6 Zakrzewska JM, Palmer J, Morisset V, et al. Safety and efficacy of a Nav1.7 selective sodium channel blocker in patients with trigeminal neuralgia: a double-blind, placebo-controlled, randomised withdrawal phase 2a trial. *Lancet Neurol* 2017; **16:** 291–300.

7 Baron R, Maier C, Attal N, et al. Peripheral neuropathic pain: a mechanism-related organizing principle based on sensory profiles. *Pain* 2017; **158:** 261–72.

8 Vollert J, Maier C, Attal N, et al. Stratifying patients with peripheral neuropathic pain based on sensory profiles: algorithm and sample size recommendations. *Pain* 2017; **158:** 1446–55.

9 Hartley C, Duff EP, Green G, et al. Nociceptive brain activity as a measure of analgesic efficacy in infants. *Sci Transl Med* 2017; **9**.

Health implications of sleep and circadian rhythm research in 2017

This has been a great year for the field of sleep and circadian rhythm research. Notably, the 2017 Nobel Prize in Physiology or Medicine was awarded to Jeffrey Hall, Michael Rosbash, and Michael Young for their discovery of the genetic mechanisms that generate circadian rhythms. The subsequent discoveries of the ubiquity of these molecular circadian clocks in the body, and of their fundamental role in the regulation of cellular function have, over the past decade, fuelled an explosion of research on the central role of sleep and circadian rhythms in health. With increased life expectancy, the parallel increase in diagnosis of neurodegenerative and cardiometabolic disorders represents a major challenge for public health. Emerging evidence indicates that sleep and circadian rhythm disturbances are not merely consequences of disease, but play important roles in the development and expression of neurodegenerative and cardiometabolic disorders.

Two articles published this year provided further insight into the mechanisms underlying the link between sleep and Alzheimer's disease. Sprecher and colleagues[1] assessed 101 cognitively healthy individuals, aged 40–65 years, with a family history of sporadic Alzheimer's disease, to assess the relation between subjective sleep quality and CSF markers of Alzheimer's disease. Individuals with a CSF profile consistent with increased amyloid deposition and tau pathology reported inadequate sleep and daytime sleepiness. This link between sleep quality and biomarkers of Alzheimer's disease strengthens the concept of sleep as an early biomarker of neurodegeneration. However, the questions of whether sleep disruption represents an early biomarker for developing amyloid pathology and, more specifically, which aspects of sleep are important for this process are still unanswered. To address these questions, Ju and colleagues[2] recruited 17 healthy adults with no cognitive or sleep complaints and normal CSF concentrations of amyloid β at baseline, who then underwent experimental acoustic disruption of slow-wave sleep. The results showed that targeted slow-wave sleep disruption increased CSF concentrations of amyloid β. The implication is that early interventions to improve sleep quality, particularly slow-wave sleep, might attenuate disease progression and be a potential therapeutic target for Alzheimer's disease.

Sleep problems and excessive sleepiness are very common in Parkinson's disease. In addition to insomnia, sleep apnoea, and rapid-eye-movement sleep behaviour disorder, there is emerging evidence for circadian rhythm dysfunction in patients with Parkinson's disease.[3] Light is the strongest timing cue for the circadian clock. Bright light exposure at an appropriate time has been used to improve sleep, mood, and alertness in both research and clinical settings. In a study by Videnovic and colleagues,[4] patients with Parkinson's disease were exposed to either bright white light or dim red light for 2 hours in the morning and afternoon. Bright white light exposure therapy twice daily decreased daytime sleepiness, improved sleep quality and increased activity (as measured by actigraphy). These data point towards the potential for circadian-based interventions to be included as part of a multicomponent approach to improve functioning in patients with Parkinson's disease.

At the end of 2016, the American Heart Association published a scientific statement on the effects of sleep duration and quality on cardiometabolic health.[5] The authors concluded that there was strong evidence that obstructive sleep apnoea and insomnia—the two most common sleep disorders—were associated with increased risk for cardiovascular and metabolic disease (risk factors for stroke and cognitive impairment). Furthermore, they recommended a public health campaign to promote healthy sleep and the incorporation of simple screening

For more on the **2017 Nobel Prize in Physiology or Medicine** see https://www.nobelprize.org/nobel_prizes/medicine/laureates/2017/

Oscar Burriel/Science Photo Library

tools for sleep disorders into clinical practice. Despite this recognition of a close link between sleep and cardiometabolic health, there is a paucity of data on sleep quality and risk of adverse pregnancy outcomes. Recent research indicates that obstructive sleep apnoea is a risk factor associated with cardiometabolic disease, but the role of sleep and circadian rhythms have been less appreciated. In 2017, a few publications examining sleep and health during pregnancy have emerged. One such study[6] was the first to use an objective estimate of sleep (as measured by wrist actigraphy) in a large cohort of pregnant women (n=782) to ascertain whether sleep was associated with risk of gestational diabetes, a condition that can cause adverse health outcomes for mother and baby. The authors found that both shorter sleep duration and a later midpoint of sleep, independent of sleep duration, were associated with an increased risk of gestational diabetes. These findings suggest that assessment of sleep duration and sleep timing is important for maternal-fetal health and that improving sleep duration and sleeping at an earlier clock time might be beneficial for pregnant women.

Research in 2017 highlighted the importance of sleep quality (both duration and timing) and appropriately synchronised circadian rhythms on neurological and cardiometabolic health. Future research aiming to develop sleep and circadian-based therapies has the potential to improve neurological health outcomes.

*Sabra M Abbott, Kristen L Knutson, *Phyllis C Zee*
Feinberg School of Medicine, Northwestern University, Chicago, IL 60611, USA
p-zee@northwestern.edu

PCZ reports a patent pending for acoustic stimulation to enhance slow-wave sleep. SMA and KLK declare no competing interests.

1 Sprecher KE, Koscik RL, Carlsson CM, et al. Poor sleep is associated with CSF biomarkers of amyloid pathology in cognitively normal adults. *Neurology* 2017; **89:** 445–53.
2 Ju YS, Ooms SJ, Sutphen C, et al. Slow wave sleep disruption increases cerebrospinal fluid amyloid-beta levels. *Brain* 2017; **140:** 2104–11.
3 Fifel K. Alterations of the circadian system in Parkinson's disease patients. *Mov Disord* 2017; **32:** 682–92.
4 Videnovic A, Klerman EB, Wang W, Marconi A, Kuhta T, Zee PC. Timed light therapy for sleep and daytime sleepiness associated with Parkinson disease: a randomized clinical trial. *JAMA Neurol* 2017; **74:** 411–18.
5 St-Onge MP, Grandner MA, Brown D, et al. Sleep duration and quality: impact on lifestyle behaviors and cardiometabolic health: a scientific statement from the American Heart Association. *Circulation* 2016; **134:** e367–86.
6 Facco FL, Grobman WA, Reid KJ, et al. Objectively measured short sleep duration and later sleep midpoint in pregnancy are associated with a higher risk of gestational diabetes. *Am J Obstet Gynecol* 2017; **217:** e01–13.

Research advances in neurological infections in 2017

Viruses are the most commonly identified causes of meningitis and encephalitis, but in as many as half of patients, particularly those with encephalitis, the cause is not identified. Hasbun and colleagues[1] examined the epidemiology of meningitis and encephalitis in 26 429 adults in the USA between 2011 and 2014. The most common causes were enterovirus (52%), unknown causes (21%), bacterial meningitis (14%), herpes viruses (8%), non-infectious causes (4%), fungi (3%), arboviruses (1%), and other viruses (1%). This study highlights the substantial problem of unknown, or unidentified, causes of meningitis and encephalitis. More routine application of molecular methods, including next generation sequencing, to CSF and brain tissue might contribute to a decrease in the number of cases with unknown causes in the future.

Powassan is a flavivirus that has been reported as an uncommon cause of severe encephalitis in the USA and Europe. The virus has two lineages: Powassan virus 1 and Powassan virus 2 (also known as deer tick virus). In the USA, Powassan virus 1 is carried by *Ixodes cookei* ticks, while deer tick virus is carried by *Ixodes scapularis* ticks, the same that can carry bacteria that cause Lyme disease. The lineages of these