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DEMENTIA RISK  
REDUCTION

## **SMOKING AND COGNITIVE DECLINE: CHOICES MAKE A DIFFERENCE**

The Public Health Center of Excellence on Dementia Risk Reduction coordinates risk reduction efforts and helps public health agencies share best practices. The Center translates the latest science on dementia risk reduction into actionable tools, materials and messaging that public health agencies can use to reduce dementia risk for all people — including those in diverse, underserved and higher-risk communities.

**Find the summaries of science and additional tools, resources and data at: [alz.org/riskreduction](https://alz.org/riskreduction)**

# SMOKING AND COGNITIVE DECLINE

## WHAT IS ALREADY KNOWN

Smoking and exposure to cigarette smoke increase the risk of cognitive decline, cognitive impairment, and dementia including Alzheimer's disease. This occurs at all stages of life. Studies have suggested heavy smoking in middle age may increase one's risk of dementia later in life by up to 50%. Lifetime exposure to cigarette smoke, even among non-smokers, also may adversely affect cognitive function. Use of oral tobacco products has also been associated with increased risks for cognitive impairment. Maternal smoking exposes the fetus to many toxins that may harm development and lead to lower cognitive functioning that may extend late into adulthood. Children and adolescents who begin smoking at or before age 15 may be at particularly greater risk for cognitive decline and loss of brain tissue later in life compared with those who begin smoking after age 15. Studies on vaping – a relatively new phenomenon – continue, but there are some preliminary indications that vaping may adversely affect brain health and increase risk for cognitive deficits.

## BACKGROUND AND EVIDENCE BASE

### *Evidence of negative health effects of cigarette smoking on the brain*

There are more than 7,000 chemicals in cigarette smoke, mostly produced by the combustion of tobacco. Many of these chemicals are toxic and/or carcinogenic. Of all the ingredients in cigarettes, nicotine is the primary cause of addiction. Nicotine is present in non-combustible products such as electronic cigarettes, heat-not-burn products, and oral pouches, which are all increasingly popular. While non-combustible nicotine products may be safer than traditional cigarettes, the long-term use of these products on health is uncertain because they are relatively new. In addition to its addictive properties, research suggests nicotine partially contributes to the negative health effects attributed to cigarette smoke.

Long-term exposure to cigarette smoke has negative effects throughout the body, but the brain and cerebrovascular system are particularly at risk. Smoking is associated with accelerated rates of brain tissue loss later in life. This is evident in a reduced volume of brain gray matter, where neuron cell bodies are located, and in degraded white matter tracts, which form communication pathways between brain regions. Cigarette smoke also increases stiffness in the small blood vessels of the brain, which contributes to a reduction of cerebral blood flow.



While these effects on the brain and cerebrovasculature can be directly measured, they are also indirectly evident in worsened cognitive function among people who smoke. In particular, long-term smoking reduces cognitive flexibility, attention, and short- and long-term memory. Nicotine can improve mood and cognitive function, but with long-term use, people who smoke become tolerant to these effects and experience withdrawal symptoms that worsen mood and cognitive function when they abstain from nicotine-containing products.

The effects of cigarette smoking on other parts of the body can indirectly worsen brain health. For instance, cigarette smoke worsens cardiovascular health by increasing blood pressure and decreasing heart rate variability, which in turn negatively affects brain tissue, cerebral blood flow, and cognitive function. The negative health effects of smoking tend to be associated with the heaviness and duration of use. However, an abundance of research has shown that smoking cessation improves brain and cerebrovascular health. Better health is predicted by the number of years an ex-smoker has quit. Smoking cessation may be most effective among younger individuals but appears to produce meaningful benefits at any age and regardless of the heaviness and duration of smoking.

### *Evidence of an association between cigarette use and dementia*

Cigarette smoke accelerates brain aging and promotes the development of Alzheimer's disease and cerebrovascular disease. Exposure to both first-hand and second-hand cigarette smoke is associated with risk



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for Alzheimer's. The general negative effects of cigarette smoke on brain structure and function may accelerate the underlying mechanisms of Alzheimer's disease.

Alzheimer's pathology is associated with the accumulation of amyloid plaques and neurofibrillary tangles in brain regions modulating the cholinergic system. These processes ultimately reduce the release of the neurotransmitter acetylcholine and reduce the number of nicotinic acetylcholine receptors. This results in the loss of cognitive function as well as balance and movement. Nicotine mimics the effects of acetylcholine. Thus, some studies have suggested that short-term use of nicotine may be helpful in restoring cognitive function in people with Alzheimer's, and some researchers have suggested that nicotine could have protective effects against Alzheimer's. However, the relationship between long-term nicotine use and Alzheimer's is confounded by the fact that nicotine is overwhelmingly delivered in cigarette smoke.

Other chemicals in cigarette smoke contribute to Alzheimer's and other types of dementia, such as neurotoxic heavy metals that increase plaque formation in the brain, and oxidizing stress agents that increase inflammation and lead to brain cell death. Oxidative stress also damages the blood brain barrier and impairs cerebral vasodilation, leading to cerebrovascular dysfunction, less cerebral blood flow, and neurodegeneration. By these and other mechanisms, cigarette smoking is associated with increased risk of microbleeds and strokes. Electronic cigarettes contain many of these same chemicals, albeit at lower levels than cigarette smoke. However, the association between electronic cigarette use and dementia is unknown, as the majority of electronic cigarette users are under the age of 45 years.

## ***Harms associated with lifetime exposure to cigarette smoke***

Environmental exposure to cigarette smoke adversely affects cognitive abilities and increases risks for dementia. Children may be especially sensitive as there is an inverse association between environmental cigarette smoke exposure and cognitive deficits among children even at low levels of exposure, although the cognitive development of infants is negatively related to the heaviness of their mothers' smoking. Among children and adolescents, smoking may inhibit the brain's development, compromise important cognitive functions, and result in smaller brain volumes.

## **IMPLICATIONS FOR PUBLIC HEALTH**

The heaviness and duration of cigarette smoking is associated with a higher risk of Alzheimer's, cognitive impairment, and dementia. There is compelling evidence that long-term smoking cessation can reverse a person's risk of developing cognitive decline. When compared with continual smokers, long-term quitters and never smokers have a decreased risk of both overall dementia and vascular dementia. Indeed, stopping smoking may be one of the best ways to reduce the risk of dementia and cognitive impairment in later life. However, smoking cessation is difficult, and less than 1 in 10 smokers successfully quit each year. Programs to prevent children and adolescents from starting to smoke may be most beneficial. The earlier in life a person begins smoking or using other nicotine products, the more likely they are to develop daily use and symptoms of dependence.

There is growing evidence that vaping and the use of oral tobacco products, especially when initiated at younger ages, are associated with impairments in memory, attention, and executive function. While long-term studies are still ongoing, early findings suggest these behaviors may contribute to cognitive challenges that could persist or worsen over time. Preventing initiation and promoting cessation remain important public health goals.

## ***The role of social determinants of health***

There are many social and cultural factors associated with the use of tobacco products. It is well-known that smoking is generally more prevalent among men than women in the United States. It is also more prevalent among individuals with less formal education and fewer economic resources. Smoking is more common among those living in rural communities and in the southern United States. Peer pressure may be a motivating factor for the initiation of smoking. It is also often linked to behaviors such as alcohol use and sedentarism and may be higher among those suffering from depression. Exposure to environmental smoke is increased by parental smoking and influenced by peer groups. It is prevalent among occupations in which coworkers or clients are more often smokers.

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## DISCUSSION

The evidence for a negative impact of smoking on cognitive health, both among those who smoke cigarettes and among those with environmental exposure to cigarette smoke, is strong. People at any age who smoke, and especially those with young children in their household, should be encouraged to stop and be provided with smoking cessation interventions. Smoking cessation provides many health benefits in addition to those for cognitive health.



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