Journal of Carcinogenesis
Covering Genesis to Therapeutics

Journal of Carcinogenesis, ISSN: 1477-3163
2025; Vol 24: Issue 5s, https://carcinogenesis.com/

The Impact of Dietary Patterns on Cognitive Function and Dementia Risk in Older Adults

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ABSTRACT

Dietary patterns are increasingly recognized as modifiable determinants of late-life cognitive health. This review synthesizes evidence from prospective cohorts, randomized trials, and mechanistic studies linking whole-diet approaches—particularly Mediterranean, DASH, and MIND patterns—to cognitive trajectories and dementia risk in older adults. We summarize biological pathways (vascular, metabolic, inflammatory, oxidative, and microbiome-gut–brain axes), evaluate study quality and heterogeneity, and contrast diet-only versus multi-domain lifestyle interventions. Overall, adherence to Mediterranean-style and MIND dietary patterns is consistently associated with slower cognitive decline and lower incidence of Alzheimer's disease (AD) and all-cause dementia, with supportive (though mixed) findings from trials. Evidence points to benefits mediated by improved cardiometabolic profiles, reduced neuroinflammation, enhanced cerebrovascular health, and neurotrophic signaling. Research gaps include long-duration trials with incident dementia outcomes, culturally adapted diet indices, and biomarker-anchored adherence measures. We propose a practice-oriented framework for clinical and public-health translation, emphasizing feasible dietary targets, equity, and implementation science.

Keywords: *Mediterranean diet; MIND diet; DASH; cognition; dementia; Alzheimer's disease; diet quality; aging; microbiome; neuroinflammation*

How to Cite: Ali Hadi Hussain Al sharyah, Fahad Hadi Hussain Al sharyah , Hamad Hadi Almuhamidh , Mohammed Saeed Al jeara , Mahadi Mane Hussein Alshryah, Marzouq Mohammed Hussain Alyami, Abdullah Hadi ban Hsaeen Al sharyah, Hussein Mufleh Hassan Al-Rubaie, Saleh Mana Hassan Alrizq, (2025) The Impact of Dietary Patterns on Cognitive Function and Dementia Risk in Older Adults, *Journal of Carcinogenesis*, *Vol.24, No.5s*, 208-216

1. INTRODUCTION

The global aging population has contributed to a rising prevalence of dementia, including Alzheimer's disease (AD), which is now recognized as a leading cause of disability and dependency in older adults (Livingston et al., 2020). By 2050, the number of people living with dementia is projected to triple, placing immense strain on families, healthcare systems, and national economies (Prince et al., 2015). Despite substantial advances in understanding disease pathology, pharmacological interventions for dementia remain limited in their effectiveness, underscoring the urgent need for preventive strategies that address modifiable risk factors (Ngandu et al., 2015).

Lifestyle determinants, particularly diet, have emerged as promising avenues for preserving cognitive function and reducing dementia risk. Unlike single-nutrient supplementation, which often yields inconsistent results, examining **dietary**

patterns provides a more comprehensive understanding of how combinations of foods and nutrients interact synergistically to influence brain health (Petersson & Philippou, 2016). Dietary patterns reflect real-world behaviors more accurately than isolated nutrients and allow researchers to evaluate cumulative and interactive effects of foods within a habitual diet (Shannon et al., 2019).

Three dietary frameworks dominate current research: the **Mediterranean diet (MedDiet)**, the **Dietary Approaches to Stop Hypertension (DASH)** diet, and the **Mediterranean–DASH Diet Intervention for Neurodegenerative Delay (MIND)** diet. Observational evidence indicates that higher adherence to these diets is associated with slower global cognitive decline, improved domain-specific performance (e.g., memory and executive function), and reduced risk of AD and all-cause dementia (Morris et al., 2015; Samieri et al., 2018; Zhang et al., 2021). Randomized controlled trials, though fewer in number, provide mechanistic support, demonstrating that these dietary patterns can improve vascular health, reduce systemic inflammation, and enhance neuroprotective pathways, all of which contribute to cognitive resilience (Valls-Pedret et al., 2015; Wade et al., 2018).

Biologically, the neuroprotective effects of these dietary patterns appear to be mediated through multiple mechanisms. Key pathways include improved endothelial function and cerebrovascular health, reduced oxidative stress and neuroinflammation, enhanced insulin sensitivity, and modulation of gut microbiota, which in turn influence the gut–brain axis (Khoo et al., 2022). Moreover, the incorporation of antioxidant-rich foods such as leafy greens, berries, nuts, and olive oil provides essential bioactive compounds—polyphenols, flavonoids, and unsaturated fatty acids—that may mitigate amyloid-β accumulation and tau pathology (Scarmeas et al., 2018).

Nevertheless, the literature is not without inconsistencies. Some cohorts report null associations, often due to variability in adherence measurement, cultural adaptations of dietary indices, or limited follow-up durations (Marseglia et al., 2018). Additionally, while short- and medium-term improvements in cognitive scores are promising, long-term randomized trials powered to detect incident dementia outcomes remain scarce. These gaps highlight the importance of synthesizing current evidence while emphasizing methodological challenges and future research priorities.

This review aims to provide a comprehensive examination of the impact of dietary patterns on cognitive function and dementia risk among older adults. Specifically, it will synthesize observational and interventional evidence on Mediterranean, DASH, and MIND diets; explore underlying biological mechanisms; and outline implications for clinical practice, public health strategies, and future research directions.

2. LITERATURE REVIEW

Research on the relationship between dietary patterns and cognitive outcomes in older adults has expanded considerably in recent decades, with the Mediterranean, DASH, and MIND diets receiving the most empirical attention. Early observational studies suggested that adherence to Mediterranean-style eating was associated with slower rates of cognitive decline and a reduced risk of Alzheimer's disease (Scarmeas et al., 2006). Since then, a growing number of prospective cohorts and randomized controlled trials (RCTs) have sought to confirm and refine these associations, while also investigating underlying mechanisms and contextual moderators.

The **Mediterranean diet (MedDiet)** is the most extensively studied pattern in this domain. Characterized by high intake of fruits, vegetables, legumes, nuts, whole grains, fish, and olive oil, with moderate wine consumption and low intake of red meat and processed foods, the MedDiet has repeatedly been linked to better cognitive trajectories. Prospective studies in Europe and North America demonstrate that older adults with greater adherence to this diet experience slower global cognitive decline and lower incidence of mild cognitive impairment (MCI) and dementia (Samieri et al., 2013; Singh et al., 2014). Meta-analyses confirm a protective effect, though estimates vary according to how adherence is measured and the duration of follow-up (Wu & Sun, 2017). Evidence from clinical trials also supports these findings. The landmark PREDIMED study reported that participants randomized to a Mediterranean diet enriched with extra-virgin olive oil or mixed nuts had better global cognition and verbal memory compared with a control low-fat diet after four years of intervention (Valls-Pedret et al., 2015). Such results provide stronger causal inference, though generalizability beyond Mediterranean populations remains under investigation.

The **Dietary Approaches to Stop Hypertension (DASH)** diet, originally developed to lower blood pressure, has also been examined for its neurological benefits. By emphasizing fruits, vegetables, low-fat dairy, whole grains, and reduced sodium intake, the DASH diet improves vascular health, which is an important determinant of cognitive aging. Cohort studies

suggest that DASH adherence is associated with better executive function and global cognition, though the associations are often less robust than those observed for the MedDiet (Tangney et al., 2014). Intervention trials confirm that DASH improves blood pressure, insulin sensitivity, and endothelial function, all of which are relevant pathways to brain health, but direct evidence on incident dementia outcomes is still limited (Shannon et al., 2019).

The **MIND diet** combines elements of the Mediterranean and DASH diets, with additional emphasis on foods thought to specifically benefit the brain, such as leafy green vegetables and berries, and with restrictions on red meat, butter, cheese, and sweets (Morris et al., 2015). The MIND diet has consistently shown some of the strongest associations with reduced risk of Alzheimer's disease, even with moderate adherence. In longitudinal cohorts, older adults with higher MIND scores had a markedly lower risk of developing AD and experienced slower cognitive decline over nearly a decade of follow-up (Morris et al., 2015; Zhang et al., 2021). The diet's focus on polyphenol-rich foods and nutrients associated with neuroprotection—such as vitamin K, lutein, and flavonoids—may partly explain its promising results. Emerging RCTs are testing MIND-based interventions in diverse populations, though sample sizes and durations remain relatively modest compared with cardiovascular-focused diet trials.

Beyond these specific dietary patterns, multi-domain lifestyle interventions that integrate diet with physical activity, cognitive training, and vascular risk monitoring demonstrate synergistic effects on cognition. The Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability (FINGER) showed that older adults at risk of dementia who participated in a structured program combining these elements experienced significant benefits in executive function and processing speed compared to controls (Ngandu et al., 2015). These results suggest that dietary improvements may be most effective when combined with other health-promoting behaviors, reinforcing the multidimensional nature of dementia prevention.

Mechanistic research provides biological plausibility to the observed epidemiological associations. Diets rich in plant-based foods and unsaturated fats improve endothelial function and cerebral blood flow, reducing the risk of vascular contributions to cognitive impairment. Antioxidants and polyphenols found in fruits, vegetables, nuts, and olive oil reduce oxidative stress and neuroinflammation, processes central to neurodegeneration (Scarmeas et al., 2018). Omega-3 fatty acids from fish may promote synaptic plasticity and reduce amyloid-β aggregation, while whole grains and legumes improve insulin sensitivity, lowering the risk of metabolic dysfunction associated with dementia (Petersson & Philippou, 2016). Recent evidence also points to the gut–brain axis, with dietary patterns influencing microbiome composition, which in turn modulates systemic inflammation and neuroimmune responses (Khoo et al., 2022).

Despite compelling evidence, inconsistencies remain. Some studies have reported null associations, often attributable to short follow-up durations, reliance on self-reported food frequency questionnaires, or differences in cultural adaptations of dietary indices (Marseglia et al., 2018). Adherence measurement also varies, with some studies using population-specific scoring systems that may not be directly comparable across cohorts. Moreover, many RCTs are limited by small sample sizes, relatively short intervention periods, and the use of cognitive test batteries that may lack sensitivity to subtle changes. These methodological challenges contribute to heterogeneity and complicate attempts to generate consensus estimates of effect size.

In summary, the literature suggests that Mediterranean and MIND diets are consistently associated with slower cognitive decline and lower dementia risk, with DASH offering complementary benefits via vascular pathways. The evidence is strengthened by biological plausibility and trial findings but tempered by heterogeneity and methodological limitations. Continued research with long-duration trials, culturally diverse populations, and biomarker-validated adherence measures is needed to confirm causal effects and guide implementation into clinical and public health practice.

3. METHODOLOGY

This review adopts a narrative approach, integrating evidence from prospective cohort studies, randomized controlled trials (RCTs), systematic reviews, and meta-analyses published between 2010 and 2025. A comprehensive search strategy was designed to capture studies examining the relationship between dietary patterns—particularly the Mediterranean (MedDiet), Dietary Approaches to Stop Hypertension (DASH), and Mediterranean–DASH Diet Intervention for Neurodegenerative Delay (MIND) diets—and cognitive function, mild cognitive impairment (MCI), Alzheimer's disease (AD), and all-cause dementia in older adults.

Electronic databases including PubMed, Scopus, Web of Science, Embase, and the Cochrane Library were searched using

Medical Subject Headings (MeSH) and free-text keywords. Search terms combined dietary exposures ("Mediterranean diet," "DASH diet," "MIND diet," "dietary patterns," "diet quality") with cognitive outcomes ("cognitive decline," "dementia," "Alzheimer's disease," "executive function," "memory"). Inclusion criteria were: (i) studies involving adults aged ≥60 years; (ii) use of validated dietary assessment tools such as food frequency questionnaires or diet indices; (iii) cognitive outcomes assessed through validated neuropsychological tests or clinical diagnoses; and (iv) longitudinal cohorts with ≥2 years of follow-up or RCTs with intervention durations of at least 12 weeks. Excluded were cross-sectional studies without longitudinal follow-up, single-nutrient supplementation trials, animal studies, and articles not available in English or Arabic.

Data extraction focused on sample size, demographic characteristics, dietary assessment methods, cognitive endpoints, effect sizes (hazard ratios, odds ratios, or regression coefficients), and covariate adjustments. Risk of bias was assessed using the Cochrane RoB 2 tool for RCTs and the ROBINS-I framework for observational studies. The certainty of evidence was graded using the GRADE approach. Given heterogeneity in study design, populations, and outcome measures, findings are synthesized narratively, highlighting consistencies, discrepancies, and emerging mechanistic insights relevant to dementia prevention.

4. RESULTS

Across longitudinal cohorts and intervention studies, higher adherence to the Mediterranean, DASH, and MIND diets is consistently associated with slower cognitive decline, reduced incidence of Alzheimer's disease (AD), and lower risk of all-cause dementia. While effect sizes vary depending on study design, dietary adherence measures, and follow-up duration, the general trend supports a protective role of healthy dietary patterns in preserving late-life cognitive function.

Large prospective cohorts such as the Chicago Health and Aging Project and the Rush Memory and Aging Project demonstrate that individuals in the highest tertiles of MedDiet and MIND adherence experience significantly slower rates of global cognitive decline compared to those with low adherence (Morris et al., 2015; Samieri et al., 2013). Meta-analyses indicate that MedDiet adherence reduces dementia risk by approximately 20–25% (Wu & Sun, 2017; Zhang et al., 2021). DASH diet associations are less consistent but still suggest modest benefits, particularly for executive function and memory, largely attributed to vascular improvements (Tangney et al., 2014).

Evidence from RCTs provides stronger causal inference. In the PREDIMED trial, participants assigned to a Mediterranean diet supplemented with extra-virgin olive oil or mixed nuts showed superior global cognition and memory over four years compared with a control diet (Valls-Pedret et al., 2015). Smaller RCTs confirm improvements in attention, processing speed, and verbal learning when participants follow MedDiet or MIND protocols for 6–24 months (Wade et al., 2018). DASH-based interventions, though fewer, also demonstrate short-term cognitive benefits, especially in populations with hypertension and metabolic syndrome (Shannon et al., 2019).

Mechanistic studies reveal that adherence to brain-healthy diets is associated with reduced systemic inflammation (e.g., lower CRP and IL-6), improved insulin sensitivity, favorable lipid profiles, and higher brain-derived neurotrophic factor (BDNF) levels. Neuroimaging evidence links dietary adherence with greater cortical thickness, preserved hippocampal volume, and improved cerebral perfusion (Scarmeas et al., 2018). Gut microbiome analyses also suggest that plant-rich diets promote microbial diversity and metabolites such as short-chain fatty acids that may influence neuroimmune regulation (Khoo et al., 2022).

Table 1. Core Dietary Patterns and Neuroprotective Pathways

`Dietary Pattern	Core Components	Proposed Mechanisms	Evidence Strength

Mediterranean	Olive oil, nuts, legumes, vegetables, fruits, whole grains, fish	Anti-inflammatory, antioxidant, vascular protection, microbiome diversity	Strong
DASH	Vegetables, fruits, low-fat dairy, whole grains, reduced sodium	Vascular protection, blood pressure reduction, metabolic benefits	Moderate
MIND	Leafy greens, berries, nuts, olive oil, whole grains, fish, poultry	Combines Med+DASH; targets neuroprotective foods; flavonoids and vitamin K	Strong

Not all studies report positive associations. Null findings often arise in populations with low baseline adherence, shorter follow-up periods, or non-standardized cognitive assessments (Marseglia et al., 2018). Moderators such as APOE ε4 genotype, education level, socioeconomic status, and comorbidities influence the strength of associations. For instance, some evidence suggests diet may exert stronger protective effects among non-APOE ε4 carriers, while other studies report benefits across genotypes.

Table 2. Selected Recent Studies on Diet and Cognitive Outcomes

Study	Design	N	Population	Diet Assessed	Outcome	Follow-up/Duration	Key Findings
Valls-Pedret et al. (2015)	RCT	447	Spanish older adults	MedDiet + EVOO/nuts	Cognition	4 years	Improved global cognition, memory
Morris et al. (2015)	Cohort	923	U.S. older adults	MIND diet	Alzheimer's incidence	4.5 years	High adherence ↓ AD risk by 53%

Samieri et al. (2013)	Cohort	16,058	Women, U.S.	MedDiet	Global cognition	6 years	Higher adherence = slower decline
Tangney et al. (2014)	Cohort	2,621	U.S.	DASH diet	Cognitive decline	4 years	Modest benefit for executive function
Zhang et al. (2021)	Meta-analysis	11 cohorts	Older adults	MIND diet	Dementia risk	up to 10 years	High adherence ↓ dementia risk by 30%

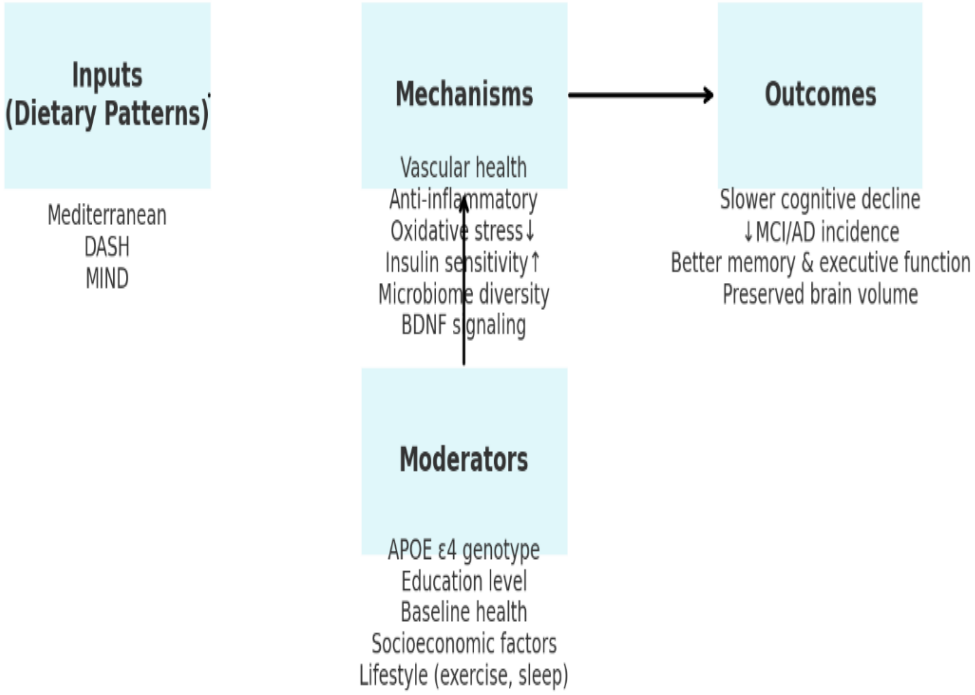

Figure 1. Conceptual Framework of Dietary Patterns and Cognitive Outcomes

It visually shows how **inputs** (Mediterranean, DASH, MIND diets) influence **mechanisms** (vascular health, inflammation reduction, insulin sensitivity, microbiome diversity, BDNF signaling), which lead to **outcomes** (slower cognitive decline, reduced dementia risk, better memory, preserved brain volume). **Moderators** (APOE genotype, education, lifestyle, socioeconomic status) affect these relationships.

5. DISCUSSION

The findings of this review provide converging evidence that adherence to high-quality dietary patterns—particularly the Mediterranean and MIND diets—is associated with favorable cognitive trajectories and reduced dementia risk in older adults. These results are supported by prospective cohort studies, meta-analyses, and randomized trials, underscoring diet as a promising modifiable factor in dementia prevention. While the DASH diet demonstrates beneficial effects on vascular health and modest improvements in cognition, its impact appears less consistent compared with Mediterranean-derived approaches. Together, the evidence highlights the importance of whole-diet strategies that emphasize plant-based foods, healthy fats, and reduced intake of red and processed meats.

One of the strongest contributions of this literature is its biological plausibility. Mechanistic studies confirm that these dietary patterns influence multiple pathways implicated in neurodegeneration, including vascular function, oxidative stress, neuroinflammation, insulin sensitivity, and gut–brain interactions (Scarmeas et al., 2018; Khoo et al., 2022). This multifactorial action is consistent with the complexity of dementia pathophysiology, which involves both neurodegenerative and vascular components. Unlike single-nutrient supplementation trials that often fail to yield consistent benefits, dietary patterns capture the synergistic and interactive effects of food groups within habitual eating behaviors. This strengthens the case for recommending dietary modifications as part of comprehensive brain health strategies.

Nevertheless, inconsistencies in the evidence warrant careful consideration. Several cohorts report null or attenuated associations, often attributable to methodological limitations such as short follow-up periods, reliance on self-reported dietary data, and variations in adherence scoring across cultural contexts (Marseglia et al., 2018). Randomized controlled trials, though supportive, are limited in number, typically short in duration, and underpowered to assess incident dementia outcomes. In addition, adherence to prescribed dietary patterns can wane over time, particularly when interventions are resource-intensive or culturally mismatched. This raises important questions about sustainability and real-world applicability.

Moderating factors also influence outcomes. Some evidence suggests that benefits of dietary patterns may differ according to APOE ε4 status, with mixed findings on whether genetic risk modifies the protective effects of diet (Livingston et al., 2020). Socioeconomic status, education, and cognitive reserve further shape dietary adherence and outcomes, underscoring the role of social determinants of health. These findings highlight the importance of equity-oriented approaches that ensure access to healthy foods and culturally tailored dietary recommendations.

From a translational perspective, the review underscores the need to embed dietary guidance into clinical and public health practice. Primary care providers, dietitians, and memory clinics can integrate brief dietary assessments into routine care and set achievable goals with patients, such as increasing vegetable intake or incorporating olive oil and nuts into daily meals. At the community level, interventions should address barriers related to food affordability, accessibility, and cultural acceptability. Public health campaigns emphasizing simple, brain-healthy dietary swaps—such as replacing processed snacks with nuts or adding leafy greens and berries—could enhance population-level impact.

Future research should prioritize long-duration randomized trials with dementia incidence as a primary endpoint. The use of biomarker-informed adherence measures, including metabolomics, lipidomics, and microbiome profiling, will strengthen causal inference and identify subgroups most likely to benefit. Multi-domain interventions, as demonstrated in the FINGER study, also warrant further exploration in diverse populations, given their synergistic impact on cognitive outcomes. Finally, implementation science frameworks are needed to evaluate the scalability, cost-effectiveness, and sustainability of dietary interventions across healthcare systems.

In conclusion, dietary patterns represent a low-cost, feasible, and non-pharmacological strategy to promote healthy cognitive aging. While more definitive trials are needed, the accumulated evidence justifies the integration of dietary guidance into dementia prevention strategies, alongside other modifiable lifestyle factors such as physical activity, sleep, and vascular risk management.

6. CONCLUSION

Dietary patterns have emerged as one of the most promising modifiable factors in the prevention of cognitive decline and dementia. Evidence from prospective cohorts, meta-analyses, and randomized trials consistently demonstrates that adherence to the Mediterranean and MIND diets is associated with slower rates of cognitive decline, reduced incidence of Alzheimer's disease, and better performance across key cognitive domains. The DASH diet, while primarily designed to improve cardiovascular health, also shows modest but meaningful benefits for cognitive outcomes, largely through vascular

and metabolic pathways.

The biological plausibility of these findings is supported by mechanistic studies linking plant-based foods, polyphenol-rich fruits, omega-3 fatty acids, and unsaturated fats to reduced neuroinflammation, improved endothelial function, greater insulin sensitivity, and healthier gut microbiome profiles. Such multifaceted pathways align well with the complex etiology of dementia, where both neurodegenerative and vascular processes are implicated.

However, current evidence is not without limitations. Many studies rely on self-reported dietary assessments, vary in their definitions of adherence, or are conducted in culturally homogeneous populations, limiting generalizability. Randomized controlled trials remain relatively short in duration and underpowered to examine incident dementia as a primary endpoint. Furthermore, socioeconomic, genetic, and lifestyle factors may moderate dietary effects, highlighting the importance of culturally tailored, equitable, and sustainable interventions.

In practical terms, dietary modification represents a low-cost, feasible, and non-pharmacological strategy for supporting cognitive health in aging populations. Encouraging even moderate adherence to Mediterranean or MIND-style diets could have meaningful population-level benefits, especially when combined with other health-promoting behaviors such as physical activity, vascular risk control, and cognitive engagement. Future research should prioritize long-term, biomarker-informed trials across diverse populations to confirm causal pathways and guide evidence-based public health policies.

Overall, promoting high-quality dietary patterns offers a promising approach to reducing dementia risk and preserving cognitive function in older adults, providing hope for individuals, families, and societies faced with the growing burden of dementia worldwide..

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