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Neurodegenerative disorders

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1. Summary

- Epidemiological studies suggest that a regular, lifelong, moderate consumption of coffee/caffeine slows down physiological, age-related cognitive decline, especially in women and those over 80 years old in particular
- Although research suggests that lifelong, moderate coffee consumption is linked to a reduced risk of developing Alzheimer's disease, further studies are warranted before any firm conclusions can be drawn
- There is a substantial amount of epidemiological research showing that as coffee consumption rises, risk of Parkinson's disease falls
- The research suggests a potential preventative effect of coffee on disease development
- According to animal studies, it is likely that caffeine in coffee is the main component responsible for the potential preventative effect of coffee
- Further research is needed before firm conclusions can be drawn
- Several recent studies suggest that moderate coffee consumption may also reduce the risk of stroke
- The mechanisms of action underlying the neuroprotective effects of coffee constituents remain unclear, although caffeine is thought to play a role. Other coffee components, including antioxidants, also seem to have an effect

2. Neurodegenerative disorders in Europe

The scale of the issue

- Cognitive functions remain relatively stable until 60 years and tend to slow down thereafter, particularly between 60 and 80 years. There is some evidence that brain function can start to deteriorate as early as 45. In addition, older adults are susceptible to developing neurodegenerative disorders, including Alzheimer's and Parkinson's diseases, for which there is no treatment at present.
- It is estimated that between 50-70% of people with dementia suffer from Alzheimer's disease¹. In addition, approximately one person out of twenty over the age of 65 suffers from Alzheimer's disease, versus less than one person in a thousand under the age of 65². By 2025, the percentage of people in the EU aged over 65 is predicted to rise from 15.4% of the population to 22.4%, which is likely to correlate with a rise in Alzheimer's disease³.
- In Europe, almost 1.2 million people are estimated to have Parkinson's disease, with about 75,000 new cases diagnosed every year⁴. The age of onset of Parkinson's disease is usually over 60, but it is estimated that one in ten people with Parkinson's disease are diagnosed before the age of 50, with slightly more men than women affected⁵.

A role for coffee and caffeine

- Extensive research has been carried out on various factors that might affect the development of neurodegenerative disorders, mainly related to diet and lifestyle.
- Caffeine is known to stimulate human cognitive function, with positive effects on alertness, concentration, learning, memory and mood. Caffeine also stimulates motor activity in animals and humans. Because of these properties, caffeine is considered a likely candidate for delaying and/or preventing physiological, age-related cognitive decline as well as a number of neurodegenerative disorders – Alzheimer's and Parkinson's diseases – as well as stroke.



3. Coffee and age-related cognitive decline

Cognitive functions (reaction time, rate of information perception and treatment) remain more or less stable until 60 years and tend to significantly slow down between 60 and 80 years. Recent research even suggests that brain function can start to deteriorate as early as 45⁶. However, both the rate and extent of this cognitive decline vary between individuals.

Coffee and caffeine boost cognitive performance in the elderly

In many studies, young and elderly subjects appear to respond to the effects of caffeine differently. Overall, older adults are more sensitive to the stimulating effects of caffeine on cognitive function, than younger subjects. The quantity of caffeine consumed may also influence the cognitive performance of older adults.

Two early studies on elderly subjects showed improved attention, psychomotor* performance and cognitive functioning with caffeine. The elderly appeared more sensitive to the protective effects of caffeine on declining mental performance over time, than the younger subjects in the studies^{7, 8}.

Another study showed that, in young subjects (18-37 years), caffeine improved performance during distraction, rather than during simple tasks. In elderly subjects (60-75 years) however, caffeine improved performance during more complex tasks, requiring sustained attention⁹.

It appears that caffeine is able to reverse the effects of cognitive aging, by making more energy resources available in elderly subjects¹⁰.

In addition, a British study of 9,003 adult subjects reported a dose-related improvement in cognitive performance on a variety of tasks with higher levels of caffeine consumption (from both coffee and tea). Once again, older people appeared more susceptible to the performance-enhancing effects of caffeine on mental performance than younger subjects¹¹.

However, two Dutch studies on subjects aged 24-81 years also found positive effects of caffeine on cognition, mainly reaction time and verbal memory, but no age-related differences^{12,13}.

Besides caffeine, other components in coffee may also enhance cognitive performance in older adults. For example, a recent pilot study on 39 healthy participants, aged 53-79 years, found that decaffeinated coffee enriched with chlorogenic acids improved mood and some mood-related behaviors, compared to regular decaffeinated coffee¹⁴.

*Of, or relating to, movement or muscular activity associated with mental processes

Coffee and caffeine slow down age-related cognitive decline

Recent studies suggest that habitual coffee/caffeine consumption may boost the cognitive reserve of older adults to some extent, particularly in women.

A recent meta-analysis, looking at the effects of coffee/caffeine on different measures of cognitive impairment and/or decline, found that caffeine intake was linked to a reduced risk of cognitive decline¹⁵, showing a preventative role of coffee.

A number of individual studies^{16,17,18} have also shown that lifetime, regular caffeine consumption (mainly from coffee) appears to reduce cognitive decline as women, in particular, get older. The protective effect of caffeine increases with age and is most pronounced in women 80 years or older^{16,17}.

In men, coffee's effect is less clear. Although, in general, studies find no consistent effect of caffeine on men's cognitive decline^{16,17,18}, one study looking at the 10-year cognitive decline of 676 healthy men only, in three European countries (Finland, Italy and The Netherlands), found that those who consumed coffee experienced a 10-year cognitive decline four times smaller than non-coffee drinkers¹⁹.

Furthermore, a survey performed in Taiwan on elderly men and women also suggested that the subjects who did not drink coffee were at a significantly higher risk of cognitive impairment than those who did²⁰.

Further research is needed to confirm the beneficial effects of coffee/caffeine on cognitive decline, and to clarify why some studies found effects only in women.



4. Coffee and Alzheimer's disease

Alzheimer's disease (AD) is a neurodegenerative disease leading to progressive cognitive decline and the accumulation in the brain of β -amyloid peptide (A) – a chain of 36-43 amino acids, most commonly known in association with AD.

There is an increasing number of scientific studies suggesting a preventative role for caffeine and anti-oxidants in the development of AD.

Coffee and caffeine linked to lower risk of Alzheimer's disease

The majority of studies in humans suggest that regular coffee/caffeine consumption over a lifetime reduces the risk of developing AD, particularly in the elderly. Coffee/caffeine appears to be particularly beneficial before the occurrence of the disease i.e. during the pre-morbid phase.

A meta-analysis looking at the effects of coffee/caffeine on AD, found a clear protective effect of coffee consumption. However, there was a large heterogeneity across the studies²¹.

Another more recent meta-analysis also found that coffee/caffeine intake was linked to a 17-20% lower risk of AD¹⁵.

A number of individual studies, following subjects for a number of years, confirm the association between caffeine intake over a period of time and a reduced risk of developing AD^{22,23}. One of these found that coffee consumption at midlife decreased the risk of AD and dementia in the elderly, with the lowest risk (65% lower) in people who drank 3-5 cups a day²⁴.

However, a couple of recent studies found no link between coffee consumption and either cognitive impairment or dementia^{25,26}.

Possible mechanisms of action

A number of animal studies point to possible mechanisms of action behind coffee/caffeine's effects on AD risk²⁷⁻³². Antioxidants in coffee and/or anti-inflammatory agents also seem to have neuroprotective properties³³⁻³⁶. Further research is needed to fully understand these mechanisms.

5. Coffee and Parkinson's disease

Parkinson's disease (PD) is a debilitating neurodegenerative disorder. It is characterized by the slowing down of motor function, resting tremor, muscular rigidity, gait disturbances, and postural reflex impairment. Parkinson's disease results from the progressive destruction of dopaminergic neurons in the midbrain, responsible for neurotransmission. There is currently no available treatment to either prevent, or slow down, this neuronal loss and the resulting dopamine (a neurotransmitter) decrease in the midbrain.

Recent experimental and epidemiological research has focused on lifestyle, dietary and environmental risk factors, including coffee consumption.

Caffeine in coffee reduces, or delays, the development of Parkinson's disease

A large number of epidemiological studies point to a preventative role of coffee/caffeine consumption in the development of PD. Coffee consumption reduces, or delays, the development of PD and caffeine is most likely the causal factor. In women, however, the interaction between caffeine and hormonal therapy still needs further clarification.

As early as 1968, a study reported a higher percentage of non-coffee consumers in the control compared to the affected group³⁷. Subsequent studies performed in Spain³⁸, Sweden³⁹ and Germany⁴⁰ found that coffee consumers were less likely to develop PD, and, those who did, had a lower coffee consumption before disease onset.

A large study of 8,004 Japanese American men living in Hawaii, followed up for 27 years, found that those who drank more than 4 cups of coffee a day were 5 times less likely to develop PD than non-coffee drinkers. The relationship was similar for caffeine from non-coffee sources⁴¹.

Two meta-analyses^{42,43}, including 20 and 26 studies respectively, reported that regular coffee drinkers were at lower risk of developing PD than non-coffee drinkers. With every 300mg increase in caffeine intake (the equivalent of 3 regular cups of caffeinated coffee), the risk of PD fell by 24-32%, confirming a strong link between caffeine intake and reduced risk of PD, that cannot be explained by bias or confounding factors⁴⁴.

In women, the relationship between coffee/caffeine consumption and PD risk is less clear. One study found that moderate consumption was the most protective⁴⁴. Another large study of 77,713 women, followed up for 18 years, reported that in those not taking postmenopausal hormones, coffee was as protective against PD as in men. In women taking estrogens, the risk for PD was similar to men's at a low coffee consumption, but significantly increased in women drinking 6 or more cups of coffee a day, compared to non-coffee drinkers⁴⁵.

Recent experimental studies have also identified a mechanism of action for caffeine's preventative role in the development of PD⁴⁶⁻⁵⁰.



6. Coffee and stroke

Recent research shows that moderate coffee consumption may reduce the risk of stroke.

A recent study of 26,556 male Finnish smokers found that the risk of developing a non-hemorrhagic stroke fell by 12% with the consumption of 4-5 cups of coffee a day. The risk was reduced further to 23% in the heaviest consumers (≥ 6 cups a day) compared to those who drink less than 2 cups a day⁵¹.

Similarly, a study of 34,670 women showed that coffee consumption (2-5 cups a day) was linked to a 22-25% reduced risk of total stroke, cerebral infarction, and subarachnoid hemorrhage but not intra-cerebral hemorrhage⁵².

In addition, the Nurses' Health Study also reported that women who drank 2-4 cups of coffee a day were 20% less likely to suffer a stroke than those who drank 1 cup a month. Other drinks containing caffeine, such as tea and caffeinated soft drinks, were not linked to risk of stroke⁵³.

Finally, a recent meta-analysis of 11 studies, including 10,003 cases of stroke among 479,689 participants, found that moderate coffee consumption may be weakly linked to a reduced risk of stroke⁵⁴.

7. Conclusion

The lifelong, regular and moderate consumption of coffee/caffeine (the equivalent of 3-5 regular cups of caffeinated coffee) appears to have a beneficial effect on our cognitive abilities. It may preserve our cognitive potential as we age, have preventative effects on the development of neurodegenerative diseases such as Alzheimer's and Parkinson's, and reduce the risk of stroke. However, further research is needed before any firm conclusions can be drawn.



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