

[Ask the Experts](#) - March 25, 2002

How long can humans stay awake?

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The easy experimental answer to this question is 264 hours (about 11 days). In 1965, Randy Gardner, a 17-year-old high school student, set this apparent world-record for a science fair. Several other normal research subjects have remained awake for eight to 10 days in carefully monitored experiments. None of these individuals experienced serious medical, neurological, physiological or psychiatric problems. On the other hand, all of them showed progressive and significant deficits in concentration, motivation, perception and other higher mental processes as the duration of sleep deprivation increased. Nevertheless, all experimental subjects recovered to relative normality within one or two nights of recovery sleep. Other anecdotal reports describe soldiers staying awake for four days in battle, or unmedicated patients with mania going without sleep for three to four days.

The more difficult answer to this question revolves around the definition of "awake." As mentioned above, prolonged sleep deprivation in normal subjects induces altered states of consciousness (often described as "microsleep"), numerous brief episodes of overwhelming sleep, and loss of cognitive and motor functions. We all know about the dangerous, drowsy driver, and we have heard about sleep-deprived British pilots who crashed their planes (having fallen asleep) while flying home from the war zone during World War II. Randy Gardner was "awake" but basically cognitively dysfunctional at the end of his ordeal.

In the case of rats, however, continuous sleep deprivation for about two weeks or more inevitably caused death in experiments conducted in Allan Rechtschaffen's sleep laboratory at the University of Chicago. Two animals lived on a rotating disc over a pool of water, separated by a fixed wall. Brainwaves were recorded continuously into a computer program that almost instantaneously recognized the onset of sleep. When the experimental rat fell asleep, the disc was rotated to keep it awake by bumping it against the wall and threatening to push the animal into the water. Control rats could sleep when the experimental rat was awake but were moved equally whenever the experimental rat started to sleep. The cause of death was not proven but was associated with whole body hypermetabolism.

In certain rare human medical disorders, the question of how long people can remain awake raises other surprising answers, and more questions. Morvan's fibrillary chorea or Morvan's syndrome is characterized by muscle twitching, pain, excessive sweating, weight loss, periodic hallucinations, and severe loss of sleep (agrypnia). Michel Jouvet and his colleagues in Lyon, France, studied a 27-year-old man with this disorder and found he had virtually no sleep over a period of several months. During that time he did not feel sleepy or tired and did not show any disorders of mood, memory, or anxiety. Nevertheless, nearly every night between 9:00 and 11:00 p.m., he experienced a 20 to 60-minute period of auditory, visual, olfactory, and somesthetic (sense of touch) hallucinations, as well as pain and vasoconstriction in his fingers

and toes. In recent investigations, Morvan's Syndrome has been attributed to serum antibodies directed against specific potassium (K^+) channels in cell and nerve membranes.

Another rare disorder, Fatal Familial Insomnia (FFI), is an autosomal dominant disease that is invariably fatal after about six to 30 months without sleep. FFI is probably misnamed because death results from multiple organ failure rather than sleep deprivation. The pathological processes include degeneration of the thalamus and other brain areas, over-activity of the sympathetic nervous system, hypertension, fever, tremors, stupor, weight loss, and disruption of the body's endocrine systems. FFI belongs to a class of infectious prion diseases that include Mad Cow Disease.

To return to the original question, "How long can humans stay awake?" the ultimate answer remains unclear. Despite the rat studies in Chicago, I am unaware of any reports that sleep deprivation per se has killed any human (excluding accidents and so forth). Indeed, the U.S. Department of Defense has offered research funding for the goal of sustaining a fully awake, fully functional "24/7" soldier, sailor, or airman. Future warriors will face intense, around-the-clock fighting for weeks at a time. Will bioengineering eventually produce genetically-cloned soldiers and citizens with a variant of Morvan's syndrome who need no sleep but remain effective and happy? I hope not. A good night's sleep is one of life's blessings. As Coleridge wrote years ago, "Oh sleep! It is a gentle thing, beloved from pole to pole," and Wilse Webb, a prominent sleep researcher, more recently called sleep the gentle tyrant: It can be delayed but not defeated.