Deciphering the biological clock

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Researchers at LUMC are trying to decipher the biological clock. This knowledge can help deal with luxury problems, such as jetlag, but can also counter diseases. Molecular neurobiologist Erno Vreugdenhil explains.

Where exactly is the biological clock?

"It is tiny area of the brain, made up of 20,000 nerve cells, that is directly in contact with the eyes. This nerve centre is linked to all different parts of the body, including all the body's organs. As a consequence, there is a particular daily rhythm that affects all our organs. This is something everyone recognises and experiences: there are certain times that are better for eating or doing sports, for example. You can learn something new more easily at certain times than others. All this is directed by the daylight that reaches these nerve cells via the eyes."

Is the biological clock equally strong for everyone?

"We all have a biological clock, even animals and plants do. Take, for example, algae that rise to the surface of water in the night, and sink to the bottom during the day so that they receive less UV light. But this clock is stronger in some people than in others. Some people can handle night work better than others, or they have fewer problems with jetlag. Young people, in particular, hae more resilience. Older people have to take their biological clock more into account. But for most people, there's no need to avoid a party to keep your biological clock happy.

"The strange thing is that, while the Earth revolves in 24 hours, some people's biological clock has a cycle of an averge of 24.3 hours, or even 24.9 hours. This is why we tend to go to bed later at the weekend and consequently also get up later, and we have a kind of mini-jetlag every Monday.

"And then there are the differences between morning and evening people. On averge, children are more morning peole, adolescents and students tend to be evening people, and for older people their activities shift more towards the morning."

Would it be better for students if lectures started later than 9 o'clock?

"Definitely not. That would only have an effect for a couple of days, but then they'd be used to it, just like the change from summer to winter time. The problem is that our natural rhythm is slightly longer than 24 hours. That means it will always be difficult to get up at the same time every day."

How will understanding the biological clock help us in health care?

"This knowledge is very important as the award of the 2017 Nobel Prize for Medicine to the discoverers of the biological clock shows. Our group has more or less demonstrated that a wrongly ticking clock is a factor in obesity and diabetes. On the other hand, we show that a good clock is needed for successful ageing. Right now we are setting up studies on cancer-related tiredness. Thirty per cent of people who are cured of breast cancer still suffer from extreme tiredness up to five years after their are cured. They often have a disturbed waking/sleeping rhythm, their cortisol and melatonin levels aren't in line with the normal cycle; in

short, all kinds of facets that are directed by the biological clock aren't working properly. The ideal thing would be to strengthen their biological clock. By giving mice the same chemo as these people have had, we are trying to discover where the problem lies, and where to look for the solution. Ultimately that may deliver a pharmacological approach, or treatments like light therapy, and lifestyle advice, such as being more physically active.

"That physical activity helps is something we have known for a long time. If you give a mouse 'jetlag' by switching the light on hours earlier or later than normal, its biological clock will adapt at a rate of an hour a day. But if the mouse has a running wheel in its cage, it adapts twice as fast. That's why you are advised, when you arrive in New York, the first thing you should do is for for a run, and preferably outside, because daylight is always good for you.

"The amount of artificial light, the ease with which we travel through time zones, the 24-hour economy—these are all relatively young phenomena. We humans do things that we are not meant to do in evolutionary terms. But we can limit the damage: for example, we know that red artificial light is harmless to our biological clock. With that insight, we can improve hospital rooms and the incubator department here."

What don't we know yet?

"We don't yet know how this clock works; we see the electrical activity in the cells, but we haven't fathomed how they work together. And we've barely even looked at the female clock. There's a reason for that: females have their monthly cycle that causes hormonal variations, so we tend to prefer doing research on males.

"Another limitation: we do our research on mice, but they are naturally

night animals. We humans are daytime beings, and there are indications that our biological clock reacts differently to the input of light. The effects of mood in animals is difficult to study. We know from humans that depression often goes hand in hand with disturbances in the biological clock, but how can you make a detailed study of that?"

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