Inhaling Pleasant Scents During Sleep Tied to a Dramatic Boost in Cognition

Inhaling a pleasant aroma during sleep has been linked to a "dramatic" improvement in memory, early research suggests.

In a small, randomized control trial researchers found that when cognitively normal individuals were exposed to the scent of an essential oil for 2 hours every night over 6 months, they experienced a 226% improvement in memory compared with a control group who received only a trace amount of the diffused scent.

In addition, functional magnetic resonance imaging (fMRI) showed that those in the enriched group had improved functioning of the left uncinate fasciculus, an area of the brain linked to memory and cognition, which typically declines with age.

"To my knowledge, that level of [memory] improvement is far greater than anything that has been reported for healthy older adults and we also found a critical memory pathway in their brains improved to a similar extent relative to unenriched older adults," senior investigator Michael Leon, PhD, professor emeritus, University of California, Irvine, told *Medscape Medical News*.

The study was published online July 24 in *Frontiers of Neuroscience*.

The Brain's "Superhighway"

Olfactory enrichment "involves the daily exposure of individuals to multiple odorants" and has been shown in mouse models to improve memory and neurogenesis, the investigators note.

A previous study showed that exposure to individual essential oils for 30 minutes a day over 3 months induced neurogenesis in the olfactory bulb and the hippocampus.

"The olfactory system is the only sense that has a direct 'superhighway' input to the memory centers areas of the brain; all the other senses have to reach those brain areas through what you might call the 'side streets' of the brain, and so consequently, they have much less impact on maintaining the health of those memory centers."

When olfaction is compromised, "the memory centers of the brain start to deteriorate and, conversely, when people are given olfactory enrichment, their memory areas become larger and more functional," he added.

Olfactory dysfunction is the first symptom of Alzheimer's disease (AD) and is also found in virtually all neurological and psychiatric disorders.

"I've counted 68 of them — including anorexia, anxiety, [attention-deficit/hyperactivity disorder], depression, epilepsy and stroke. In fact,

by mid-life, your all-cause mortality can be predicted by your ability to smell things," Leon said.
Leon and colleagues previously developed an effective treatment for autism using environmental enrichment that focused on odor stimulation, along with stimulating other senses. "We then considered the possibility that olfactory enrichment alone might improve brain function."

Rose, Orange, Eucalyptus…

For the study, the researchers randomly assigned 43 older adults, aged 60 - 85 years, to receive either nightly exposure to essential oil scents delivered via a diffuser (n = 20; mean [SD] age, 70.1 [6.6] years) or to a sham control with only trace amounts of odorants (n = 23; mean age, 69.2 [7.1] years) for a period of 6 months.
The intervention group was exposed to a single odorant, delivered through a diffuser, for 2 hours nightly, rotating through seven pleasant aromas each week. They included rose, orange, eucalyptus, lemon, peppermint, rosemary, and lavender scents.
All participants completed a battery of tests at baseline, including the Mini-Mental State Examination (MMSE), which confirmed normal cognitive functioning. At baseline and after a 6-month follow-up, participants completed the Rey Auditory Verbal Learning Test (RAVLT) as well as three subsets of the Wechsler Adult Intelligence Scale–Third Edition (WAIS-III).
Olfactory system function was assessed using "Sniffin Sticks," allowing the researchers to determine if olfactory enrichment enhanced olfactory performance.
Participants underwent fMRI at baseline and again at 6 months.

Brain imaging results showed a "clear, statistically significant 226% difference between enriched and control older adults in performance on the RAVLT, which evaluates learning and memory (timepoint × group interaction; $F = 6.63$; $P = .02$; Cohen's $d = 1.08$; a "large effect size").
They also found a significant change in the mean diffusivity of the left uncinate fasciculus in the enriched group compared with the controls (timepoint × group interaction; $F = 4.39$; $P = .043$; $h^2 p = .101$; a "medium-size effect").
The uncinate fasciculus is a "major pathway" connecting the basolateral amygdala and the entorhinal cortex to the prefrontal cortex. This pathway deteriorates in aging and in AD and "has been

suggested to play a role in mediating episodic memory, language, socio-emotional processing, and selecting among competing memories during retrieval."

No significant differences were found between the groups in olfactory ability.

Limitations of the study include its small sample size. The investigators hope the findings will "stimulate larger scale clinical trials systematically testing the therapeutic efficacy of olfactory enrichment in treating memory loss in older adults."

Commenting for *Medscape Medical News*, Donald Wilson, PhD, professor of child and adolescent psychiatry and of neuroscience and physiology, the Child Study Center, NYU Langone Medical Center, New York, said that multiple studies have "demonstrated that problems with sense of smell are associated with and sometimes can precede other symptoms for many disorders, including AD, Parkinson's disease, and depression."

Recent work has suggested that this relationship can be "bidirectional" — for example, losing one's sense of smell might promote depression, while depressive disorder might lead to impaired smell, according to Wilson, also director and senior research scientist, the Emotional Brain Institute, Nathan Kline Institute for Psychiatric Research, who wasn't involved with the study.

This "two-way interaction" may raise the possibility that "improving olfaction could impact non-olfactory disorders."

This paper "brings together" previous research findings to show that odors during bedtime can improve some aspects of cognitive function and circuits that are known to be important for memory and cognition — which Wilson called "a very exciting, though relatively preliminary, finding."

A caveat is that several measures of cognitive function were assessed and only one (verbal memory) showed clear improvement.

Nevertheless, there's "very strong interest now in the olfactory and nonolfactory aspects of odor training and this training expands the training possibilities to sleep. This could be a powerful tool for cognitive improvement and/or rescue if follow-up studies support these findings," Wilson said.

Front Neurosci. Published online July 24, 2023. Full text

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