

# Damage to cell membranes causes cell aging, finds new study

February 22 2024

---



Kintsugi, the traditional Japanese art of repairing broken pottery by mending cracks with lacquer and gold. Kintsugi visibly incorporates the history of an object into its new form. In this analogy, cell membrane damaged is repaired, however, rather than restoring the cell to its original form, the new cellular nature is irreversibly changed and the cells behave differently in our body.

Credit: Amy Cao, Salk Institute

Our cells are surrounded by a fragile membrane that's only 5 nanometers thick, 1/20 of a soap bubble. Cells are easily damaged by physiological

activities, including muscle contraction and tissue injury. To cope with such damage, cells are equipped with mechanisms that can repair membrane damage to a certain degree.

Mechanical damage to the [cell membrane](#) was previously believed to trigger two simple cellular outcomes: recovery or death. In a new study, however, researchers have uncovered a third outcome—[cellular senescence](#). The work appears in *Nature Aging*.

"When I started this project, I simply aimed to understand the repair mechanisms of damaged cell membrane," recalls Professor Keiko Kono, head of the Okinawa Institute of Science and Technology Membranology unit and senior author of the study, which involved multiple members from the unit, including Kojiro Suda, Yohsuke Moriyama, Nurhanani Razali and colleagues. "Unexpectedly, we ended up discovering that cell membrane damage, in a sense, switches cell fate."

The key to determining cell fate is the extent of damage and subsequent calcium ion influx. The thin cell membrane damage can be easily repaired, allowing the cells to continue cell division without any trouble. The highest level of cell membrane damage induces cell death. However, a middle level of cell membrane damage turns the cells into senescent cells several days later, even though membrane resealing seems successful.

Cancer cells divide unlimitedly. In contrast, non-cancerous normal cells have a limited capacity for cell division—around 50 times before division is irreversibly stopped, and the cells enter a state known as cellular senescence. Senescent cells are still metabolically active, but unlike young and [healthy cells](#), they produce various secretory proteins that upregulate immune responses in both nearby tissues and distant organs. This mechanism can induce both beneficial and detrimental

changes in our body, including acceleration of wound healing, cancer promotion, and aging.

During the last decade, numerous studies have reported that senescent cells exist in animal bodies, including humans, and that the removal of senescent cells can rejuvenate body functions in experimental animals. However, the cause of cell senescence in the human body remains a controversial topic.

"The [gene expression profile](#) and bioinformatics suggested that cell membrane damage explains the origin of senescent cells in our bodies, specifically the ones near damaged tissues," explains Professor Kono.

The best-established inducer of cellular senescence is repeated [cell division](#). Many other stresses also induce cellular senescence in a laboratory setting, such as DNA damage, oncogene activation, and epigenetic changes. The long-standing dogma in the research field was that various stresses induce cellular senescence ultimately via the activation of DNA damage response.

However, the authors uncovered that cell membrane damage induces cellular senescence via a different mechanism that involves calcium ions and the tumor suppressor gene p53. These findings may contribute to developing a strategy to achieve healthy longevity in the future.

**More information:** Plasma membrane damage limits replicative lifespan in yeast and induces premature senescence in human fibroblasts, *Nature Aging* (2024). [DOI: 10.1038/s43587-024-00575-6](https://doi.org/10.1038/s43587-024-00575-6)

Provided by Okinawa Institute of Science and Technology

Citation: Damage to cell membranes causes cell aging, finds new study (2024, February 22)  
retrieved 27 April 2024 from <https://phys.org/news/2024-02-cell-membranes-aging.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.