

Sleep deprivation affects stem cells, reducing transplant efficiency, study finds

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Credit: Vera Kratochvil/public domain

Drowsy mice make poor stem cell donors, according to a new study by

researchers at the Stanford University School of Medicine.

A sleep deficit of just four hours affects by as much as 50 percent the ability of stem cells of the blood and immune system to migrate to the proper spots in the bone marrow of recipient [mice](#) and churn out the cell types necessary to reconstitute a damaged immune system, the researchers found.

Although the research was done in laboratory mice, the findings have possible implications for human [stem cell transplants](#). Tens of thousands of these procedures, often referred to as bone marrow transplants but more properly called [hematopoietic stem cell](#) transplants, are performed each year to rescue patients with immune system disorders or cancers.

"Considering how little attention we typically pay to sleep in the hospital setting, this finding is troubling," said Asya Rolls, PhD, a former postdoctoral scholar at Stanford. "We go to all this trouble to find a matching donor, but this research suggests that if the donor is not well-rested it can impact the outcome of the transplantation. However, it's heartening to think that this is not an insurmountable obstacle; a short period of recovery sleep before transplant can restore the donor's cells' ability to function normally."

Rolls, who is now an assistant professor at the Israel Institute of Technology, shares lead authorship of the study, which will be published Oct. 14 in *Nature Communications*, with Stanford postdoctoral scholar Wendy Pang, PhD, and Ingrid Ibarra, PhD, the assistant director of the Stanford Cardiovascular Institute. Luis de Lecea, PhD, a professor of psychiatry and behavioral sciences, and Irving Weissman, MD, director of the Stanford Institute of Stem Cell Biology and Regenerative Medicine, share senior authorship.

Rested mice yield more effective stem cells

Rolls studied [laboratory mice](#) that had been gently handled for four hours to prevent them from sleeping while their comrades dozed. She and her colleagues then collected stem cells from the bone marrow of drowsy and of well-rested mice and injected them into 12 mice that had received what would normally be a lethal dose of radiation. (The recipient mice also received an injection of their own [bone marrow cells](#) collected prior to radiation to make it possible to quantify the relative abilities of the donated stem cells to engraft successfully.)

The researchers then assessed the prevalence of a kind of immune cell called a myeloid cell, which were derived from the donated stem cells in the blood of the recipient mice, at eight and 16 weeks after transplantation. They found that, although stem cells obtained from well-rested donors made up about 26 percent of the myeloid cells in the animal over time, stem cells from sleepy donors made up only about 12 percent of the recipients' myeloid cells.

Rolls and her colleagues compared the ability of fluorescently labeled stem cells from sleepy and from rested mice to migrate properly from the recipients' blood into the bone marrow. After 12 hours, 3.3 percent of stem cells from spritely mice were found in the bone marrow, versus only 1.7 percent of stem cells from sleepy mice.

Further testing in the laboratory dish showed that hematopoietic stem cells from the sleep-deprived mice responded less strongly than their peers to naturally occurring chemical signals that trigger cellular migration. They also expressed lower levels of an RNA message that controls the expression of a family of proteins called SOC, known to inhibit the migration of hematopoietic stem cells.

Letting tired mice catch up on sleep

Although the effect of sleep deprivation was stark in this study, Rolls and her colleagues found that it could be reversed by letting the drowsy mice catch up on their ZZZs. Even just two hours of recovery sleep restored the ability of the animals' stem cells to function normally in the transplantation tests.

"Everyone has these [stem cells](#), and they continuously replenish our blood and [immune system](#)," said Rolls. "We still don't know how sleep deprivation affects us all, not just [bone marrow](#) donors. The fact that recovery sleep is so helpful only emphasizes how important it is to pay attention to sleep."

Provided by Stanford University Medical Center

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