

EFFECT OF WALNUTS ON COGNITIVE HEALTH

Maham ZaheerStudent of MS-AHS, Faculty of Allied Health Sciences, Superior University, [Lahore.-](#)
Maham.zaheer@superior.edu.pk**Tabeen Irfan**Lecturer Department of Human Nutrition and Food Technology Faculty of Allied Health Sciences-
tabeen.irfan@superior.edu.pk**Hifza**Student of MS-AHS, Faculty of Allied Health Sciences, Superior University, Lahore.
hifzamasood11@gmail.com**Fajar Ashraf**Student of MS-AHS, Faculty of Allied Health Sciences, Superior University, [Lahore.-](#)
Fajarashraf51@gmail.com**Shanza Tanveer**Student of MS-AHS, Faculty of Allied Health Sciences, Superior University, [Lahore.-](#)
shanzatanveer03@gmail.com**Memona Abid**Student of MS-AHS, Faculty of Allied Health Sciences, Superior University, [Lahore.-](#)
memonaabid441@gmail.com**Ali Raza**Lecturer Department of Human Nutrition and Food Technology Faculty of Allied Health Sciences-
aliraza01@superior.edu.pk**Corresponding Author: Maham Zaheer****ABSTRACT:**

Food choices strongly impact both your brain performance and mental fitness during the aging years. People study walnuts for dietary benefits, including their healthy mix of polyunsaturated fats, plant chemicals, and other active plant compounds in their design such as polyphenols, polyunsaturated fatty acids, and antioxidants. Walnuts perform a key role in brain health because they provide many healing nutrients. These nuts enhance brain function because they contain omega-3 fatty acids, especially ALA, which reduces brain swelling and improves how neurons communicate with each other. Polyphenols and antioxidants in walnuts fight oxidative stress, which damages brain cells while contributing to Alzheimer's disease. Studies show that eating walnuts often helps people remember better along with speeds up mental tasks, and keeps their brain healthy. Regular walnut consumption helps prevent dementia and slows brain aging since it improves brain flexibility and

shields it from inflammatory damage. Walnuts actively create new brain cells and protect brain-derived neurotrophic factor, which enables learning and memory functions. People can naturally protect their cognitive health through all life stages by adding walnuts to their regular meals.

This review aims to examine both the biological basis and medical uses of walnuts for cognitive health support. Research shows walnuts help cognitive health through their ability to fight oxidative stress and protect brain cells, plus their effect on neuroinflammation and memory network strengthening. Numerous research studies with people in both clinical and observational settings show that daily walnut consumption helps aging brains work better, especially for those who age normally and are at risk of developing neurodegenerative conditions. Analysis of animals and machines reveals that walnuts stimulate brain cell growth and lower beta-amyloid amounts, which showcase their brain protection benefits.

Other than aging, walnuts also have a very good effect on mood regulation and mental clarity. Walnuts support healthy blood flow, which is associated with improved oxygen delivery and nutrients to the brain. Because of its cardiovascular benefits, it is known for its cognitive benefits, because it is believed that things which are good for the heart are good for the brain too. So, adding

a handful of walnuts to your daily diet might be beneficial for your brain health, thus promoting overall health and a happy, healthy lifestyle.

Scientists still need to discover the best amount and time to use walnuts. They also need to measure their lasting benefits on thinking abilities. Additional well-designed clinical trials need to take place to prove the walnut benefits clearly. Studying walnut effects on brain function helps find better dietary options for the prevention of mental health loss from age.

INTRODUCTION:

A walnut originates as an edible seed in trees from the *Juglans* genus, especially *Juglans regia*. People use this nutritious walnut kernel for many types of wellness support because it exists inside a tough, wrinkled shell. People have grown walnuts as food plants for many generations, and scientists first found them in Europe and Central Asia. Past records show ancient Greeks and Romans enjoyed walnuts because of their many vitamins and minerals. In modern times, the top walnut farming nations consist of the United States, China, Iran, and Turkey.

Walnuts are known for their high monounsaturated fatty acids content while delivering a good supply of omega-3 fats that are necessary for health. The nut contains arachidonic acid, which helps structure cell membranes.

Throughout history, walnut consumption has represented spiritual learning because its shape looks like a human brain. Their unique plant shape gives walnuts status as a mental health food that people take for brain benefits. Walnuts have different phytochemicals, including melatonin, ellagic acid, vitamin E, carotenoids, and polyphenols. The antioxidants in walnut compounds show promise at protecting against aging, inflammation, brain disorders, and some forms of cancer.

The fattiness of walnuts offers high amounts of vitamin E, with alpha-tocopherol and gamma-tocopherol types. Walnuts have 100 grams of natural gamma-tocopherol at 21 mg, which provides 140% of your necessary vitamin E daily intake. The fat-soluble antioxidant vitamin E defends skin cells and mucus membranes against oxidation damage done by free radicals.

You will find significant amounts of B vitamins, riboflavin, niacin, thiamine, pantothenic acid, vitamin B6, and folate (B9) when you consume walnuts. The anti-inflammatory nutrients in walnuts decrease blood pressure risks and fight cardiovascular conditions, along with lowering cancer incidence, like colon and prostate cancers, according to medical research (1).

The antioxidant content in walnuts surpasses vitamin E by up to 15 times in antioxygenic strength. Regular consumption of nuts promotes heart health because they have maximum antioxidants when compared to other tree nuts. Walnuts hold more beneficial antioxidants than other nuts with tough exteriors.

Cells receive protection from harmful free radicals and their connection to disease through the role of antioxidants. The daily intake of walnuts helps decrease cholesterol levels and eases the body's inflammatory response while shielding us against free radical damage (2).

The composition of walnuts has been reported to be:

Table 1. Composition of walnuts (3).

Protein	13.6-22.3%
Fats	65.4-70.6%
Ash	2%

Another study shows the composition of walnuts:

Table 2. Detailed nutritional content of walnuts (4).

Carbohydrate(g)	13.71
Proteins (g)	15.2

Fats(g)65.21
Calcium (mg) 98
Fiber (g) 6.7
Sodium (mg) 2
Cholesterol(mg) 0
Potassium(mg) 441
Vitamin A (IU) 20
Iron (mg) 2.91
Phosphorus (mg) 380
Thiamin (mg) 33
Riboflavin (mg) 9
Niacin (mg) 9

Neurodegenerative diseases develop rapidly when a person endures prolonged oxidative stress and persistent inflammation. These conditions weaken cell protection and build up toxic proteins inside the brain. Through time, the aging body reacts negatively to certain harmful elements, which later damage and destroy brain cells. The disrupted neural connections produce memory loss and thinking problems as the end result (5).

Mahboobeh Ghasemzadeh Rahbardar and Hossein Hosseinzadeh explain that medical history shows walnuts (*Juglans regia* L.) have long protected the nervous system because people used ancient practices to heal with walnut treatment. Scientists have conducted laboratory and animal tests to show walnut extracts can help patients dealing with specific movement or mental health issues (6). Walnuts provide health benefits because these nuts contain multiple natural substance categories. The beneficial compounds in walnuts consist of gallic acid, protocatechuic acid, ferulic acid, sinapate, ellagic acid, p-hydroxybenzoic acid, p-coumaric acid, quercetin 3-galactoside, juglone, vanillic acid, myricetin, kaempferol, apigenin, luteolin, and daidzein. Walnuts offer extensive protection to the brain because their natural components fight inflammation and disease while boosting brain health (5).

People widely recognize that regular walnut consumption supports healthy brain performance. Scientific studies prove that increasing walnut intake supports optimal brain performance. Eating walnuts provides medical benefits to people who face memory loss due to Alzheimer's or age. The strong levels of polyunsaturated omega-3 and plant polyphenols make walnuts unique in protecting brain health. The essential nutrients fight brain cell damage and minimize how much inflammation and stress affect your system.

Additionally, walnuts also have a calming effect on the nervous system and aid in appetite control, making them a very valuable addition to the diet. Some studies also suggest that walnuts have a very positive impact on beneficial bacteria in the gut. Regular consumption of walnuts has been linked to a lower risk of stroke, diabetes, and some types of cancer.

Research shows that walnuts contain different beneficial components that help treat specific medical conditions in medical tests. Ellagitannins from the polyphenol group help lower levels of oxidative stress and inflammation in scientific studies (8). The nuclear factor erythroid 2-related factor pathway in cells can become activated by ellagitannins. The Nrf2 pathway moves Nrf2 from the cytoplasm to the nucleus in response to oxidative stress. Genes involved in detoxification, antioxidant defense, and anti-inflammatory response are then produced as a result of their binding to the antioxidant response components on the target gene promoters (9,10,11).

Figure 1. Mechanism of action of walnuts in reducing inflammation and oxidative stress (Picture by author)

The FDA supports neural protection using walnut-rich diets because walnut fatty acids can transform into anti-inflammatory EPA and DHA. Consumers should consider adding walnuts to their diet because research shows this food may slow down damage to brain cells during aging while helping to control seizures. With antioxidants at high levels and fewer lipids or proteins that oxidize, plus reduced free radicals, walnuts lower damage from oxidative stress and stop brain conditions.

Figure 2: Role of Walnut peptides in different illnesses through a variety of ways (Picture by author)

LITERATURE REVIEW:

The connection between walnuts and cognitive health receives strong interest today because these nuts contain many nutrients like omega-3 fatty acids, antioxidants, and polyphenols. Understanding how diet can help preserve brain health becomes more important when these diseases develop more often in society. Research on walnuts continues because scientists found they might defend brain health, leading them to test if these nuts boost mental functions. Many studies indicate that supplementing the diet with walnuts is beneficial for brain health. This

literature review combines results from different studies about walnut effects on cognitive health to show how these nuts affect the brain.

POSSIBLE MECHANISM:

Antioxidative and anti-inflammatory activity

Surplus free radicals attack brain cells, which destroy neurons, affect memory function, and raise the chances of developing Alzheimer's and Parkinson's dementia. Most cerebral brain cell damage results from inflammation combined with an overabundance of free radicals in the system (12). Research proves that applying walnut extracts to the mouse brain reduces beta-amyloid stress effects but helps protect mitochondrial functions. The walnut extract successfully downregulated TNF- α , TNFR1, p-IkB, COX-2, and IL-1 β protein levels, which indicate inflammation in the nervous system (14). Scientists show walnut extracts work to balance superoxide dismutase and glutathione enzymes when delivered to mice with A β 1-42 injections. Walnuts contain antioxidant and anti-inflammatory phenolic compounds that show strong activity. Tests proved that catechins help BV-2 microglia cells make more nitric oxide while eliminating DPPH radicals effectively. Similarly, Quercetin reduced ROS production by controlling heme oxygenase1 (16,17).

Figure 03: Mechanism of walnut active ingredients in reducing neuroinflammation by reducing OS (Picture by author)

The activity of the antioxidant enzyme was notably increased by Gallic Acid (18). Walnuts and their main ingredient demonstrate disease-preventive benefits in the brain because of their antioxidant and anti-inflammatory effects (19).

Gut-Brain Microbiome

The gut-brain axis works two ways between the gut and brain, and walnuts help this system by building a healthy gut environment and lowering inflammation while improving brainpower. The gut microbiota uses neural, immune system, hormone, and natural defense mechanisms to connect the brain and gut bacteria effectively. Pathogenic bacteria-derived LPS triggers inflammation in both your digestive system and total body organs (20). Persistent intestinal swelling can damage brain barriers faster, which increases the entry of proinflammatory substances into brain tissue

(21). According to research, walnuts enhanced our gut with helpful bacteria like *Lactobacillus* but decreased problematic bacteria types *Anaerotruncus* and *Bacteroides* (22). Through experiments with dextran sulfate sodium-treated mice, scientists found that leucine-proline-phenylalanine from walnuts decreased levels of inflammatory cytokines in mouse blood and reversed the dysbiosis of the gut microbiota, resulting in a restoration of microbiota diversity and an increase in the relative abundance of the *Lachnospiraceae* and *Ruminococcaceae* (23).

Figure 04: Mechanism of Walnut consumption in preventing inflammation in the CNS (Picture by author)

The study shows that eating walnuts calms inflamed tissue while reshaping unfavorable gut bacteria, which helps block nerve system swelling.

WALNUTS AND COGNITIVE DISORDERS

Walnuts and Alzheimer's disease

Alzheimer's disease leads to mental degeneration in patients because too much brain amyloid plaque builds up in their brain. It is seen that Alzheimer's disease development can be slowed through walnut consumption because the nuts reduce inflammation and protect brain tissues due to their omega-3 fatty acids, polyphenols, and antioxidants. Eating walnuts repeatedly helps brain health when neurons work better, and a decline in cognitive abilities is reduced.

In a research, Abha Chauhan and Ved Chauhan show that the Amyloid Beta protein forms the main material of brain amyloid plaques in Alzheimer's disease patients. Scientific evidence shows that the Amyloid Beta protein ($A\beta$) causes cell death through excessive production of harmful free radicals within neurons. Neuroinflammation declines when $A\beta$ enhances inflammatory proteins and enzymes. Research shows that walnuts provide substances that fight inflammation and protect against oxidative damage. Several research studies show that eating walnuts can lower Mild Cognitive Impairment risk and delay Alzheimer's disease development in humans and animals (6).

In their research, Balu Muthaiyah and other colleagues divided AD-tg mice into three equal groups labeled T0, T6, and T9 for this experimental study. From the fourth month onward, researchers fed T6 and T9 AD-tg mice two different diets containing 6% and 9% walnuts alongside AIN-93G. Both AD-tg mouse groups that ate a walnut-enriched diet experienced significant progress in their condition. The research results matched what appears in regular Alzheimer's disease patients. Results demonstrated that adding walnuts to the diet supports lowering the risk and slowing down Alzheimer's disease development.

Walnuts and Parkinson's disease

Parkinson's disease damages your movement systems through the death of neurons that create dopamine. Nutrient-rich walnuts slow Parkinson's progression because they fight disease triggers such as oxidative stress and inflammation.

The brain cells producing dopamine gradually disappear from the substantia nigra while striatal dopamine supply drops significantly in patients with

Parkinson's disease. Diminished activity of dopaminergic neurons causes motor impairments, according to scientific research by authors (24,25). The buildup of alpha-synuclein damage from inflammation and low water channels triggers apoptotic pathways as key causes of Parkinson's disease (24,26,27). The levels of MAO go up in patients who have Parkinson's disease. The human body produces more MAO with age, Oxidative stress damages nerve and brain neurons. The production of ROS, especially hydrogen peroxide, by MAO-B damages both dopamine cells and the surrounding tissue (28).

Figure 05; The roles of mitochondrial damage, oxidative stress, and apoptosis in Parkinson's disease pathology (Picture by author)

Research confirmed that walnut extract treatment of primary mesencephalic cells blocked their production of nitric oxide and reactive oxygen species. Parkinson's disease animals who receive walnut extract preserve their dopamine system in the striatum part of the brain (28). A research study administered walnut treatments to mice with Parkinson's and confirmed increases of dopamine and ATP concentration in both the striatum and substantia nigra. The study documented enhancement of cells' antioxidative defenses and activities of mitochondrial complex I. Parkinson's-related reductions of SOD, CAT enzymatic activities, and damage-linked TBARS were also discovered in vivo.

Walnuts show promise as a treatment option for Parkinson's disease through research that reduces brain stress and stops dopamine losses in these specific areas (5).

Walnuts and Epilepsy

Epilepsy appears as a brain disorder when abnormal brain functions trigger repeated seizures. Scientific studies show that walnuts help decrease brain inflammation and protect cells from damage, but additional analysis is essential to prove this effect on seizure control. Neurological disorders like epilepsy affect 50 million people throughout the globe. Brain seizures damage antioxidant protection, which forces cells to oxidize proteins, DNA, and fats before turning into neural deterioration (29).

When researchers tested this effect, rats got less neural damage after they received pentylentetrazole with walnut kernels (30). Research reveals that walnut consumption slows down the development of epilepsy and reduces its electrical and behavioral symptoms. Regular walnuts enhanced their anti-convulsive effect because rats needed more pentylentetrazole to induce myoclonic jerks and had lower death rates, plus milder seizure levels. Research

reveals that walnut kernel extract shows combined seizure protection benefits with diazepam medication

(32). Before pentylenetetrazole tests, researchers found J. regia fruit with ethanolic extract provided mice protection, which increased seizure onset and maintained GSH and CAT levels while lowering MDA outcomes in brain tissue (29). Research shows walnut peptide extracts given through the abdominal area make changes to benzodiazepine receptors and boost seizure resistance levels (33).

Research in animals shows that walnut consumption and its components help decrease seizure quantity while boosting the seizure protection level in these models. Scientists found that feeding walnut kernels to rats increases their seizure protection while decreasing nerve cell death and survival issues. People treating drug-resistant epilepsy should consider walnut-derived treatments because studies show these products effectively reduce seizures. Consuming walnuts in our food may help preserve nerve cells and decrease seizure frequency in epilepsy.

Walnuts and Mild Cognitive Impairment

Experts consider Mild Cognitive Impairment to be an age-directed decline in memory and thinking skills that an individual shows, yet can still manage their daily routines. Evidence shows that having MCI raises dementia risks, but some individuals experience no further decline or improve their symptoms. Based on research by Abha and Ved Chauhan, 10% to 20% of older adults over 65 years old experience MCI. The increasing number of aging adults will make MCI detection and lifestyle therapy more important to prevent future dementia cases (6).

Spanish medical researchers tested 30g of mixed nuts a day on their adult test participants with special emphasis on nuts, including 15g of walnuts and 7.5g of both hazelnuts and almonds. People in the test group performed better in mental tasks than participants in the measurement group. Regular walnut consumption during longer periods helped older females boost their mental abilities according to research results (6). Consecutive analysis of 64 young individuals proved that walnut supplements positively modify brain performance in 8 weeks. Researchers determined that eating walnuts led to better abstract verbal reasoning results through their study (36).

Research into early memory loss helps show that eating walnuts reduces the development of mental impairment issues.

Walnuts' effect on anxiety and depression

Depression and anxiety work as major cognitive health problems in people; depression makes someone unhappy and uninterested, and anxiety triggers strong anxiety and fear. WHO figures show anxiety disorders affect 301 million worldwide, but depression impacts 280 million people in different nations. Depression impacts thirty percent of university students who experience this health concern. A research indicates university students experienced clinical depression at a rate of 30.6%, which exceeds the level found in everyday populations (43).

Research shows that stress makes people eat differently and changes how their body processes food at the same time (37). Scientists showed that consuming foods from the Mediterranean diet lessened patients' mental health conditions, particularly depression (38). Multiple scientific investigations confirm that consuming walnuts benefits mental health since they contain omega-3 fatty acids and amino acids, alpha-linolenic acid, and tryptophan.

The research displayed major improvements in stress, depression symptoms, and brain health in undergraduate university students upon walnut supplementation in the diet for 16 weeks (42). American people developed fewer depression symptoms when researchers examined their walnut and nut consumption data. Among all participants, walnut intake still provides lower average depression scores. The research team found that some forms of depression occurred less often in walnut eaters. People taking the treatments notice more excitement about doing things, as well as better energy control with decreased hopelessness. Women also report less hopelessness. Besides feeling happier and having better moods throughout the day, patients handling depression also study better and become more hopeful about the future. Research shows that nuts deliver health benefits to people overall (39). Consumption of walnuts can be very beneficial. Walnut peptide is a bioactive peptide extracted from protein present in walnuts. Walnuts are nutritious food rich in protein, minerals and polyunsaturated fatty acids. Research shows that walnut peptide enhances sleep quality, cognition and memory in human clinical trials and mouse models. Walnut peptides are commonly used in beverages and food products due to their functional properties and nutritional benefits. Adding walnut peptide powder to yogurt or milk can be a beneficial way to consume nutrients which can help in overcoming disorders like anxiety and depression (53).

Thus, consumption of walnuts might be very beneficial for mental disorders such as depression and anxiety other than other chronic cognitive diseases and cardiovascular diseases. However, more researches are needed to

understand their mechanism properly through which walnuts are working to prevent mental disorders.

Effect of Walnuts on Cognitive Behaviour in Stroke Patients

Stroke damage causes a severe mental decline that affects memory skills and thinking power. Nutrition experts have started looking at walnut diets because of the proven brain protection they

offer. Walnuts provide polyunsaturated fatty acids (PUFAs) and antioxidants like polyphenols and melatonin, plus anti-inflammatory substances that help reduce the harmful effects of brain stress and inflammation.

The study by Arab & Ang (2015) evaluated the connection between walnut supplements and brain abilities among US adults through NHANES data in a single data point assessment. When researchers ran the DSST test for adults who ate at least 10 grams of walnuts daily, they discovered that walnut consumers did better on mental tests than the control group. The research demonstrates that walnut consumption brings better cognitive outcomes for senior adults, even though the study included participants without strokes. Health studies show that stroke survivors develop cognitive aging faster because their brain blood vessels are damaged (44).

A systematic review and meta-analysis by Cahoon et al. (2021) consolidated evidence from 18 studies on walnut consumption and cognitive outcomes. People who consumed walnuts showed small but regular improvements in their memory skills, thinking speed, and control abilities. Studies with elderly adults and patients at high cardiovascular risk demonstrated walnuts' clear benefit in reducing vascular cognitive impairment through better blood flow and reduced cell damage from oxidative stress (45).

Chauhan and Chauhan (2020) examined how walnuts affect brain health at the biochemical level. They found that alpha-linolenic acid in walnuts increases learning potential through brain cell connections and fights brain swelling by controlling NF-kappa B and TNF-alpha functions. Polyphenols such as ellagic acid find and remove free radicals to defend neurons from harmful oxidative stress. Organisms use these processes during stroke recovery because increased inflammation and oxidative stress cause more brain damage (6).

Researchers in Food & Function (2025) tested how walnuts added to a breakfast affect the cognitive performance of young adults in a crossover study. People who ate walnuts performed better on cognitive tasks, and their brain activity improved, as shown through MRI results of their prefrontal cortex. Although this research study involved only healthy participants, its

findings show that walnut intake before rehabilitation exercises might help stroke patients maintain cognitive focus longer (46).

Medical research shows walnuts can help stroke patients recover better mental abilities. Consumers who eat walnuts show better thinking skills according to research findings, whereas basic scientific studies have discovered anti-inflammatory and antioxidant effects. Studies about walnut use in stroke patients need immediate testing to show how well walnuts work and what amount to consume. Adding walnuts to the diet after a stroke can help patients recover better thinking skills at a low cost while also improving their quality of life.

Effects of Walnuts on Cardiovascular Diseases:

Research shows that these heart and blood vessel problems you develop in middle age may lead to memory loss or dementia. In 2019, CVDs caused 32% of total deaths worldwide, which equaled

17.9 million deaths according to WHO estimates. All parts of society worldwide experience cardiovascular diseases, yet they cause three-fourths of these deaths according to WHO data (World Health Organization, 2021).

Research shows that adding walnuts to the diet might improve good cholesterol levels and decrease blood pressure, and also help prevent plaque growth and reduce inflammation while reducing all cholesterol counts.

Mostafa Rashki's research with Mahboobeh Ghasemzadeh Rahbardar and Mohammad Hossein Boskabady demonstrates that walnuts protect genes and proteins in cholesterol metabolism structures by lowering the production of HMGCR, SREBP-2, CYP51, and alternative genes. Thus improving lipid profiles. Walnut protein and walnut protein hydrolysates successfully lower systolic blood pressure according to this research, but walnut proteins hold superior lasting antihypertensive outcomes. Walnuts reduce oxidative and heart tissue damage to defend against heart failure and heart attacks through lipid management (50).

The available research strongly proves that walnuts can boost cardiovascular health, which benefits brain performance. Walnuts enhance heart health by enhancing blood flow through your body while lessening swelling and delivering omega-3 fatty acids and antioxidants. They protect brain health and lessen the chance of brain aging-related issues. Eating walnuts as part of a balanced diet effectively supports heart and brain health.

Figure No 06: The curative effect of Walnuts on hyperlipidemia & atherosclerosis

Figure No 07: The curative effect of Walnuts on hypertension

Walnuts and Type 2 Diabetes:

Someone with type 2 diabetes develops excessive blood sugar levels as part of a permanent medical condition, which makes the body either use less insulin or become insulin resistant. The main causes behind type 2 diabetes include unhealthy lifestyle habits like being overweight and not moving enough. Room blood sugar problems can be prevented with routine healthcare that uses diet, food, exercise, and medicine. Research shows that individuals with type 2 diabetes face a high risk of developing dementia compared to non-diabetic people (6). The research team of An Pan and others confirmed that walnut supplementation improves blood vessel function better in type 2 diabetes patients (51). The research conducted by Mirzababaei Atieh and colleagues confirmed that eating walnuts decreased fasting insulin concentration and enhanced blood glucose levels (52). These research projects demonstrate how walnuts assist type 2 diabetes patients in managing their insulin levels better. Thousands of walnuts daily raise your cells' response to insulin and help control blood sugar, which keeps your brain working at its best. The many nutrients found in walnuts boost their brain protection power and help make you smarter.

CONCLUSION

Cognitive health plays a vital role in the aging process and overall wellness, in which nutrition is a key factor in supporting brain functioning and performance. Among various food sources, walnuts have gained extraordinary recognition due to their nutritional composition that includes high levels of polyunsaturated fatty acids, polyphenols, and other beneficial bioactive compounds. Walnuts are nutrient-dense and have considerable benefits for cognitive health. They are an excellent source of omega-3 fatty acids, most importantly in Alpha linolenic acid (ALA) that enhances brain functioning by decreasing inflammation and by enhancing communication between neurons. Moreover, walnuts are packed with antioxidants and polyphenols that aid against oxidative stress, which is a major cause of neurodegenerative diseases such as Alzheimer's. Scientific research suggests that daily intake of walnuts can help in improving memory, intellectual processing, and production of brain-derived neurotrophic factor (BDNF), a protein vital for learning and memory. With these advantages in mind, adding walnuts to overall brain health.

Oxidative stress and inflammation are key contributors to the development of many degenerative diseases. Studies reveal that walnut extracts improve oxidative markers, neuroinflammation, and support the antioxidant enzyme activity of the brain. Bioactive compounds like catechins, quercetin, and gallic

acid in walnuts play an important role in protecting against neuronal damage. Research shows walnuts increase beneficial gut bacteria and reduce harmful strains linked to neuroinflammation. By improving gut health and reducing systemic inflammation, walnuts may help protect the brain and maintain cognitive function. Alzheimer's disease, marked by memory loss and cognitive decline, is linked to amyloid plaque buildup and oxidative stress in the brain. Studies in both humans and mice suggest that regular walnut intake can lower the risk and slow the progression of Alzheimer's disease. Research shows that walnut extracts can lower harmful oxygen species that are very reactive and preserve dopamine levels and their metabolites in the brain. These findings suggest that walnuts could potentially slow the progression of Parkinson's disease.

Studies on animal models have shown that walnut consumption may reduce seizure severity, which could offer therapeutic potential in managing epilepsy, especially in drug-resistant cases. Research, including clinical trials, has shown that regular nut consumption, particularly walnuts, may enhance cognitive performance in both older adults and young individuals. These findings suggest that incorporating walnuts into the diet could help delay the progression of MCI. Walnut consumption can help in declining the rate of post-stroke cognitive impairment (which affects memory, attention). Research reveals that walnut intake can improve heart health by lowering blood pressure, reducing harmful cholesterol LDL. These cardioprotective effects not only support cardiovascular function but also promote better brain health and reduce the risk of neurodegenerative diseases. Walnut consumption can enhance insulin sensitivity and help blood sugar levels, improving metabolic health.

In conclusion, growing evidence supports the role of walnuts as a powerful dietary component for promoting cognitive health and overall brain functioning. Rich in antioxidants, anti-inflammatory components, and omega-3 fatty acids, walnuts can reduce the effects of degenerative diseases like Alzheimer's, Parkinson's disease, and Epilepsy. They can also aid in cardiovascular and metabolic health, which are closely linked to cognitive function by regulating blood sugar levels and cholesterol. Furthermore, it also has positive impacts on gut-brain axis and may support recovery from stroke. It can delay the onset of mild cognitive impairment. Incorporating walnuts into a balanced diet is a natural and effective strategy for enhancing brain function and reducing the risk of age-related cognitive decline across various populations. Furthermore, for a better understanding of how walnuts

affect and improve brain health and reduce the risk of chronic neurodegenerative diseases, further researches are needed for the proper and clear indication on the dosage of walnuts. Further research is needed to understand how much amount of walnuts should be added to the diet for brain benefits. Most of the existing studies focus on the beneficial effect of walnuts on older adults, more studies are needed on the younger population to understand its beneficial effects on the younger population too.

REFERENCES

- Amaral J. S., Casal S. Pereira J. A., Seabra R. M., Oliveira B. P. P. (2003). Determination of sterol and fatty acid compositions, oxidative stability, and nutritional value of six walnut (*Juglans regia* L.) cultivars grown in Portugal. *J. Agric. Food Chem.*, 51, pp. 7698- 7702.
- Anderson K. J., Teuber S. S., Gobeille A., Cremin P., Waterhouse A. L., Steinberg F. M. (2001). Walnut polyphenolics inhibit in vitro human plasma and LDL oxidation. *J. Nutr.*, 131, (11), pp. 2837-2842.
- Şahin, İ., Akbaş, H., 2001. Farklı Yöre ve Çeşitlerden Cevizlerin Teknolojik Özelliklerinin Araştırılması. Türkiye 1. Ulusal Ceviz Sempozyumu, 5-8 Eylül 2001, Tokat, 104-114.
- Anonymous, 2019b. <https://food.ndtv.com/health/5- incredible-benefits-of-walnut-oil- for-healthand-beauty-1697195>
- Rahbardar, M.G., Hosseinzadeh, H., 2024a. Neuroprotective effects of walnut (*Juglans regia* L.) in nervous system disorders: A comprehensive review. *Iranian Journal of Basic Medical Sciences* 27, 1492. <https://doi.org/10.22038/ijbms.2024.79854.17302>
- Chauhan A, Chauhan V. Beneficial Effects of Walnuts on Cognition and Brain Health. *Nutrients*. 2020 Feb 20;12(2):550. doi: 10.3390/nu12020550. PMID: 32093220; PMCID: PMC7071526.
- (Muthaiyah, Balu et al. 'Dietary Supplementation of Walnuts Improves Memory Deficits and Learning Skills in Transgenic Mouse Model of Alzheimer's Disease'. 1 Jan. 2014 : 1397 – 1405.)
- Sharifi-Rad J, Quispe C, Castillo CMS, Caroca R, Lazo-Vélez MA, Antonyak H, Polishchuk A, Lysiuk R, Oliinyk P, De Masi L, Bontempo P, Martorell M, Daştan SD, Rigano D, Wink M, Cho WC. Ellagic Acid: A Review on Its Natural Sources, Chemical Stability, and Therapeutic Potential. *Oxid Med Cell Longev*. 2022 Feb 21;2022:3848084. doi: 10.1155/2022/3848084. Retraction in: *Oxid Med Cell Longev*. 2024 Jan 9;2024:9801541. doi: 10.1155/2024/9801541. PMID: 35237379; PMCID: PMC8885183.

- Gandhi, Gopalsamy Rajiv, et al. "Health functions and related molecular mechanisms of ellagitannin-derived urolithins." *Critical Reviews in Food Science and Nutrition* 64.2 (2024): 280-310.
- Sánchez-Ortega, M.; Carrera, A.C.; Garrido, A. Role of NRF2 in Lung Cancer. *Cells* 2021, 10, 1879. <https://doi.org/10.3390/cells10081879>
- Banc, R.; Rusu, M.E.; Filip, L.; Popa, D.-S. The Impact of Ellagitannins and Their Metabolites through Gut Microbiome on the Gut Health and Brain Wellness within the Gut–Brain Axis. *Foods* 2023, 12, 270. <https://doi.org/10.3390/foods12020270>
- Zhu, X.; Su, B.; Wang, X.; Smith, M.A.; Perry, G. Causes of oxidative stress in Alzheimer disease. *Cell. Mol. Life Sci.* 2007, 64, 2202–2210. [Google Scholar] [CrossRef]
- Min, J.; Lee, U.; Kang, J.Y.; Park, S.K.; Shin, E.J.; Kim, H.-J.; Kim, C.-W.; Kim, M.-J.; Heo, H.J. Anti-Amnesic Effect of Walnut via the Regulation of BBB Function and Neuro- Inflammation in A β 1-42-Induced Mice. *Antioxidants* 2020, 9, 976–1000. [Google Scholar]
- Min, J.; Lee, U.; Kang, J.Y.; Park, S.K.; Shin, E.J.; Kim, H.-J.; Kim, C.-W.; Kim, M.-J.; Heo, H.J. Anti-Amnesic Effect of Walnut via the Regulation of BBB Function and Neuro- Inflammation in A β 1-42-Induced Mice. *Antioxidants* 2020, 9, 976–1000. [Google Scholar]
- Zou, J.; Cai, P.S.; Xiong, C.M.; Ruan, J.L. Neuroprotective effect of peptides extracted from walnut (*Juglans sigilata* Dode) proteins on A β 25-35-induced memory impairment in mice. *J. Huazhong Univ. Sci. Technol. Med. Sci.* 2016, 36, 21–30. [Google Scholar] [CrossRef] [PubMed]
- Lv, Y.; Wei, K.; Meng, X.; Huang, Y.; Zhang, T.; Li, Z. Separation and identification of iron-chelating peptides from defatted walnut flake by nanoLC-ESI-MS/MS and de novo sequencing—ScienceDirect. *Process Biochem.* 2017, 59, 223–228. [Google Scholar] [CrossRef]
- Shen, P.; Lin, W.; Deng, X.; Ba, X.; Han, L.; Chen, Z.; Qin, K.; Huang, Y.; Tu, S. Potential Implications of Quercetin in Autoimmune Diseases. *Front. Immunol.* 2021, 12, 689044. [Google Scholar] [CrossRef]
- Radan, M.; Dianat, M.; Badavi, M.; Mard, S.A.; Bayati, V.; Goudarzi, G. In vivo and in vitro evidence for the involvement of Nrf2-antioxidant response element signaling pathway in the inflammation and oxidative stress induced by particulate matter (PM10): The effective role of gallic acid. *Free. Radic. Res.* 2018, 53, 210–225. [Google Scholar] [CrossRef]

- Tan, B.; Wang, Y.; Zhang, X.; Sun, X. Recent Studies on Protective Effects of Walnuts against Neuroinflammation. *Nutrients* 2022, 14, 4360.
<https://doi.org/10.3390/nu14204360>
- Rieder, R.; Wisniewski, P.J.; Alderman, B.L.; Campbell, S.C. Microbes and Mental Health: A Review. *Brain Behav. Immun.* 2017, 66, 9–17. [Google Scholar] [CrossRef] [PubMed]
- Villarán, R.F.; Espinosa-Oliva, A.M.; Sarmiento, M.; De Pablos, R.M.; Argüelles, S.; Delgado-Cortés, M.J.; Sobrino, V.; Van Rooijen, N.; Venero, J.L.; Herrera, A.J.; et al. Ulcerative colitis exacerbates lipopolysaccharide-induced damage to the nigral dopaminergic system: Potential risk factor in Parkinson's disease. *J. Neurochem.* 2010, 114, 1687–1700. [Google Scholar] [CrossRef] [PubMed]
- Byerley, L.O.; Samuelson, D.; Blanchard, E.; Luo, M.; Lorenzen, B.N.; Banks, S.; Ponder, M.A.; Welsh, D.A.; Taylor, C.M. Changes in the gut microbial communities following addition of walnuts to the diet. *J. Nutr. Biochem.* 2017, 48, 94–102. [Google Scholar] [CrossRef]
- Zhi, T.; Hong, D.; Zhang, Z.; Li, S.; Xia, J.; Wang, C.; Wu, Y.; Jia, Y.; Ma, A. Anti-inflammatory and gut microbiota regulatory effects of walnut protein derived peptide LPF in vivo—ScienceDirect. *Food Res. Int.* 2022, 152, 110875. [Google Scholar] [CrossRef]
- Mohammadzadeh L, Rahbardar MG, Razavi BM, Hosseinzadeh H. Crocin protects malathion-induced parkinson-like disease by inhibiting apoptosis and α -synuclein accumulation in rats' striatum. *J Mol Neurosci.* 2021;72:983–993. doi: 10.1007/s12031-022-01990-3. [DOI] [PubMed] [Google Scholar][Ref list]
- Essa MM, Subash S, Dhanalakshmi C, Manivasagam T, Al-Adawi S, Guillemin GJ, et al. Dietary supplementation of walnut partially reverses 1-methyl-4-phenyl-1, 2, 3, 6- tetrahydropyridine induced neurodegeneration in a mouse model of Parkinson's disease. *Neurochem Res.* 2015;40:1283–1293. doi: 10.1007/s11064-015-1593-2. [DOI] [PubMed] [Google Scholar][Ref list]
- Alavi MS, Fanoudi S, Ghasemzadeh Rahbardar M, Mehri S, Hosseinzadeh H. An updated review of protective effects of rosemary and its active constituents against natural and chemical toxicities. *Phytother Res.* 2021;35:1313–1328. doi: 10.1002/ptr.6894. [DOI] [PubMed] [Google Scholar][Ref list]

- Najafi N, Ghasemzadeh Rahbardar M, Hosseinzadeh H, Hayes AW, Karimi G. Chemical agents protective against rotenone-induced neurotoxicity. *Environ Toxicol Chem*. 2022;104:149–175. [Google Scholar][Ref list]
- Choi JG, Park G, Kim HG, Oh DS, Kim H, Oh MS. In Vitro and in Vivo Neuroprotective Effects of Walnut (*Juglandis Semen*) in Models of Parkinson's Disease. *Int J Mol Sci*. 2016 Jan 15;17(1):108. doi: 10.3390/ijms17010108. PMID: 26784178; PMCID: PMC4730349.
- Bhati, P., et al. "Ameliorative effect of sodium valproate in combination with *Juglans Regia* fruit extract against pentylenetetrazole induced convulsions in Mice." *Journal of Applied Pharmaceutical Sciences and Research* (2018): 23-28.
- Asadi-Shekaari M, Kalantaripour TP, Nejad FA, Namazian E, Eslami A. The anticonvulsant and neuroprotective effects of walnuts on the neurons of rat brain cortex. *Avicenna J Med Biotechnol*. 2012 Jul;4(3):155-8. PMID: 23407239; PMCID: PMC3558213.
- Harandi, S., et al. "Effect of walnut (*Juglans regia* L) consumption on anticonvulsant low- frequency stimulation in rats." (2013): 177-187.
- Asadi-Shekaari M, Eslami A, Kalantaripour T, Joukar S. Potential mechanisms involved in the anticonvulsant effect of walnut extract on pentylenetetrazole-induced seizure. *Med Princ Pract*. 2014;23(6):538-42. doi: 10.1159/000365759. Epub 2014 Sep 4. PMID: 25196480; PMCID: PMC5586938.
- Jahanbani R, Bahramnejad E, Rahimi N, Shafaroodi H, Sheibani N, Moosavi-Movahedi AA, Dehpour AR, Vahdati K. Anti-seizure effects of walnut peptides in mouse models of induced seizure: The involvement of GABA and nitric oxide pathways. *Epilepsy Res*. 2021 Oct;176:106727. doi: 10.1016/j.epilepsyres.2021.106727. Epub 2021 Jul 16. PMID: 34333374.
- Martínez-Lapiscina, Elena H., et al. "Mediterranean diet improves cognition: the PREDIMED-NAVARRA randomised trial." *Journal of Neurology, Neurosurgery & Psychiatry* 84.12 (2013): 1318-1325.
- Valls-Pedret, Cinta, et al. "Mediterranean diet and age-related cognitive decline: a randomized clinical trial." *JAMA internal medicine* 175.7 (2015): 1094-1103.
- Pribis, Peter, et al. "Effects of walnut consumption on cognitive performance in young adults." *British journal of nutrition* 107.9 (2012): 1393-1401.

Madison A, Kiecolt-Glaser JK. Stress, depression, diet, and the gut microbiota: human- bacteria interactions at the core of psychoneuroimmunology and nutrition. *Curr Opin Behav Sci.* 2019 Aug;28:105-110. doi: 10.1016/j.cobeha.2019.01.011. Epub 2019 Mar 25. PMID: 32395568; PMCID: PMC7213601.

Kris-Etherton, Penny M., et al. "Nutrition and behavioral health disorders: depression and anxiety." *Nutrition reviews* 79.3 (2021): 247-260.

Arab, Lenore, Rong Guo, and David Elashoff. "Lower depression scores among walnut consumers in NHANES." *Nutrients* 11.2 (2019): 275.

Julvez, Jordi, et al. "Walnuts, long-chain polyunsaturated fatty acids, and adolescent brain development: protocol for the walnuts smart snack dietary intervention trial." *Frontiers in Pediatrics* 9 (2021): 593847.

Pribis, Peter. "Effects of walnut consumption on mood in young adults—a randomized controlled trial." *Nutrients* 8.11 (2016): 668.

Herselman, M.F.; Bailey, S.; Deo, P.; Zhou, X.-F.; Gunn, K.M.; Bobrovskaya, L. The Effects of Walnuts and Academic Stress on Mental Health, General Well-Being and the Gut Microbiota in a Sample of University Students: A Randomised Clinical Trial. *Nutrients* 2022, 14, 4776. <https://doi.org/10.3390/nu14224776>

Ibrahim, Ahmed K., et al. "A systematic review of studies of depression prevalence in university students." *Journal of psychiatric research* 47.3 (2013): 391-400.

Arab, L., & Ang, A. (2015). A cross-sectional study of the association between walnut consumption and cognitive function among adult US populations represented in NHANES. *Journal of Nutrition, Health & Aging*, 19(3), 284–290. <https://doi.org/10.1007/s12603-014-0569-2>

Cahoon, D., et al. (2021). Walnut intake, cognitive outcomes and risk factors: A systematic review and meta-analysis. *Annals of Medicine*, 53(1), 972–998. <https://doi.org/10.1080/07853890.2021.1925955>

The impact of a walnut-rich breakfast on cognitive performance and brain activity. *Food & Function* (2025). <https://doi.org/10.1039/D4FO04832F>

Guasch-Ferré, Marta, et al. "Effects of walnut consumption on blood lipids and other cardiovascular risk factors: an updated meta-analysis and systematic review of controlled trials." *The American journal of clinical nutrition* 108.1 (2018): 174-187.

Estruch, Ramón, et al. "Primary prevention of cardiovascular disease with a Mediterranean diet supplemented with extra-virgin olive oil or nuts." *New England journal of medicine* 378.25 (2018): e34.

- Tindall, Alyssa M., et al. "Replacing saturated fat with walnuts or vegetable oils improves central blood pressure and serum lipids in adults at risk for cardiovascular disease: a randomized controlled-feeding trial." *Journal of the American Heart Association* 8.9 (2019): e011512.
- Rashki, M., Ghasemzadeh Rahbardar, M. and Boskabady, M.H. (2025), Nutritional Advantages of Walnut (*Juglans regia* L.) for Cardiovascular Diseases: A Comprehensive Review. *Food Sci Nutr*, 13: e4526. <https://doi.org/10.1002/fsn3.4526>
- Pan, A., Sun, Q., Manson, J. E., Willett, W. C., & Hu, F. B. (2013). Walnut consumption is associated with lower risk of type 2 diabetes in women. *The Journal of nutrition*, 143(4), 512-518.
- Mirzababaei A, Daneshvar M, Abaj F, Daneshzad E, Hosseininassab D, Clark CCT, Mirzaei K. The Effect of Walnut (*Juglans regia*) Leaf Extract on Glycemic Control and Lipid Profile in Patients With Type 2 Diabetes Mellitus: A Systematic Review and Meta- Analysis of Randomized Clinical Trials. *Clin Nutr Res*. 2022 Apr 25;11(2):120-132. doi: 10.7762/cnr.2022.11.2.120. PMID: 35558998; PMCID: PMC9065396.
- Li, Qinxin, et al. "Combination of Walnut Peptide and Casein Peptide alleviates anxiety and improves memory in anxiety mice." *Frontiers in nutrition* 10 (2023): 1273531.