

Samsung HCL Webinar

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**Lighting, One Step Further  
for Mankind**

Part 1.

# **Change in the Role of Lighting During Pandemic Era**

# **Q&A**





# Panelists



**Chang-wook Kim**

Professor, Kookmin University

*"I think the best HCL lighting is one that follows circadian rhythm, I think the most advanced form of HCL use both DAY and NITE lighting and should be automatically adjusted as time passes."*



**Tae-hwa Han**

Professor, Yonsei Medical Center

*"If there's too much light, it can disturb our melatonin secretion. In the short run, it could ruin a good night's sleep. But when this accumulates, it could cast a dark shadow on our health and lead to other illnesses."*



**Elio Jin-ha Kim**

Samsung LED

*"Harnessing the non-visual effects of LEDs in a beneficial way for humans is basically what we would define as human-centric lighting."*



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# 1. Effects of Light to Circadian Rhythm



What are some bad habits that can disrupt circadian rhythm?

Using excessively bright light at night may cause difficult in sleeping or poor sleep quality, and using a warm light during the daytime may cause drowsiness at times when you need to concentrate.





# 1. Effects of Light to Circadian Rhythm



What kind of impact does disrupting your circadian rhythm have on the body?

The brain, as well as cells, and genes, have their own biological clock. As such, human organs also live by syncing with our circadian rhythm. Changing from day to night, changes in temperature or external environment, all impact our circadian rhythm. Because our biological clock plays a role in regulating the body's metabolic activity, disrupting it is a major cause of a wide range of diseases like sleep disorders, chronic fatigue, obesity, diabetes, cardiovascular disease, dementia, and mental disorders.





# 1. Effects of Light to Circadian Rhythm



What effects does using the wrong kind of lighting have on our body?

Using the wrong kind of light can be harmful to humans. You're probably familiar with the term "light pollution," which came about as humans began using light excessively. It means that we are being exposed to more light than we actually need. Our bodies are affected when we use overly bright lights for long hours. What happens then is our bodies confuse nighttime for daytime and don't secrete enough melatonin. This results in disrupted sleep. Not only does sleep quality affect our health, but many papers have also reported that it can lead to serious illnesses. It doesn't just cause short term sleep disruption- in the long term, disruption to your circadian rhythm can cause obesity, metabolic syndrome, cardiovascular disease, increased risk of cancer, mood disorders and cognitive dysfunction.





# 1. Effects of Light to Circadian Rhythm



Given that lighting is this important, are there any potentially harmful side effects of artificially controlling it and influencing our circadian rhythm?

Aren't there potential side effects of controlling your circadian rhythm with light?

As long as it is used for its intended purpose as a functional product that improves a living environment, I don't believe that HCL products will cause any negative side effects. However, since it is not a medical product, it cannot be used for treatment purposes.





# 1. Effects of Light to Circadian Rhythm



It seems that lighting shapes your environment. Is there any limit to space size that human-centric lighting can cover?

This depends on the location and illuminance of the light, so it is difficult to state a specific number. Illuminance is defined as the amount of incoming light per unit area, which decreases in inverse proportion to the square of the distance. Also, since the amount of light that enters the human eye is what's important, things like the angle of the light source and reflection off of surrounding objects are also variables. The direction a light is installed in a user's space, how far away a person is, the light's illuminance - all contribute to a how a light's influence can vary in a space.





## 2. Clinical Test for Human-centric Lighting



How was the clinical test designed?

In order to verify the effectiveness of our products, we conducted clinical tests on 30 test subjects from April 2019 to February 2020. Through this experiment, we verified that LM302N DAY's melatonin suppression improved test subjects' concentration, and that LM302N NITE resulted in faster melatonin secretion compared to conventional lighting.





## 2. Clinical Test for Human-centric Lighting



What were you aiming to measure through the clinical test?

We had subjects live in spaces installed with Samsung HCL products and tested their melatonin levels, if there were stable changes in circadian rhythms, and whether they had an improvement in eye fatigue. In addition, we conducted a d2 test to see if there was an increase in concentration during the day. Scores confirmed that this was the case.





## 2. Clinical Test for Human-centric Lighting



You said that you conducted a clinical test on the effect of spectrum-optimized lighting on circadian rhythm. What exactly does it mean to optimize a spectrum?

When people are exposed to light, we react in two different ways, visual and non-visual. Although we can't sense it, wavelengths around 480nm impact our circadian rhythm. Therefore, light spectrums are optimized differently for daytime and nighttime. DAY lighting emphasizes cyan wavelength light, while NITE lighting reduces cyan light for spectrum optimization.





## 2. Clinical Test for Human-centric Lighting



How are melatonin levels measured?

Melatonin is a hormone secreted from the pineal gland when the brain's central clock, SCN, gives a signal. It is secreted mainly from evening until morning, and is secreted in the largest quantities in the very early hours of the morning. Although melatonin can be detected in plasma, saliva, urine, etc., it was collected from saliva for this study and analyzed by Greencross. The concentration of melatonin in the collected sample was analyzed by a KIT called ELISA, which detects discolored melatonin using an antigen-antibody reaction.





### 3. Effective Application for Better Lives

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If used well, could light improve someone's insomnia?

Several studies have shown that light itself works to normalize mood, circadian rhythms and endocrine systems, promote metabolism, relieve pain, and dilate blood vessels. In addition, it's also applied as treatment not only for psychiatric diseases such as depression and insomnia, but also endocrine diseases, skin diseases, pain, and obesity.





### 3. Effective Application for Better Lives



Home is now no longer a space that we just rest, but a space that we need to be able to work in. Could you recommend how we should adjust the lighting in our homes to maintain a healthy circadian rhythm?

I think lighting in the house should be used according to people's circadian rhythm.

In terms of spaces, it's better to use DAY lighting in places where you work intensively, and NITE lighting in resting areas like living rooms and bedrooms. However, it's better to control lighting in terms of time rather than purpose.

In summary, during the day, especially in the morning, it's better to use a light with an enhanced 480nm wavelength, higher illuminance and color temperature, and at night, it's better use a light with a weakened 480nm wavelength, lower illuminance and color temperature.





### 3. Effective Application for Better Lives



Home is now no longer a space that we just rest, but a space that we need to be able to work in. Could you recommend how we should adjust the lighting in our homes to maintain a healthy circadian rhythm?

Since home is now a multi-purpose space, you're probably wondering whether or not you can achieve work efficiency and comfort through lighting. A house can be a multipurpose space used by different people for different purposes. If each individual had more choices for lighting options, they could increase the utilization, quality of life, and personal satisfaction regarding the space. I mentioned the case about our family earlier, but the light needed by the elderly and the light needed by students could differ. With the appropriate lighting, I believe that rooms can serve a true purpose and not just be physical divisions of space. There are many single-person households these days, but they live in relatively small homes. Even if there isn't a lot of space, I believe that they can serve as both a workspace and bedroom if fitted with the appropriate lighting. I think if we can craft a more efficient and stable environment, regardless of space, we will not only be more productive but also boost mental and physical health.





### 3. Effective Application for Better Lives



You mentioned that it's good for humans, but is it also beneficial for pets or even plants?

Although plants and animals all have a rotating circadian rhythm of 24 hours, their reactions to light are different. HCL is a human-centric light that is designed based on the human retina, which absorbs ~480nm light by a substance called melanopsin. Because of this, it will not likely have a great effect on dogs, cats, plants, etc. For example, although there aren't many published papers on dogs or cats, some research shows that their reaction to the light/dark cycle is less regular than humans', and their peak time of core body temperature is different. In addition, for plants, they have a much higher sensitivity to the wavelength of light than humans. Reactions, such as promoting photosynthesis or color development, are different depending on wavelength, so there are various plants grown using LEDs with controlled wavelengths.





### 3. Effective Application for Better Lives



Is there a good light for home workouts?

From a human biological clock standpoint, exercise and work are all inputs, zeitgeber, that impact circadian rhythm. Therefore, rather than having a direct relationship with each other, both exercise and light impact circadian rhythm. Just looking at exercise and lighting, although it depends on the type and amount of exercise, the afternoon is a good time and blue light-enhanced lighting may help suppress melatonin. However, in relation to circadian rhythm, my recommendation is as follows. When you wake up in the morning, your blood pressure rises sharply, so very light exercise is good. As you become more alert throughout the morning, you'd be better to do things mainly related to the mind. In the afternoon, I recommend you to exercise and get in a lot of movement. Before going to bed, it is better to refrain from exercising and instead do some light stretching.





### 3. Effective Application for Better Lives



It's said that the best thing for our bodies is natural light, but is natural light better or is artificial light with selectively controlled wavelengths better?

We say that natural light is good because it is automatically synchronized with human circadian rhythm: we receive light that is rich in blue light in the morning and, as we approach the evening, our eyes receive weaker light, which is relatively less in blue - due to the altitude of the sun and scattering effect. And unlike artificial lighting, sunlight has a full spectrum of visible light and includes a wide range of non-visual wavelengths, such as ultraviolet rays and infrared rays, which have other benefits like sterilization and body temperature maintenance. Therefore, natural light is relatively better, but because most of us spend our lives under artificial lighting, we need lighting designed to suit our modern lifestyles and environment. Until now, artificial lighting was geared towards energy efficiency or whiteness. However, for our circadian rhythm, we must be able to adjust the wavelength of light over the course of the day to match the sun.





### 3. Effective Application for Better Lives



It's said that the best thing for our bodies is natural light, but is natural light better or is artificial light with selectively controlled wavelengths better?

In terms of treatment or supplementary functions, I think there will definitely be a time to use artificial lighting.





## 4. Circadian ICT Research Status



How does the level of human-centric lighting technology in Korea compare to that in the US or Europe?

We can separate this question into foundations and applications. To start, in regard to foundational research, I think that the US established specialized research institutes before Korea and has played a leading role in developing Circadian standards. The three American scientists who uncovered the genetic mechanisms of circadian rhythm won the 2017 Nobel Prize in Physiology or Medicine. However circadian rhythm has only been studied in depth for 20-30 years, and I think that moving forward, we will be able to apply research on where and how to use it and allow us to take the lead in developing new ideas.





## 4. Circadian ICT Research Status



Please share a little more on what kind of research the Circadian ICT Center is conducting.

The Circadian ICT Research Center is a research institute that specializes in circadian rhythm and operates with the support of the Ministry of Science and ICT, Information & Communications, and Technology. This center evaluates the effect of display screens and lighting on circadian rhythm and researches how to strengthen circadian rhythm through light therapy. As one of its main focuses, the center developed a biosensor that quantitatively measures how much 480nm light the body receives to examine circadian rhythm. The center also has its own clinical lab for measuring biological changes in melatonin levels, EEG, and ECG. Overall, it is a leading institution in Korea that conducts research on circadian rhythm, including developing nano LED devices for light therapy and deep learning algorithms for processing big data on biological signals.





## 4. Circadian ICT Research Status



What is ICT convergence research, more precisely?

Circadian research requires knowledge from several different disciplines. Therefore, experts from various fields such as physiology, neuroscience, electrical engineering, and chemistry must come together- this is what we call convergence research. Moreover, not only do you need to develop hardware related parts, such as sensors for measurement, but also the algorithms necessary to transmit and interpret big data related to circadian rhythms. The information, communication, and technology required for this is immense. As such, circadian research is an ICT-based multidisciplinary field, and this is why it is referred to as 'ICT Convergence Research.'





## 4. Circadian ICT Research Status



Aside from the clinical tests you discussed, is there other research on the relationship between light and our circadian rhythm?

There are a number of collaborative industry-academic studies, so I can't provide specific results, but there have been a lot of clinical trials related to display screens, in addition to lighting. In fact, display screens can be considered a kind of lighting, and there is research that shows that a display screen used close to the eye, such as VR, has a greater influence on our circadian rhythm.

