

Light for health and well-being.





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Light for health and well-being.

BrainLit is a health technology company first-and-foremost, that focuses on light to deliver significant health and wellbeing improvements.

Our business is about solving a very common problem – we don't get enough daylight. Standard indoor lighting does not meet our light exposure needs, which significantly affects our health.

With Biocentric lighting, we deliver the same benefits of proper daylight exposure, indoors. Biocentric lighting is a self-learning system leveraging LED luminaires, light control systems, UI, sensors and light recipes to optimally mimic the solar day. With our light solutions, customers experience better sleep, increased performance and faster recovery – all pillars of good health.

The company was founded in Lund in 2012 by Tord Wingren, one of the inventors of Bluetooth technology. Headquartered in Lund, Sweden, BrainLit has a North American subsidiary with offices in New York.



**We bring
daylight
indoors.**



What are circadian rhythms, and why do they affect our health?

Circadian rhythms are the result of an adaptation to earth's rotation applying a 24-hour structure on bodily physiology. Your circadian rhythm regulates your sleep, body temperature, metabolism and the production of hormones. Many factors impact and are affected by our circadian rhythm, such as food intake, exercise and sleep.

A synchronized circadian rhythm is a vital piece of the puzzle that helps your body's internal mechanisms function properly.

Sleep cycles are directly linked to our circadian rhythm. Research shows that light can correct a disturbed circadian rhythm. Blue light has a direct alerting effect - especially blue-enriched light in the morning stabilizes the circadian rhythm.

The problem: We don't get enough daylight.

Our modern 24-hour society and working conditions are often in conflict with our intrinsic photobiology, and on average we spend 90% of our time indoors. This leads to a lacking synchronization with daylight, as traditional indoor lighting does not have the necessary properties to entrain the circadian rhythm.

The level of light we are exposed to also varies in every environment.

For example, a sunny day outside might give 100,000 lux, a cloudy day 10,000 lux, whereas indoor lighting commonly only provides 300 lux illuminance. Additionally, outside light shows a wide spectrum of colors while indoor lighting such as incandescent, fluorescent or halogen light sources only provide a limited color spectrum and are lacking in the blue wavelengths important for circadian entrainment.

Unnatural exposure to light is common at night.

A typical evening light environment at home provides around 20 lux m-EDI. An increase to 50 lux m-EDI, which the use of a laptop or phone may provide, might cause a sleep delay by 1.5 hours if you are exposed to regular office lighting during the day. In contrast, using BCL light (m500) during the day, that sleep time delay would be reduced by 40%.

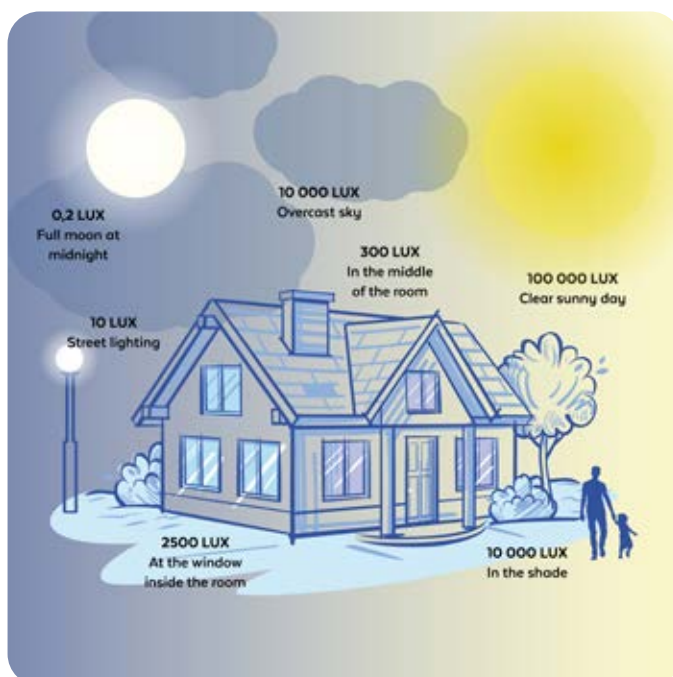
Modern habits limits our access to daylight.

Working hours and social life patterns are often separated from the solar day. Our habits also vary which directly affects our sleeping schedules. This creates a conflict with our body's circadian rhythm.

Several factors of our modern lifestyle can disrupt the circadian rhythm with negative health consequences, and they are often overlooked:

- Too little daylight to synchronize with the solar day
- Unnatural light exposure outside the solar day
- Our social rhythm is out of sync with the solar day
- Our social rhythm varies (shift work, late night out etc)

Circadian misalignment is associated with short and long term health consequences. These include failure to process information, loss of attention, immune suppression, increased risk of infection and cancer, cardiovascular dysfunction and memory impairment.



Biocentric lighting helps restore and sustain your natural circadian rhythm.

Biocentric lighting considers the most important aspects of daylight throughout the 24-hour cycle and dynamically changes over the course of the day. It is designed to address the visual, emotional and biological aspects of light.



Instant and long-lasting benefits

The effects of light are prominent even after leaving a light environment. This means that even if you travel or spend time away from the light, if you normally spend your days in Biocentric lighting, you will not be as affected by these changes as you otherwise would.

Strong circadian impact light during the day, means less circadian disruption caused by blue light exposure from evening screen time. So in addition to supporting a balanced circadian rhythm, Biocentric lighting also helps you protect yourself against poor light.

Key benefits

- Improved mood
- Better sleep
- Improved alertness
- Better cognitive function

**Reclaim
your rhythm.**

Validated by science.

Biocentric lighting is fundamentally designed from the deep understanding of the circadian system in human beings by our scientific board, with professors in medicine, environmental psychology, psychiatry and physics as prominent members.

Each member is in place to ensure that BrainLit continues to reflect the latest research and understanding of human physiology.



Thorbjörn Laike

Member of the Scientific Board
PhD. Professor of Environmental Psychology at the Department of Architecture and Built Environment, Lund University.



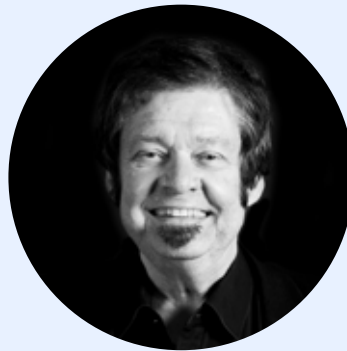
Klas Sjöberg

Chairman of the Scientific Board
PhD. Consultant and Associate Professor at the Gastro Clinic at Skåne University Hospital.



Tord Wingren

Founder, Head of Strategy & Head of Sales EU
M.Sc Electrical Engineering.



Lars Samuelson

Member of the Scientific Board
PhD. Professor of Semiconductor Electronics at Lund University.
Awarded the “Einstein Professorship” by the Chinese Academy of Sciences.
Appointed Fellow of the American Physical Society.



Madeleine Selvander

Member of the Scientific Board
PhD. Ophthalmologist.
Former senior consultant at Skåne University Hospital.
Head of private ophthalmology clinic Sundets Ögonläkare.

Madeleine Selvander

- We investigate scientific research that may become relevant for BrainLit and discuss new ways to implement scientific findings.

Science never sleeps, research goes on all day, every day. Thus a science based company like BrainLit must always keep up with the latest scientific findings, or risk becoming obsolete. For this reason, since the company was founded, it has developed its product around the advice provided by its scientific advisory board, tasked with keeping management updated and finding new ways to implement the technology.

Madeleine Selvander is one of the members of the scientific advisory board. As an ophthalmologist and former eye surgeon, she literally knows the workings of the human eye from the inside out. Not to mention how it is affected by light and what impact this in turn has on the rest of our biology.

– BrainLit’s technology is based on two different aspects of science. On the one hand, the technological base of LED lights, optics and nano technology to produce short wavelength light and recreate daylight conditions indoors. On the other hand, how our bodies react to the light gathered in our eyes, and our ability to analyse this, explains Madeleine Selvander.

Less than 20 years ago a new kind of photoreceptor cell was discovered in the human eye. The ipRGCs cell is a special type of ganglion cell found in a deeper level of the retina than the rods and cones. This type of cell reacts to blue wavelength light, around 480 nm, and control our circadian rhythm.

Adapting to individual chronotypes

– Indoor luminaires, for example lightbulbs, halogen lights and fluorescents, produce very little light with these wavelengths. When we lack this stimulus, we lose our sense of day or night. A day and a night equals 24 hours, but most people have a circadian rhythm slightly longer than 24 hours, so we need the light to set our rhythm or it will start lagging. For office workers, this means that they become evening persons, but still have to get up early in the morning and suffer from sleep deprivation, says Madeleine Selvander.

– We investigate scientific research that may become relevant for BrainLit and discuss new ways to implement scientific findings. This is the foundation of BrainLit’s technological vision; providing indoor light with the quality of natural outdoors light and thus resetting our circadian rhythms instead of letting workplace conditions gradually



wear us down. For Madeleine Selvander, who is not only an ophthalmologist but also has an engineering background, her first contact with BrainLit seemed determined by fate.

– I met Peter K Andersson, who was then the CEO of BrainLit, and he mentioned something about light and how it affects us. To be honest, I was very skeptical, but also intrigued and curious. If I was unaware of this, the same had to be true for many others as well. So I became persistent in telling them they needed help from someone younger – and maybe from a woman, she laughs.

Today, she is one of the experts of the scientific advisory board. Klas Sjöberg, chief physician of gastroenterology at the world renowned University of Lund is the chairman and summons the board every six weeks. The other members are Thorbjörn Laike, professor of environmental psychology, Lars Samuelsson, professor of semiconductor electronics and Tord Wingren, the founder of BrainLit, who contributes in all areas from his unique perspective and vision.

Aligning research and technology

– We investigate scientific research that may become relevant for BrainLit and discuss new ways to implement scientific findings. Often BrainLit has technological solutions that may be used in research, but no one has yet done that research. For instance, BrainLit has the patent and the technological solution for personalized light conditions, but the research on how personalized light differs from standard light is currently quite limited. This is mostly due to the problem of the individual variations and the challenge to get accurate data of the actual light they are exposed to, says Madeleine Selvander

Sometimes the technology is ahead of the science. In this case the scientific advisory board acknowledge the possibility to accelerate research by offering researchers the use of BrainLit’s technology to get more accurate data. But despite the wide areas of expertise gathered in the board, there are still subjects that need further exploration.

– We will invite experts in chronobiology and how our biology is affected by the circadian rhythm and BioCentric Lighting. Together, we have a more than basic understanding of the functions, but to have access to truly deep knowledge of this intricate relationship... That would be so interesting! Madeleine Selvander concludes.



BCL or HCL - What is the difference?

Biocentric lighting (BCL) is built with many years of experience and a focus on circadian rhythm and health aspects at its core. Everything from luminaire to light design and control system, is designed with circadian effective light in mind. The luminaires are optimized for a large tunability in circadian effect. Light design is meticulously done to ensure that the prescribed M-EDI levels are met. Light recipes are inspired by the latest science and adapted to the user group to not only meet, but also exceed existing standards. All light recipes are developed with a chronobiological simulation model, to ensure optimal circadian entrainment. In addition, care is taken to create dynamic, welcoming and interesting light environments - daylight indoors. The Biocentric lighting system is protected by foundational patents.

HCL is a vaguely defined term. Sometimes HCL systems are merely aesthetics, a standard lighting system with a color temperature varying throughout the day. Sometimes the systems are designed to adhere to one of the aspiring standards of circadian light, but it may be unclear if this is indeed controlled all the way from design to application. This makes it difficult to assess the effectiveness and choose the right product. In contrast, Biocentric light guarantees circadian effective light levels to the user.

HCL

Fulfills: emotional and visual needs

Health impact design base:
visual qualities

Recipe: varying color from dawn till dusk

Design target: resembling variation of natural daylight from visual standpoint

Application design: generic recipe and visual light design

Circadian impact: not always specified

Deployment: tedious and costly installation and commissioning

Platform: generic building/lighting automation HW and SW

BCL

Fulfills: circadian, emotional and visual needs

Health impact design base:
circadian qualities

Recipe: tailored variation of circadian impact to achieve specific results for individuals around the clock

Design target: support and strengthen circadian rhythm based on individual circumstances

Application design: visual, circadian and emotional light design specific to the application

Circadian impact: specified mEDI variation over time

Deployment: preconfigured plug-n-play

Platform: developed specifically to deliver Biocentric lighting

Our solutions

We deliver healthy and safe environments using light. Our solutions can be used for instant sanitary purposes or to support long term health and wellbeing.

Biocentric lighting

With Biocentric lighting (BCL), we bring daylight indoors. Whether you are a global enterprise or a small organisation, we offer a solution to fit your needs.

Disinfection lighting

With disinfection lighting using UV-C, we can quickly, safely and automatically disinfect both air and surfaces to create a safe and healthy environment.

Biocentric lighting

Customized

Customized solutions from BrainLit are designed according to your needs and requirements. The lighting design is adapted to the surroundings and each solution comes with unique light recipes for the users.

Sets

With our sets you will get Biocentric lighting for a specific space or an entire room. The sets contain light recipes customized for the users. In addition, the sets are easy to expand and easy to install.

Free-standing

Our free-standing solution Alven makes healthy lighting available wherever you need it. Simply plug it in and enjoy the light, or use the app to give yourself a boost.

Visit brainlit.com to read more.

Disinfection lighting

The world we live in is uncertain and the recent pandemic has highlighted the fact that viruses and bacteria can live both in the air and on surfaces and thereby spread and affect our health. As we learn to live with these infection outbreaks there is demand for an efficient way to disinfect frequently visited public spaces to protect people from harmful pathogens. We have developed a unique system that uses UV-C lighting to quickly, safely and automatically disinfect both air and surfaces to create a safe and healthy environment.



UVen

With the UVen solution, unoccupied areas are exposed to UV-C light for disinfection.



Our segments

BrainLit's solutions can deliver measurable organizational improvements to a variety of segments – including office, education, healthcare and sports environments.



Office

Traditional office lighting does not support our physiological needs. The importance of office lighting is crucial for employee well-being, productivity and comfort. With healthier lighting, staff members feel better, see higher levels of concentration and find it easier to focus on tasks. Proper lighting ergonomics reduce tension in eyes, neck, and shoulders, and has been shown to ease headaches for some of our customers. Getting the right type of light at the right time of day is also vital to support your sleep schedule.

With Biocentric lighting solutions, the light can be adapted to different activities throughout the day, for conference rooms and meetings.

Sports

Balancing training, work commitments, family and personal life is a difficult challenge for an elite athlete. Many times sleep is sacrificed to meet all their expectations. However, sleep deprivation can have several negative effects on performance. A greater risk of sports injuries has been linked to insufficient sleep. Good sleep, and even sleep extension, can deliver performance improvements, which Biocentric lighting helps deliver.



In elite sports, frequent travel and schedule changes can affect performance. Ensure high performance regardless of time or place with Biocentric lighting.



Healthcare

Patients are usually indoors 24 hours a day, and staff within healthcare work long hours, often in shifts. These factors have negative effects on sleep. It is well known that sleep quality among patients in hospitals is affected by factors such as discomfort, anxiety, noise, inappropriate light exposure, and pain. A good night's sleep is vital for recovery and well-being, but also to maintain alertness at work. With Biocentric lighting, the environment becomes more comfortable whilst promoting circadian alignment with multiple health benefits.

Biocentric lighting helps ensure a stable and regular sleep cycle, so that your healthcare facility promotes faster recovery.

Education

Kids and adolescents often struggle with a delayed circadian rhythm, impacting their sleep and development. Studies show that this can be alleviated by receiving a healthy amount of light during the day. Variable lighting also helps teachers achieve learning outcomes with lighting that supports specific tasks, such as calculus, quiet reading or group work. With BrainLit ready-made classroom sets, you can create a Biocentric lighting environment for the students and teachers in the class room.

Improve student test results, promote creativity and productivity for students and teachers with Biocentric lighting.

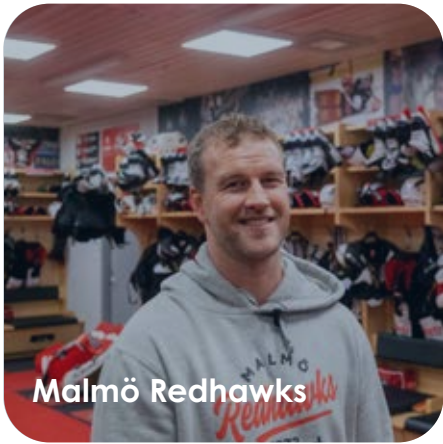


Our customers

From healthcare, to sports, to office spaces and much more. We help our customers find the right solution according to business needs, as well as design custom made light recipes. Read our customer cases by visiting brainlit.com.



Cosmodent



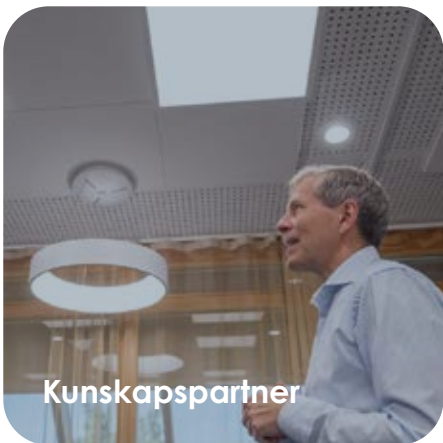
Malmö Redhawks



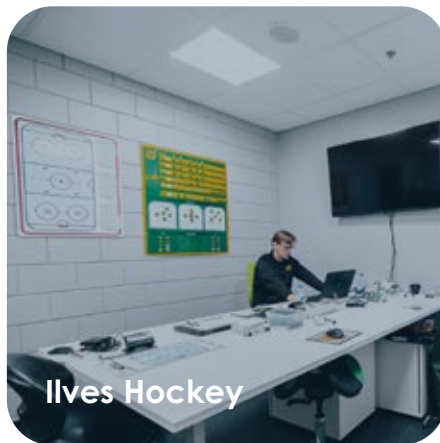
Grand Hotel Lund



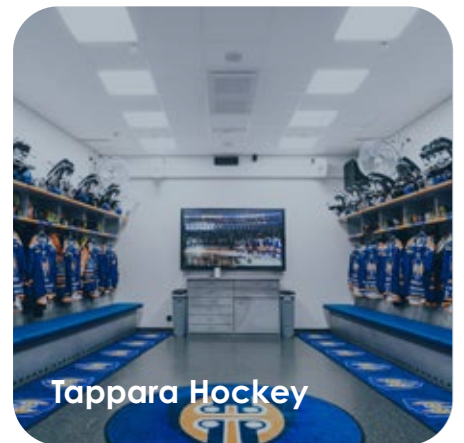
Helsingborg Hospital



Kunskapspartner



Ilves Hockey



Tappara Hockey

Benefits for businesses

- Reduce staff sick absence*
- Improve employee productivity
- Reduce risk of injury at work
- Support faster recovery and fall prevention within healthcare facilities and long-term stay

*As reported by BrainLit customers.

Benefits for people

- Secure a regular and stable circadian rhythm
- Benefit from the light even when you're away
- Maintain high long term vitality despite changes to schedules
- Entrain your sleep to the working day after just 2 weeks in Biocentric lighting*

*In an average Biocentric lighting environment with BCL m500.

7% better sleep quality
12% higher alertness level

As reported by team members from hockey clubs using Biocentric lighting.





The Crunchfish office is situated in the thriving old harbor area of Malmö, in the Media Evolution City building, a modern co-working space established in 2012 in an old factory building. The 1,100 square meter office is branded The Penthouse and spans the entire 4th floor. Crunchfish sublets parts of the space to five other tenants.

–Working at Crunchfish is intense right now.

I sleep less than normal as there is so much to do. BioCentric Lighting keeps me alert during the workdays, and in the evenings, it helps me to quickly fall asleep. Then I wake up feeling rested, ready to take on another day. Those focused morning hours keep me ahead of the game, CEO Joachim Samuelsson explains.

One third of the area is occupied by Crunchfish itself. This has been fully equipped with Biocentric lighting, but it is also one of the first installations to utilize the free-standing Alven solution. The Biocentric lighting system is also installed in the open shared area and in the office of Pej, one of the other tenants at The Penthouse, where Joachim Samuelsson was an early investor and serves as a member of the board.

A healthier work environment.

-You would previously feel your mind starting to slack during the afternoon, says Samuelsson. You kept looking at your watch and wondering when it was time to go home. Since we installed Biocentric lighting, that doesn't happen anymore. Now, our office space is like one big dynamic light shower. We are all much more alert and feel better. The slightly increased monthly rent is well worth being more efficient and healthier.



– Now, our office space is like one big dynamic light shower. We are all much more alert and feel better.

Joachim Samuelsson, CEO Crunchfish



References

Circadian rhythms

Reiter RJ, Rosales-Corral S, Sharma R. Circadian disruption, melatonin rhythm perturbations and their contributions to chaotic physiology. *Adv Med Sci*. 2020 Sep;65(2):394-402.

Elise Facer-Childs (2018) <https://theconversation.com/morning-lark-or-night-owl-how-our-body-clocks-affect-our-mental-and-physical-performance-106486>, accessed on 2022-01-20

Czeisler, C. A. et al. Stability, Precision, and Near-24-Hour Period of the Human Circadian Pacemaker. Published by: American Association for the Advancement of Science. Stable URL: <http://www.jstor.org/stable/2898429>. Linked references are available on JSTOR for this article. *Science* (80-.).284, 2177–2181 (1999).

Sleep Foundation (2022) <https://www.sleepfoundation.org/circadian-rhythm/can-you-change-your-circadian-rhythm>, accessed 2022-01-27

Foster RG. 2020 Sleep, circadian rhythms and health. *Interface Focus*

Evans, J. A. & Davidson, A. J. Health consequences of circadian disruption in humans and animal models. *Progress in Molecular Biology and Translational Science* vol. 119 (2013)

Chaix A, Zarrinpar A, Panda S. The circadian coordination of cell biology. *J Cell Biol*. 2016 Oct 10;215(1):15-25.

Addison K and Harris J (2019) How Do Our Cells Tell Time?. *Front. Young Minds*. 7:5. doi: 10.3389/frym.2019.00005

Biocentric lighting

Nagare R, Woo M, MacNaughton P, Plitnick B, Tini-anov B, Figueiro M, Access to Daylight at Home Improves Circadian Alignment, Sleep, and Mental Health in Healthy Adults: A Crossover Study, *Int J Environ Res Public Health* (2021) Sep 23;18(19):9980.

Figueiro, M. G. et al. The impact of daytime light exposures on sleep and mood in office workers. *Sleep Health* 3, 204-215, doi:10.1016/j.sleh.2017.03.005 (2017).

Viola AU, James LM, Schlangen LJ, Dijk DJ, Blue-enriched white light in the workplace improves self-reported alertness, performance and sleep quality, *Scand J Work Environ Health* (2008) Aug;34(4):297-306.

Effects of light

O'Hara-Wright M, Gonzalez-Cordero A. Retinal organoids: a window into human retinal development. *Development*. 2020 Dec 24;147(24):dev189746.

Wahl S, Engelhardt M, Schaupp P, Lappe C, Ivanov IV. The inner clock-Blue light sets the human rhythm. *J Biophotonics*. 2019 Dec;12(12):e201900102.

van Maanen, A. M. Meijer, K. B. van der Heijden, F. J. Oort, The effects of light therapy on sleep problems: A systematic review and meta-analysis. *Sleep Med Rev* 29, 52-62 (2016).

Grant et al., Daytime Exposure to Short Wavelength-Enriched Light Improves Cognitive Performance in Sleep-Restricted College-Aged Adults. *Front Neurol* 12, 624217 (2021).

Rüger, M et al. Human phase response curve to a single 6.5h pulse of short-wavelength light. *J Physiol* (2013).

Münch, et al. Blue-Enriched Morning Light as a Countermeasure to Light at the Wrong Time: Effects on Cognition, Sleepiness, Sleep, and Circadian Phase. *Neuropsychobiology* 274, 207–218 (2016).

Schlangen LJM, Price LLA. The Lighting Environment, Its Metrology, and Non-visual Responses. *Front Neurol*. 2021. doi: 10.3389/fneur.2021.624861.

Musiek ES, Holtzman DM. Mechanisms linking circadian clocks, sleep, and neurodegeneration. *Science*. 2016 Nov 25;354(6315):1004-1008.

Gabel, V. et al. Effects of Artificial Dawn and Morning Blue Light on Daytime Cognitive Performance, Well-being, Cortisol and Melatonin Levels. *Chronobiol. Int.* 30, 988–997 (2013).

Song et al., The Effect of Blue-enriched White Light on Cognitive Performances and Sleepiness of Simulated Shift Workers: A Randomized Controlled Trial. *J Occup Environ Med* 63, 752-759 (2021).

D. Canazei, P.; Staggl, S.; Pohl, W., Effects of dynamic ambient lighting on female permanent morning shift workers. *Lighting Res. Technol.* 46, 140-156 (2014).

Geoffroy, C. M. Schroder, E. Reynaud, P. Bourgin, Efficacy of light therapy versus antidepressant drugs, and of the combination versus monotherapy, in major depressive episodes: A systematic review and meta-analysis. *Sleep Med Rev* 48, 101213 (2019).

Konis K, Mack WJ, Schneider EL. Pilot study to examine the effects of indoor daylight exposure on depression and other neuropsychiatric symptoms in people living with dementia in long-term care communities. 2018:1071-1077.

Office

Van de Putte, E. et al. The influence of integrative lighting on sleep and cognitive functioning of shift workers during the morning shift in an assembly plant. *Appl Ergon* 99, 103618, doi:10.1016/j.apergo.2021.103618 (2022).

Hviid, C. A. P., C.; Dabelsteen, K. H. A field study of the individual and combined effect of ventilation rate and lighting conditions on pupils performance. *Building and Environment* 171, 106608, doi:https://doi.org/10.1016/j.buildenv.2019.106608 (2020).

Zhou, Y. et al. Does Bright Light Counteract the Post-lunch Dip in Subjective States and Cognitive Performance Among Undergraduate Students? *Frontiers in Public Health* 9, doi:10.3389/fpubh.2021.652849 (2021).

Sports

Thun E, Bjorvatn B, Flo E, Harris A, Pallesen S. Sleep, circadian rhythms, and athletic performance. *Sleep Med Rev.* 2015. doi:10.1016/j.smrv.2014.11.003

Halson SL, Juliff LE. Sleep, sport, and the brain 2. 234:13-31.

Venter RE. Role of sleep in performance and recovery of athletes: A review article. *South African J Res Sport Phys Educ Recreat.* 2012;34(1):167-184.

FIMS Position Statement: Air Travel and Performance in Sports. March 2004.

Knaier et , Dose-response relationship between light exposure and cycling performance. *Scand J Med Sci Sports* 26, 794-801 (2016).

Healthcare

Tan X, van Egmond L, Partinen M, Lange T, Benedict C. A narrative review of interventions for improving sleep and reducing circadian disruption in medical inpatients. *Sleep Med.* 2019;59:42-50. doi:10.1016/j.sleep.2018.08.007

Joarder AR, Price A. Impact of daylight illumination on reducing patient length of stay in hospital after coronary artery bypass graft surgery. *Light Res Technol.* 2013;45(4):435-449. doi:10.1177/1477153512455940

J.A. Olson, D. Z. Artenie, M. Cyr, A. Raz, V. Lee, Developing a light-based intervention to reduce fatigue and improve sleep in rapidly rotating shift workers. *Chronobiol Int* 37, 573-591 (2020).

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