



Can fight or flight turn hair white?

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An old tale going back to the 1789-1799 French revolution says that Marie Antoinette, the last queen of France, was sentenced to the guillotine after being accused of treason, it is said that her hair turned white overnight. It is believed that the stress caused by being sentenced to death resulted in the change of Marie's hair color. Although the story may seem farfetched, research suggests that high levels of stress can indeed change the hair to a white color.

Recently, a team of researchers led by Bing Zhang from the Harvard University Stem cell institute, identified a mechanism that links hyperactivation of the sympathetic nervous system and a rise in norepinephrine to a reduction of stem cells that specifically regenerate pigment in the hair follicles of mice. It was clearly noted this linkage turns hair white¹.

"For the longest time it's been said that stress makes the hair turn white, but until now there was no scientific basis for this belief. Our study proved that the phenomenon does indeed occur, and we identified the mechanisms involved. In addition, we discovered a way of interrupting the process of hair color loss due to stress".

- Co-author Thiago Mattar Cunha

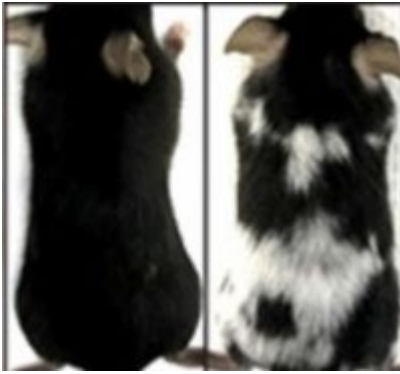
When the researchers involved in this study first tried to figure out why acute stress can cause gray hair, the stress hormone cortisol was expected to be the main causative factor for the loss of hair colour, because stress elevates levels of the hormone cortisol in the body. But it came as a surprise to the researchers that once the adrenal gland from the mice was removed so that they could not produce cortisol, the hair still turned grey under stress. This suggested that cortisol was not a main causative factor in the hair turning gray.

This then led to the researchers to expand the focus of the experiment to the entire sympathetic nervous system (SNS), which directly impacts the fight or flight response in both humans and mice. The experiments involved the use of a dark furred mouse and it was noted that the SNS can touch every mouse hair follicle. When pain-induced stress was applied, it triggered a fight-or-flight response from the mice in the autonomic nervous system that caused a rise in norepinephrine levels. This rise in norepinephrine then disabled the pigment-regeneration ability of the stem cells present in the hair follicle.

"Acute stress, particularly the fight-or-flight response, has been traditionally viewed to be beneficial for an animal's survival. But in this case, acute stress causes permanent depletion of stem cells."

- Lead author Bing Zhang

This research paper was widely praised within the scientific community in 2020. The significance of these findings can be expanded past hair follicles and allow scientists globally to better understand how acute stress can impact other tissues and organs within the human body. This, perhaps, allowing for different treatments of known conditions, treatments that can reduce the impact of stress on our bodies.



Stress turns hair white: Comparison of representative control mouse with black fur (left) to a representative mouse subject to sustained stress for several months (Right)¹.

References

1. Zhang B, Ma S, Rachmin I, et al. Hyperactivation of sympathetic nerves drives depletion of melanocyte stem cells. *Nature*. 2020;577(7792):676-681. doi:10.1038/s41586-020-1935-