LIGHT and Health

Basics
What is LIGHT?

Light is radiation!

Light is together with air and water a basic and unreplacable nourishment of mankind and nature.
What is Health?

Health is a situation of fully well-being and not only the absence of illness (WHO, 1946)
LIGHT influences Health by ...

- optimized visual conditions 25%
- by changing mood
- mental performances
- physical processes 75%

(J. Liberman)
... by changing moods
... mental performances
... physical processes
Healthy light conditions are the environmental conditions to which men could adapt during evolution ...

1 second in 1 hour
Amerika at 11.00 pm ...

... the modern mankind
Photobiological effects depend on ...

- light intensity
- light spectrum
- exposition time
- exposition duration

(eventually also on spatial light distribution, history of exposition, etc.)

**LIGHT** is the most important timer!
Zeitgeber: Licht, Umgebungstemperaturen, Essenszeiten, Streß und körperliche Anstrengung

**The Rhythm of Life**

- 10:30 P.M.: Bowel movements suppressed
- 12:00 Midnight: Deepest sleep
- 4:30 A.M.: Lowest body temperature
- 6:00 A.M.: Sharpest blood pressure rise
- 7:30 A.M.: Melatonin secretion stops
- 8:30 A.M.: Bowel movement likely
- 10:00 A.M.: High alertness
- 12:00 Noon: Best coordination
- 3:30 P.M.: Fastest reaction time
- 5:00 P.M.: Greatest cardiovascular efficiency and muscle strength
- 6:00 P.M.: Highest blood pressure
- 7:00 P.M.: Highest body temperature
- 9:00 P.M.: Melatonin secretion starts

**Cyclical Events**


Core Body Temperature Rhythms in Insomnia Versus Controls

Rectal Temperature (°C)

Hours From Sleep Onset

Melatonin: represents the body`s clock

Light is not the reason of the circadian rhythm, (endogen controled) but influences and changes the rhythm!
1.) the Melatonin synthesis is blocked by light falling into the eye - after sunset the melatonin production is increasing

2.) Melatonin shows in experiments with cell cultures and animals onkostatic effects

3.) Melatonin shows antioxidantic effects and probably protects against tumors

The effect of Melatonins as Antioxidans is expected to be 60-70 times higher than of vitamin C or E! (Reiter 2002; Reiter et al., 2004).


The positive effects of could be ...

- improving the quality of sleep (12) (13)
- stabilizing the circadian rhythm (2) (7) (8)
- improving vitality and alleviates distress (3)
- healing effects (shorten healing times) (4) (6)
- reduction of analgesic medication use (5)
Simulation of Sunrise

Usually:

start: 30 min - 2 hours before wake up
Light therapy at morning
Literatur:


(2) Gögenur, I. et al. (2005): Disturbed core body temperature rhythm after major surgery. Sleep and Biological Rhythms, 2, pp. 226-228.


Etc.
Running studies at BLL …

Field study „Wochenbettstation“
(in cooperation with the `Frauen- und Kopfklinik Innsbruck`)
Wochenbettstation - LKH Innsbruck

„day situation“
Wochenbettstation - LKH Innsbruck

„evening situation“
Wochenbettstation - LKH Innsbruck

„night situation“
Running studies at BLL …

Laboratory study „Work at day and night“
(in cooperation with ‚UMIT‘)
Running studies ...

Laboratory study „Sunroom“
(competence center)
Running studies …

Theoretical study „Melatonin Spectrum“
(competence center)
Melatonin suppression of different lamps:

<table>
<thead>
<tr>
<th>Lichtquelle</th>
<th>Halogen</th>
<th>NAV</th>
<th>HCI WDL</th>
<th>LED weiß</th>
<th>LED amber</th>
<th>Plank 1200K</th>
<th>Plank 1800K</th>
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<td>536</td>
<td>210</td>
<td>478</td>
<td>813</td>
<td>96</td>
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</table>

Maximum of light with minimum of melatonin suppression.
results of simulations of different spectra
Relevance for IEA45 project / energy savings:

• more light increases health ?
• > contradiction betw. energy conservation and optimal lighting conditions ?
• > increasing utilization of daylight/sunlight saves energy ?

Light and Health:

• light and health > further reseach is needed
• melatonin suppression: complex interaction > not usable like V(λ) function
• tailored spectra (lamps) for different applications ?
• increasing utilization of daylight/sunlight by new architecture and systems
Thank you for your attention!