 1896, the Finsen Institute was set up in Copenhagen and by the turn of the century, 500 patients had been treated.







THE PAST

Beneficial effects of UV radiation on diseases other than cancer

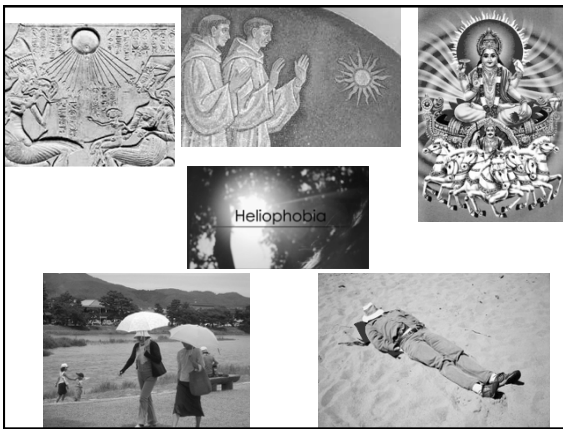
Asta Juarez

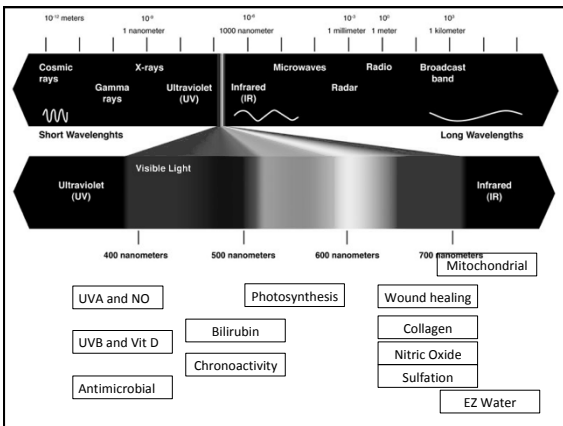
Heliotherapy

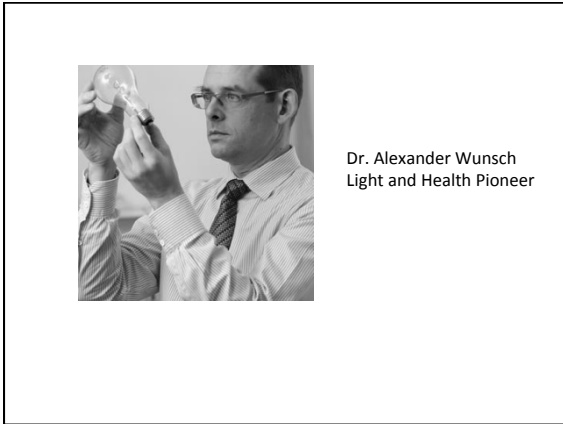
By the year 1933, there were over 165 different diseases for which sunlight proved to be a beneficial treatment.

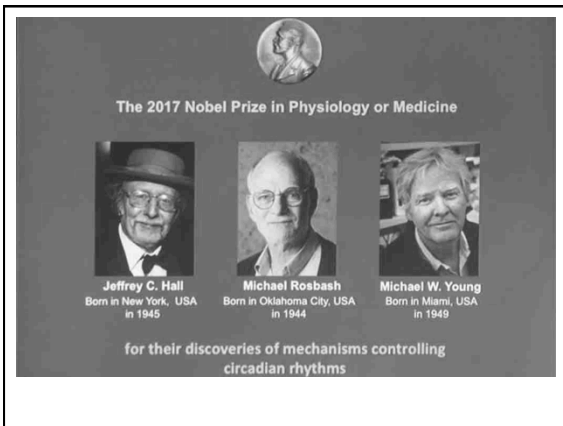
<p>Old studies revealed that exposing patients to controlled amounts of sunlight</p> <ul style="list-style-type: none"> ✓cured some infectious diseases, ✓lowered blood pressure (up to 40 mm Hg drop), ✓decreased cholesterol, ✓lowered abnormally high blood sugar in diabetics, ✓increased the number of white blood cells. 	<ul style="list-style-type: none"> <input type="checkbox"/>Gout (podagra), <input type="checkbox"/>rheumatoid arthritis, <input type="checkbox"/>colitis, <input type="checkbox"/>arteriosclerosis, <input type="checkbox"/>anemia, <input type="checkbox"/>cystitis, <input type="checkbox"/>eczema, acne, psoriasis, herpes, lupus, sciatica, <input type="checkbox"/>kidney problems, <input type="checkbox"/>asthma, <input type="checkbox"/>burns, etc.
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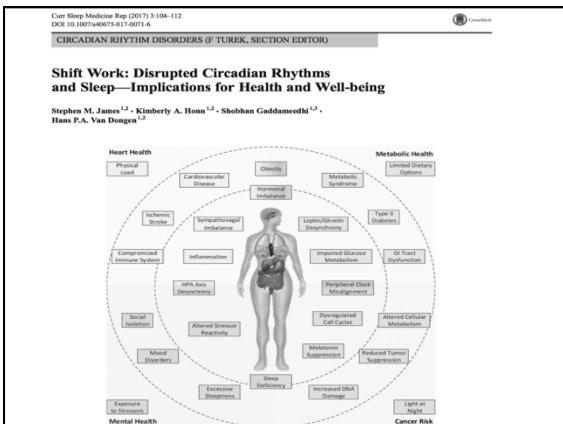












Circadian Rhythm and Health

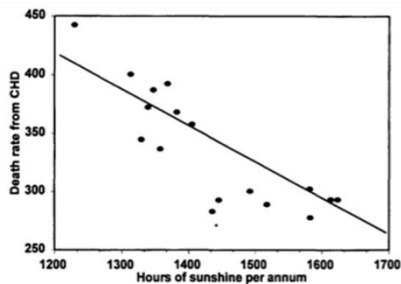
- **MI, angina, stent thrombosis, stroke, arrhythmia, aortic dissection more common in early morning hours**
Braunwald E: On circadian variation of myocardial reperfusion injury. *Circ Res* 2012; 110:6-7)
- **Infarct size larger in morning hours**
Circ Res 2012; 110:105-10)
- **Increased cancer and cardiovascular disease risk in night-shift workers.**
Occup Environ Med 2006; 63:451-5)
- **ICU delirium and "post hospital syndrome"**
JAMA Psychiatry 2014; 71:397-403)
- **Obesity and insulin resistance**
Proc Natl Acad Sci U S A. 2016 Mar 8;113(10)
- **Behavioral health: Depression, PTSD, GAD, BPD**
International Review of Psychiatry, April 2014; 26(2): 139-154

Desynchronization Mechanisms

- Circadian misalignment causes internal *desynchronization of the HPA axis*:
- Sympathovagal balance is then disrupted as indicated by *changes in heart rate variability*:
- Mechanisms underlying elevated risk for CVD due to shift work include *disrupted 24-h rhythms of blood pressure and vascular function, proinflammatory states, and altered lipid and glucose metabolism*

Obes Rev. 2013;14(5):405-16
Proc Natl Acad Sci U S A. 2016 Mar 8;113(10):E1402-11.
Hypertension. 2016;68(1): 243-50.
Sleep Med Rev. 2016
Scand J Work Environ Health. 2010;36(2):96-108.
Horm Mol Biol Clin Investig. 2014;18(1): 47- 54

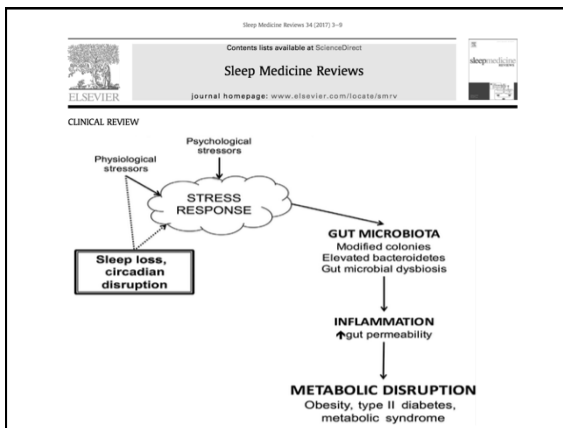
Heart Disease Mortality and Sunlight*

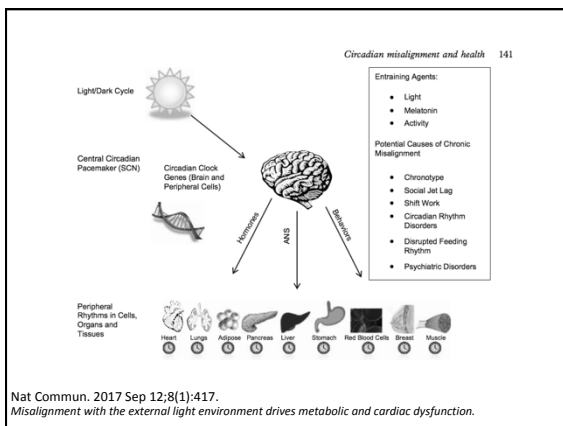


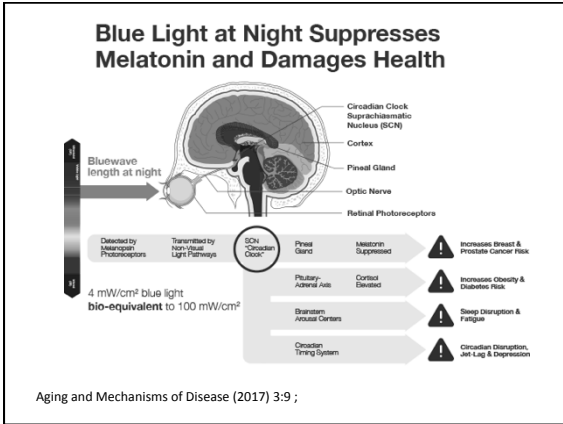
*Grimes et al., *Q. J. Med.* 1996; 89:579-589

Circadian Disruption and Cancer

- Maintaining synchronized circadian rhythms in peripheral systems is critical for the *fine-tuning of cellular processes including cell cycles, DNA repair, apoptosis, and immune modulation*. Dysregulation of the cell cycle, accumulation of DNA damage, and reduced tumor suppression (*Cell Metab. 2016;24(2):324–31*)
- *Melatonin is protective against oxidative DNA damage* (*Occup Environ Med. 2016;73(8)*)
- *Adipokines* (cell-signaling proteins) secreted by fat tissue and involved in immune responses—and more generally the development of a compromised immune system due to circadian misalignment—may connect these different factors (*Chronobiol Int. 2016;33(6): 581–8*)

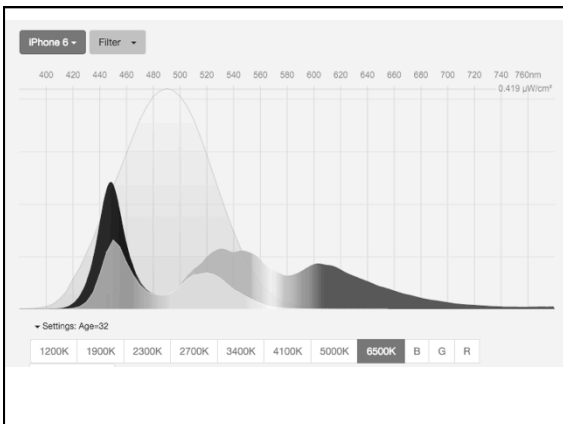


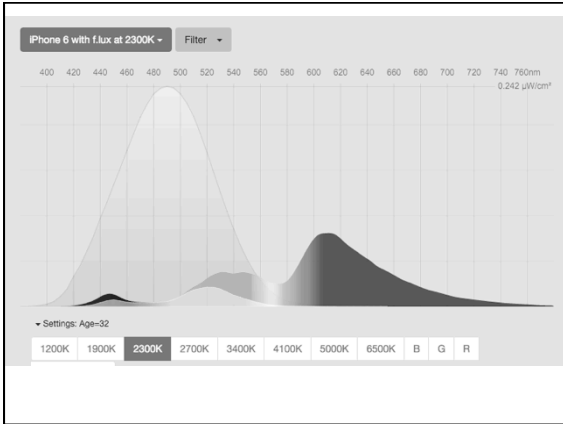




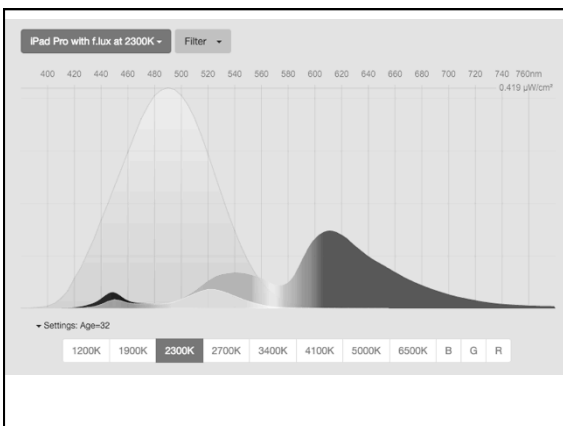
Melatonin

- Hormone of darkness
- Very sensitive to blue light
- Facilitates sleep cycle
- Increases cell regeneration
- Anti-oxidant activity; ROS scavenger
- Antagonizes Aromatase and lowers estrogen production in tissues
- Modulates immune regulatory function
- Antagonizes cortisol
- Key substance for chronobiologic adaptation (day/night and summer/winter)

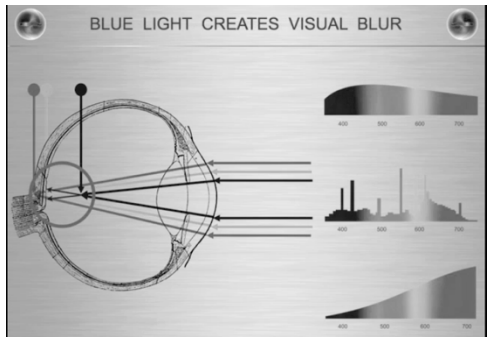






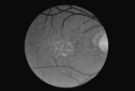


BLUE LIGHT CREATES VISUAL BLUR




Courtesy Dr. Alexander Wunsch

The diagram illustrates how blue light affects the eye. It shows a cross-section of the eye with light rays entering from the left. To the right, there are three graphs: a spectrum of light intensity, a bar chart showing light intensity across different wavelengths, and a graph showing the relationship between wavelength and light intensity. The text 'BLUE LIGHT CREATES VISUAL BLUR' is at the top.

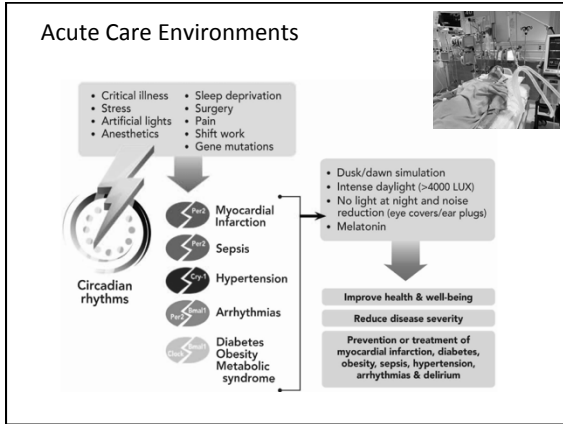
Age-Related Macular Degeneration 

- In modern societies 30-50% of people over 65 years of age show signs of AMD
- For 85% of cases there is no cure
- Progression leads to blindness
- Statistical correlation with chronic complex disease and changes in light exposition
- Melanopsin receptors sensitive to the oxidative stress of blue light

Molecular Vision 2016; 22:61-72

Fluorescent Light 

- NHS- Nurses Health Study (Harvard)
- 120,000 nurses followed 30+ years
- 30% increase of breast cancer after 15 years of night work
- Other studies have shown increased risk up to 60%



CLINICAL CONCEPTS AND COMMENTARY

Jerrold H. Levy, M.D., F.A.P.A., FCCM, Editor

Health Implications of Disrupted Circadian Rhythms and the Potential for Daylight as Therapy

Jason Brainard, M.D., Merit Cobel, B.S., Benjamin Scott, M.D., Michael Koeppen, M.D., Tobias Eckle, M.D., Ph.D.


"We envision a near future in which use of daylight (real or simulated) to entrain circadian rhythms will become standard of care for patients not only in the ICU but also in the operating room and postanesthesia care unit. It is certainly intriguing that findings from recent biomedical research may challenge us to restore ancient patterns of exposure to daylight, under which life has evolved for the last 4 billion years."

Copyright © 2015, the American Society of Anesthesiologists, Inc. Wolters Kluwer Health, Inc. All Rights Reserved. Anesthesiology 2015; 122:1170-5


REVIEW ARTICLE


Vitamin D Deficiency

Michael F. Holick, M.D., Ph.D.
N Engl J Med 2007; 357:266-281 | July 19, 2007 | DOI: 10.1056/NEJMr070553

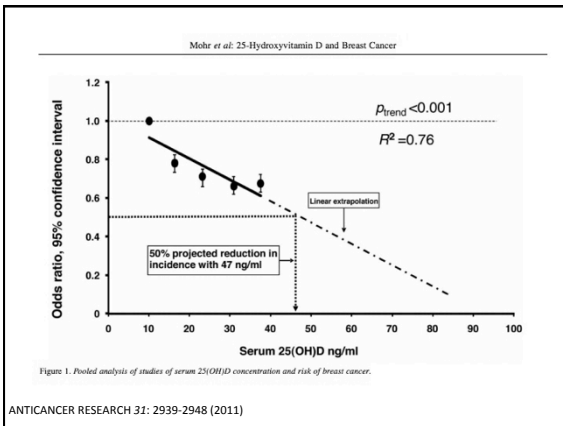


- Author of the UV Advantage
- Sunblocks with factor 15+ reduce sulfated cholecalciferol by 99.9%
- More thoughtful dosed sunlight exposure could reduce cancer incidence in USA by as much as 50%
- Melanoma risk significantly reduced with occupational sun exposure

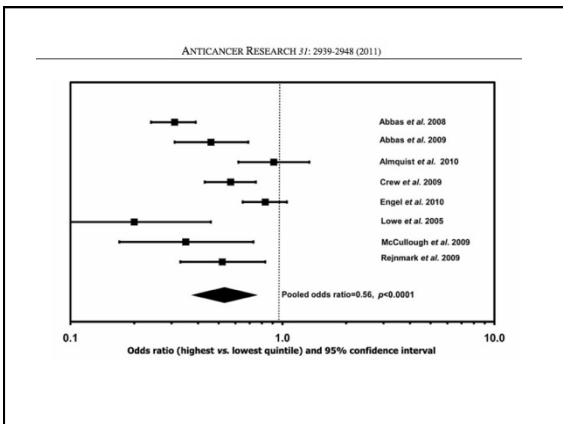




- Many epidemiologic studies associate low vitamin D levels with most chronic, complex diseases.
- Modulates 3% human genome
- Anti-inflammatory, DNA repair, apoptosis, anti-oxidant, etc.
- Sunlight = sulfation
- Sunlight is the ultimate source of vitamin D
- Studies suggest a desirable blood level of at least 30 - 50 ng/ml
- ? Sunlight vs. supplement



ANTICANCER RESEARCH 31: 2939-2948 (2011)



**Vitamin D and Reduced Risk of Breast Cancer:
A Population-Based Case-Control Study**

Julia A. Knight,¹ Maia Lesosky,¹ Heidi Barnett,¹ Janet M. Raboud,¹ and Reinhold Vieth²

Table 2. ORs and 95% CIs for an association between vitamin D--related exposure variables at ages 10 to 19 (sun exposure and dietary vitamin D) and breast cancer in cases and controls.

	Cases (n)	Controls (n)	OR (95% CI)	OR* (95% CI)
Girls 10-19 yrs most sun	222	1,040	0.31	0.31 (0.18, 0.53)

Table 3. ORs and 95% CIs for an association between vitamin D--related exposure variables at ages 20 to 29 (sun exposure and dietary vitamin D) and breast cancer in cases and controls.

	Cases (n)	Controls (n)	OR (95% CI)	OR* (95% CI)
Women 20-29 yrs most sun	1,022	4,485	0.49	0.49 (0.35, 0.68)

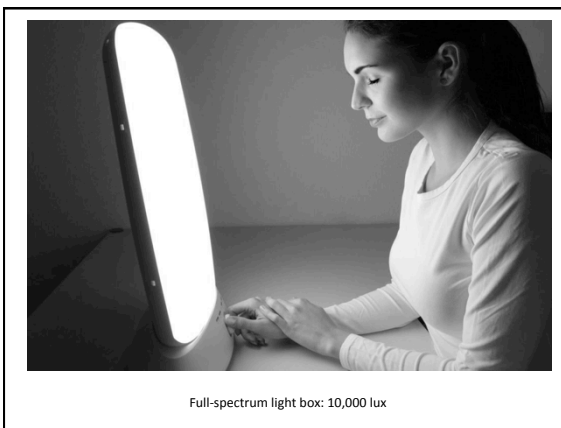
Table 4. ORs and 95% CIs for an association between vitamin D--related exposure variables at ages 30 to 39 (sun exposure and dietary vitamin D) and breast cancer in cases and controls.

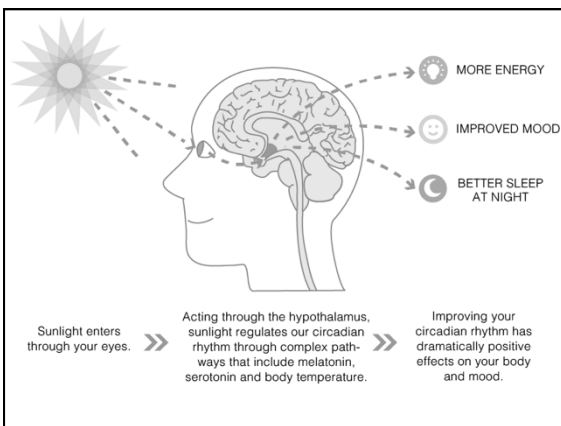
	Cases (n)	Controls (n)	OR (95% CI)	OR* (95% CI)
Women 30-39 yrs most sun	1,022	4,485	0.00	0.00 (0.00, 0.00)

Table 5. ORs and 95% CIs for an association between vitamin D--related exposure variables at ages 40 to 49 (sun exposure and dietary vitamin D) and breast cancer in cases and controls.

	Cases (n)	Controls (n)	OR (95% CI)	OR* (95% CI)
Women 40-49 yrs most sun	1,022	4,485	0.00	0.00 (0.00, 0.00)

Courtesy Michael Holick MD, PhD





UVA and Nitric Oxide (NO)

What is the role of nitric oxide (NO)?

- ✓ Vasodilatation
- ✓ UV-induced melanogenesis
- ✓ UV-induced immunosuppression
- ✓ Inflammation
- ✓ Apoptosis
- ✓ Wound healing
- ✓ Antimicrobial effects

Bacteria – *Staphylococcus aureus*
 Dermatophytes – *Trichophyton rubrum*,
Trichophyton mentagrophytes
 Yeasts – *Candida albicans*

Dermato-Endocrinology 4:2, 109–117; April/May/June 2012; G 2012 Landes Bioscience

Photobiomodulation

Improved tissue function
 • anti-inflammatory effects
 • improved energy metabolism

Cytochrome C Oxidase (CCO) Absorption

Red light at 660 nm and Infrared light at 830/840 nm


CCO is a photoacceptor

Light **must be absorbed** by a **photoacceptor** in order for a photochemical reaction to take place.


All photons which are transmitted through or reflected away from the tissue produce no effect.

At wavelengths of 660 and 830/840 nm, Cytochrome C Oxidase is **most efficient** absorbing light.

Time-Restricted Feeding



- Time restricted feeding e.g. consume all food within 10-hour
- Decreases in body weight and visceral fat
- Significant reductions in breast cancer recurrence and improved prognosis (Patterson et al. UCSD)
- Improved cardiovascular disease risk profile
- Decreased inflammation (Biogerontology. 2015 Dec;16(6): 775-88)
- Decreased neuroinflammation (Neurobiol Aging. 2015 May; 36(5):1914-23)
- Autophagy (Autophagy, 2014;10:11, 1879-1882)



Is this always a good idea?



INGREDIENTS	PRODUCTS
AVOID Oxybenzone Vitamin A (retinyl palmitate) Added insect repellent	AVOID Sprays Powders SPF above 50
LOOK FOR Zinc oxide Avobenzone Mexoryl SX	LOOK FOR Cream Broad-spectrum protection Water-resistant SPF to suit your needs, 15-50

Aluminum Nanoparticles: Highly Destructive in the Brain*

- Destroyed mitochondria and severely depleted ATP
- Induced autophagy and programmed cell death
- Increased permeability of blood brain barrier
- Were persistent
- Far more damaging than larger sized aluminum particles



*L Chen et al., Nanomedicine Feb 2013; 9(2): 212–221.

Summary



- Decreased sunlight exposure and increased “junk light” exposure are major contributors to chronic complex disease.
- Sensible sunlight e.g. 30” /day or more unprotected as tolerated to avoid burning
- Allow full spectrum dawn light to access your retina
- Consider Vitamin D lamp (Sperti UVB 5-10 ”/day)
- Incandescent, halogen, warm LED; CRI (color rendering index) 95+
- Ditch the CFUs, fluorescents when able
- Blue blocker glasses after sunset
- Full-spectrum light at 10k lux for 30” for seasonal affective disorder, sleep disruption, improved cognition.
- F.lux or Iris apps for adjustment color temperature and blue blocking (2300 Kelvin an ideal setting for light intensity on computers, tablets, smart phones)
- Time-restricted feeding a powerful Zeitgeber

Zeitgebers

Summary: Entrain Circadian Rhythms

 Go Outdoors ...	Best strategy: Bright natural light in the day Orange light at night Daily exercise Intermittent fasting Feeding only in the daytime Warm temperatures in day, cool at night Social interactions in the day Stress in the day, no stress at night Regular sleep schedule	 ... Interact ...
 ... Exercise ...		 ... Love ...
 ... Eat ...		 ... Sleep ...

Logan et al. Journal of Physiological Anthropology (2015) 34:9



Thank you !
