

ICNIRP 7th International NIR Workshop
Edinburgh, United Kingdom, 9-11 May 2012

Health Risks for The Eye from Optical Radiation

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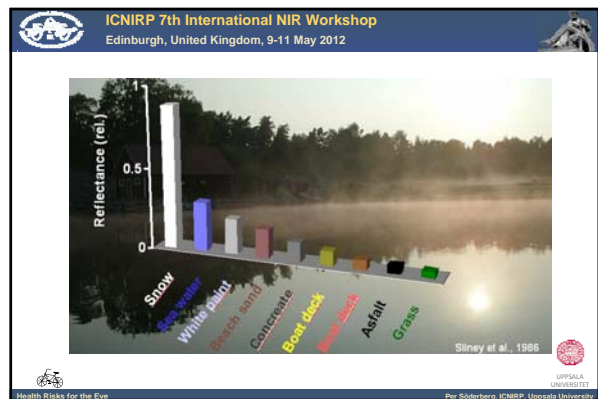
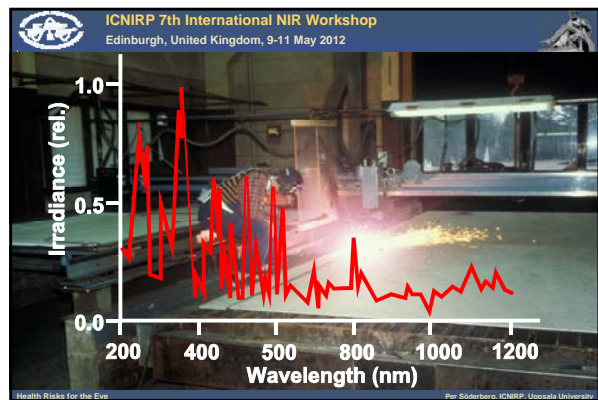
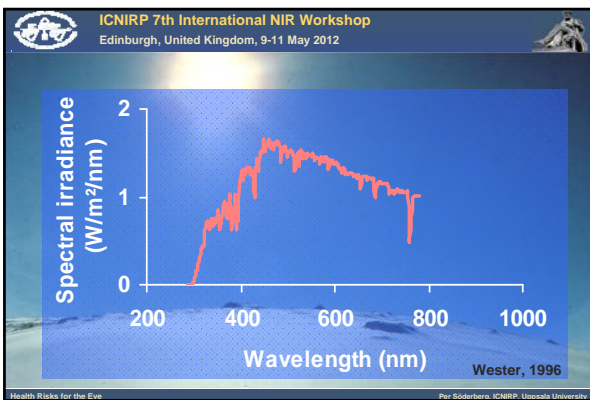
Health Risks for the Eye

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Take Home Message

- Effects of optical radiation in the eye strongly depends on exposure conditions and transmittance characteristics in the eye
- Ultraviolet radiation causes photochemical damage in the eye lids, the conjunctiva, the cornea, the uvea and the lens
- Light causes photochemical damage in the retina
- Effects of near infrared radiation in the lens are thermal only

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Coroneo effect

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Above threshold, short delay onset

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Below threshold, chronic exposure

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Above threshold, short delay onset

Wavelength (nm)	Biological eff. (rel.)
250	0.4
260	0.6
270	1.0
280	1.0
290	0.6
300	0.5
310	0.2
320	0.1

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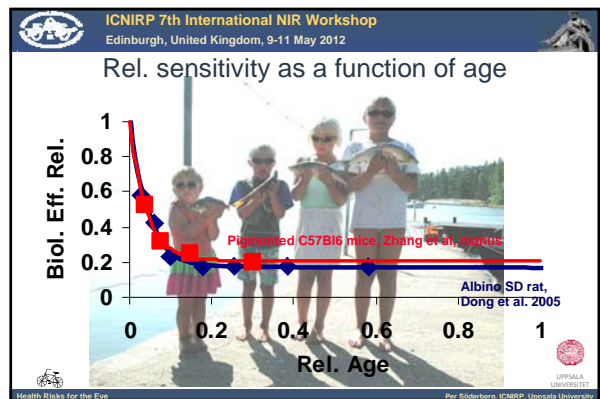
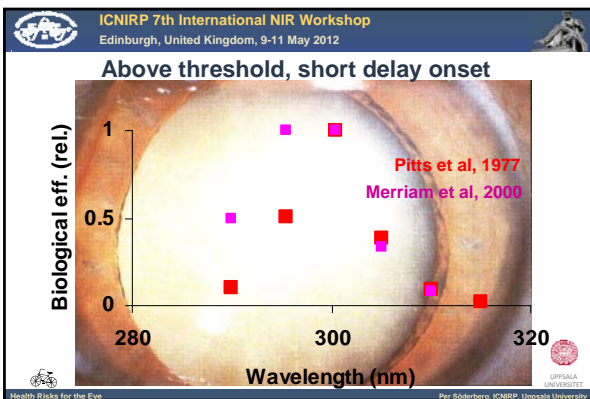
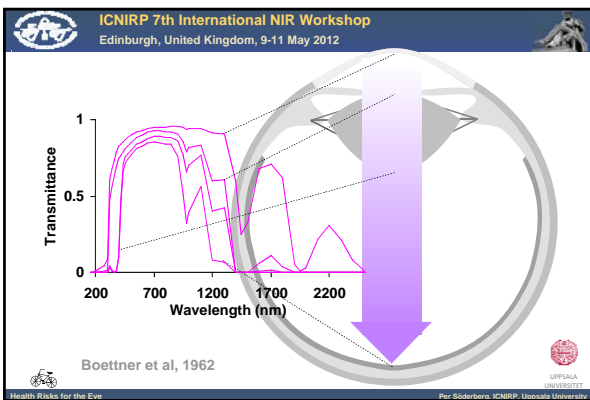
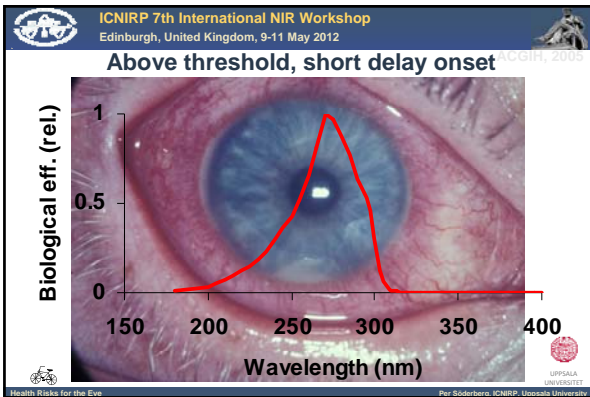
Below threshold, chronic exposure

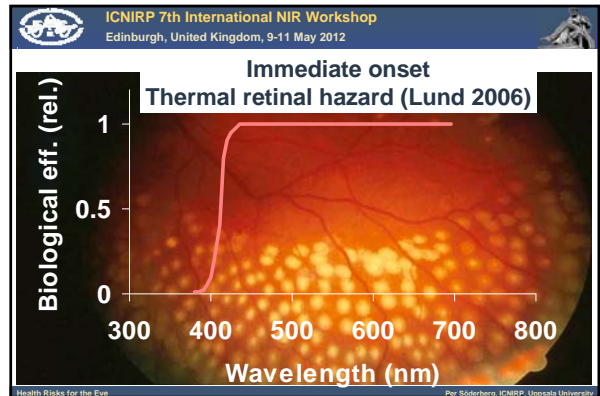
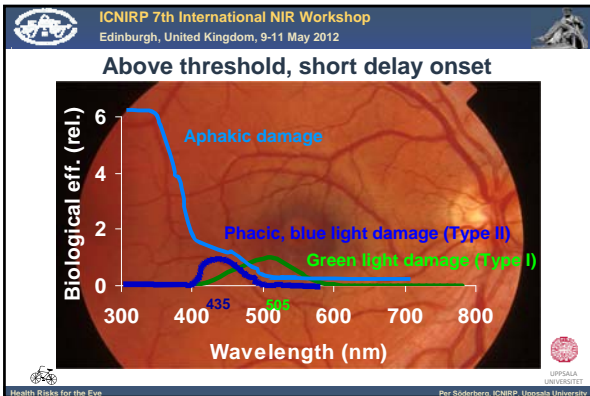
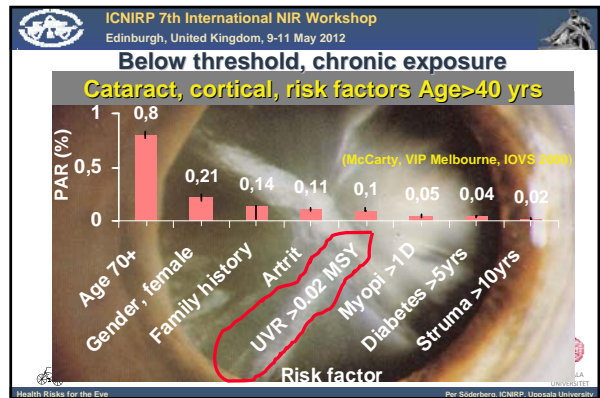
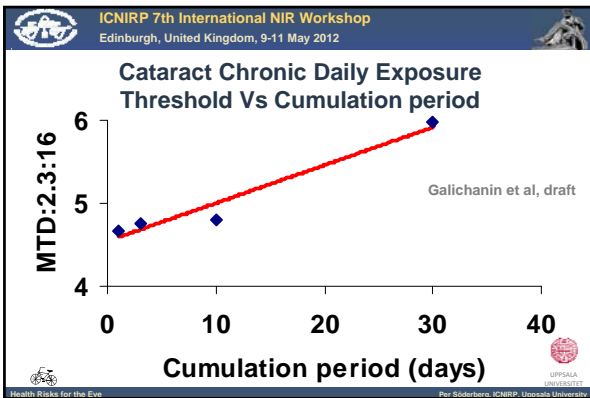
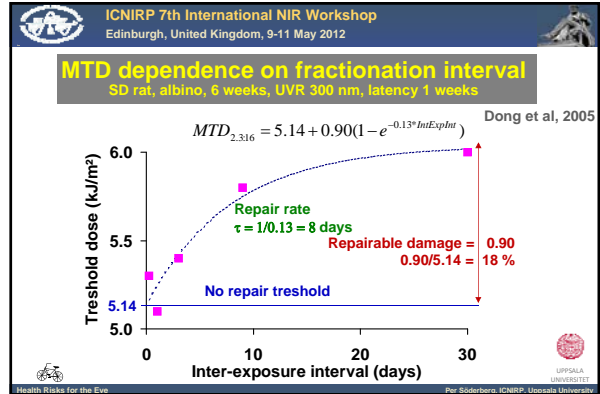
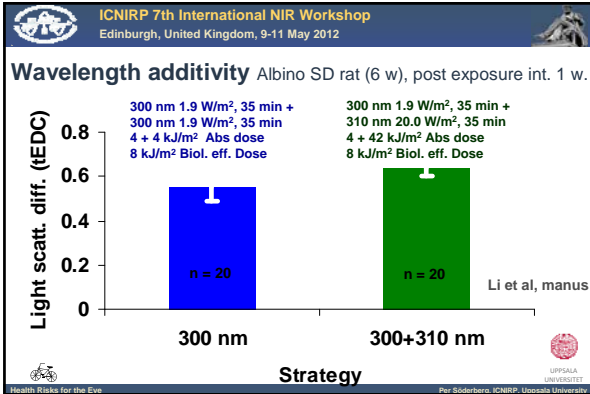
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Below threshold, chronic exposure

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Chronic subthreshold exposure to light

Macular degeneration?

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IRR and cataract?

Epidemiological association between chronic exposure to IRR and cataract (Lydahl, 1984)

Photochemical effect?

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Near IRR and cataract – thermal only/photochemical ?

Experimental evidence

Wolbarsht, 1980
Rabbit, in vivo
1064 nm, NdYag, CW
20 W/cm²

Pitts 1980
Rabbit, in vivo
715-1400 nm filtered lamp
4 W/cm²

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Light scattering as a function of exposure time

Albino Sprague Dawley rat, 150 g (6 wks),
1090 nm, 96 W/cm², 3 W within pupil spot size 2 mm, post exposure time: 1 week

Exposure time (min)	Light scat. diff. (tEDC)	n
20	~0.01	21
20	~0.02	21
40	~0.01	19
60	~0.01	21

Wolbarsht (1064 nm, 20 W/cm²) Th: 2 kJ/cm², n = 6
Pitts (715-1400 nm, 4 W/cm²) Th: 4 kJ/cm², n = 4

57 kJ/cm², 103 kJ/cm², 189 kJ/cm², 344 kJ/cm²

Yu et al, draft

No evidence for photochemical effect!

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Summary

- ☞ Ultraviolet radiation exposure of ocular structures is determined by ambient scattering and transmittance characteristics of the eye
- ☞ - Ultraviolet radiation causes photochemical damage in the eye lids, the conjunctiva, the cornea, the uvea and the lens.
- Light causes photochemical damage in the retina
- ☞ The assumption in the ICNIRP broadband guideline that near IRR causes thermal damage only appears correct

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