

Salivary markers that indicate sleep deficit

In the framework of its programme of scientific research focusing on prevention of drowsiness and inattentiveness at the wheel, the VINCI Autoroutes Foundation publishes the first findings of an original study on biological screening for sleep deprivation. These works conducted by the Hôtel-Dieu - Université Paris Descartes Centre du Sommeil (sleep centre) show that partial sleep deprivation for two consecutive nights modifies the biological markers present in saliva. They also confirm that sleep deprivation, a source of drowsiness, increases both lack of vigilance and stress.

"Over and above promising perspectives for progress in self-assessment of drowsiness at the wheel, this study confirms the negative effects of sleep deprivation, which can have serious consequences on drivers: the risk of nodding off but also a lower capacity to react to events and a greater tendency to drive aggressively. It is worth sharing these findings with as many people as possible, especially when we know that more than eight out of ten drivers go to bed later or get up earlier than usual before they leave on a long trip¹", says Bernadette Moreau, executive officer of the VINCI Autoroutes Foundation.

Sleep deprivation can be measured through biological markers in saliva...

The study measured biomarkers sensitive to sleep debt in saliva, such as cortisol and α -amylase in young, healthy subjects exposed to partial sleep deprivation. Saliva samples were collected after a period of two consecutive nights in which hours of sleep were restricted to three hours per night (between 3 and 6 am), with analyses carried out at regular intervals².

The results show **lower levels of cortisol** recorded in the morning (-37%) **and of α -amylase** recorded in the afternoon (-15%) after sleep deprivation – **these variations can be analysed as biological indicators of lack of sleep.**

According to Professor Damien Léger, head of the Hôtel-Dieu Centre de Sommeil, *"this study confirms that sleep deprivation triggers a biological modification in our organism from the very first hours. It encourages us to pursue our research, although at this stage it does not allow us to come up with individual tools for prevention of accidents due to drowsiness."*

... and generates episodes of drowsiness, reduced attention as well as mood swings, detrimental to safe and calm driving.

At the same time as the saliva sampling, subjective assessment of drowsiness carried out using the Stanford scale³ shows **appreciably higher levels of drowsiness following sleep restriction (+72%)**. These results therefore corroborate those obtained through saliva analysis.

In addition, **measurement of sustained attention using the Macworth⁴ clock test show significantly higher levels of forgetfulness (+120%) and twice as many errors such as "false alarms"** (subject reacts despite the absence of a stimulus) following sleep deprivation.

¹ Barometer of responsible driving 2017 – IPSOS for the VINCI Autoroutes Foundation

² These analyses had previously been carried out with the same subjects over a period without sleep deprivation (8 hours of sleep a night for 8 days) to ensure a comparative control situation.

³ Stanford scale: test that assesses the subject's level of sleepiness over a day on a scale of 7 points (0: very alert / 7: very sleepy)

On the behavioural level, the scales measuring level of calmness and tension applied after each saliva sampling and the "mood states profile"⁵ reveal **a decrease in feelings of calmness and an increase in the levels of stress and fatigue experienced** (by a factor of 3), **aggressiveness** (by a factor of 2) and **confusional states** (also by a factor of 2). These feelings are also associated with a decrease in the sensation of vitality and sociability. These findings confirm that behaviour is indeed modified by lack of sleep.

This is why, the VINCI Autoroutes Foundation reminds drivers of several simple tips for limiting the risks of drowsiness and inattentiveness at the wheel, which are responsible for almost half of the fatal accidents occurring on motorways⁶ in France:

- >> make sure to have a good night's sleep before you leave
- >> avoid travelling at night (between 10 pm and 6 am)
- >> take regular breaks throughout your trip, at least every two hours
- >> stop at a service or rest area as soon as you feel signs of fatigue
- >> don't hesitate to change drivers regularly.

Methodology:

The – non-invasive – study involved 17 young, healthy men having experienced two consecutive nights of sleep restricted to three hours a night (sleeping period between 3 am and 6 am in the morning) in 2016. Strict compliance with awake/sleep rhythms (sleeping period from midnight to 8 am from D-7 to D-1) during the week preceding the sleep restriction period and during the sleep restriction period (sleeping period from 3 am to 6 am from D-2 to D-3) was controlled by actimetry analysis before the saliva samples were taken.

During the awake period before and after the chronic restriction of sleep, levels of these biomarkers in saliva were measured at regular intervals. In parallel, subject drowsiness (Stanford scale) and objective drowsiness (Macworth clock sustained attention test) together with stress levels experienced using VAS-type scales were explored at the same regular intervals in order to discriminate between possible effects of stress and the specific effects of sleep debt. The profile of these moods was also evaluated at the beginning and end of the day, on days 1 and 3 of each session.

The saliva samples taken were immediately stored at -20°C and then at -80°C until analysis. Concentrations of α -amylase, cortisol and immunoglobulin A in saliva were determined using an enzyme-linked method or ELISA (Salimetrics®).

The statistic data was processing using SigmaStat® 3.5 software (Systat®, San Jose, CA) and analysed by ANOVA 2-type repetitive measuring tests, supplemented by a post-hoc test: sampling time as an intra-subject factor \times condition (control nights *versus* sleep restriction nights) as the inter-subject factor.

About the VINCI Autoroutes Foundation for Responsible Driving

Created in February 2011, the VINCI Autoroutes Foundation for Responsible Driving is a laboratory, observatory and source of information specifically focused on improving road safety. It aims to help bring about change in driver behaviour and to encourage drivers to contribute to their own safety and to that of other road users. Its actions include: information campaigns to raise awareness of road risks; funding for innovative scientific research in certain areas of risky driver behaviour that have not been sufficiently explored or are poorly identified by road users; and, finally, to fund initiatives by non-profit associations or citizen initiatives aimed at encouraging responsible driving.

<http://fondation.vinci-autoroutes.com> and Twitter account @FondationVA

<http://roulons-autrement.com> and Twitter account @RoulonsA

The "Roulez éveillé" (Drive alert) application: this application, designed for the VINCI Autoroutes Foundation by the Université de Strasbourg Centre for Neurocognitive and Neurophysiological Investigation (Ci2N), allows drivers, in particular, to test their level of wakefulness thanks to a 30-second test, listen to a sophrology podcast to facilitate falling asleep and watch a humorous tutorial indicating tips for taking an effective nap in the car. The application is available free on App Store and Google Play, in French and in English.



Media contacts:

Estelle Ferron, tel.: 06 34 99 33 61, estelle.ferron@vinci-autoroutes.com

Ludovica Giobbe, tel.: 06 15 33 64 30, ludovica.giobbe@vae-solis.com

⁴ Macworth clock sustained attention test: attention and vigilance test developed in 1950 by the British Royal Air Force which highlights attention deficit due to continuous concentration on an always identical task.

⁵ Profile of mood states (POMS): enables measurement of a person's mood over 7 dimensions (tension, anxiety, fatigue, depression, confusion, vitality and empathy)

⁶ ASFA – Analysis of fatal accidents and injuries 2016