Diet and Stroke

Recent Evidence Supporting a Mediterranean-Style Diet and Food in the Primary Prevention of Stroke

Sindhu Lakkur, PhD; Suzanne E. Judd, PhD, MPH

Every year there are ≈795,000 incident strokes, a leading cause of long-term disability in the United States.1 The cost of stroke in 2010 was $36.5 billion and is projected to increase, with lost wages being the most substantial cost.1 Identifying targets for primordial prevention of stroke is critical to public health as the population in the United States is aging. Diet is often suggested as a stroke prevention option because diet quality has effects on weight maintenance and blood pressure control beyond directly reducing the risk of stroke.2

On the basis of impact of diet on blood pressure and cholesterol, a recent Cochrane Review estimated that dietary interventions may decrease stroke risk by 19%.3 In addition to blood pressure and cholesterol, diet may increase the risk of stroke through other mechanisms, including insulin resistance, inflammation, thrombosis, endothelial function, and oxidation.4 When describing diet and stroke risk, one can consider nutrients, foods, food groups, and dietary patterns.4,5 The multiple of methods used to quantify diet can lead to confusion in terms of dietary recommendations because many studies seem to conflict with one another. Recently, in an effort to simplify and clarify nutritional recommendations, dietary pattern approaches have been the focus of national recommendations for dietary change.9 In fact many are simply recommending a Mediterranean-style diet.10

The Mediterranean diet refers to the dietary patterns, which were found in the olive-growing areas of the Mediterranean region in the early 1950s and 1960s and has long been associated with better cardiovascular health.11,12 In the Seven Countries Study, Ancel Keys observed that the Greek island of Crete had the lowest rates of coronary heart disease of the 7 countries, sparking interest in the Mediterranean diet.11 Although details of this pattern may vary, the Mediterranean diet is characterized by high amounts of plant-based food, olive oil, and moderate amounts of meat, dairy, and wine.11

This review will focus on the evidence for a Mediterranean-style diet, and the foods that characterize this diet and stroke.

Mediterranean Diet and Stroke Prevention

A recent meta-analysis of 12 studies also found that high adherence to the Mediterranean diet pattern was associated with reduced stroke risk (risk ratio [RR], 0.71; 95% confidence interval [CI], 0.57–0.89),13 which was confirmed in a second systematic remeta-analysis in 2014 that added an additional 3 studies (RR, 0.68; 95% CI, 0.58–0.79), which included the Prevención con Dieta Mediterránea (PREDIMED) trial.14 This was the first large, multicenter, randomized control trial (RCT), to examine primary prevention of cardiovascular disease through a Mediterranean diet.15 Although the study was not designed to specifically examine stroke, the effect of the dietary intervention in reducing stroke risk was greater than the effect on myocardial infarction. For stroke, the hazard ratio was 0.61 (95% CI, 0.44–0.86) and for myocardial infarction, hazard ratio was 0.77 (95% CI, 0.52–1.15). The Mediterranean diet in this study recommended consumption of tree nuts and peanuts, fresh fruits, vegetables, fish, legumes, white meat, and wine.15 Consumption of soda drinks, commercial bakery goods, spread fats, red meat, and processed meats was discouraged.15

To better understand and expand on these findings, we will examine the evidence for the individual components of the Mediterranean diet in terms of stroke risk (Table). If specific components of the Mediterranean diet drive the association between high adherence to the pattern and reduced stroke risk, more targeted dietary recommendations for stroke risk reduction can be provided. Diet and stroke prevention has been the subject of several reviews, which have been conducted on studies published through 2012.4,6–8 Since 2012, however, several meta-analyses and systematic reviews on the associations between a wide variety of dietary factors and stroke have been conducted. Our review examines the most current comprehensive studies on diet and stroke prevention, through the lens of recommended or discouraged foods in the Mediterranean diet.

Fruits and Vegetables

Five or more servings of fruits and vegetables should be consumed a day in a Mediterranean diet.15 Previous reviews of
diet and stroke have found strong evidence supporting an association between fruit and vegetable consumption and stroke risk.4,6 This was confirmed by a meta-analysis of 20 prospective cohort studies published in 2014, which found that the highest quartile of consumption was associated with a 21% lower risk of stroke (RR, 0.79; 95% CI, 0.75–0.84) compared with the lowest quartile of fruit and vegetable consumption.16 When examined separately, there was a linear association between fruit and vegetable consumption and stroke risk. Furthermore, several studies studying diet quality have consistently demonstrated that dietary patterns that include large amounts of fruits and vegetables are associated with lower rates of stroke.5,27

Fruits and vegetables are a rich source of micronutrients and antioxidants that decrease lipid peroxidation; however, a recent meta-analysis of RCTs of antioxidant supplements (folate, β-carotene, selenium, vitamin B6, vitamin B12, vitamin C, vitamin D, and vitamin E) found that antioxidant supplements did not significantly reduce the risk of stroke.28 Similarly, another meta-analysis of 5 prospective studies found that each 20 μmol/L of circulating vitamin C was associated with a 19% reduction in stroke risk; however, only dietary vitamin C intake, not supplemental intake, had a statistically significant inverse association with stroke risk.28,29 This suggests that some micronutrients have stronger associations with reduced stroke risk when obtained from dietary, rather than from supplemental sources. The interpretation of meta-analyses of supplementation is complicated by several factors. Many modifiable stroke risk factors (coronary heart disease, diabetes mellitus) take years to develop; it is possible that micronutrient supplementation at the time of the RCT does not reduce stroke risk. Supplements administered at different stages of stroke risk factor development may have different effects.20 In addition, the effect of micronutrient supplementation on stroke risk among micronutrient-deficient populations has not been well examined in meta-analyses, and it is possible that correcting overt micronutrient deficiency would have a differential association with stroke risk compared with what has been observed in populations that are micronutrient replete.28,29 Additional studies are needed to further elucidate mechanisms through which micronutrient supplementation may reduce stroke risk in all populations before recommendations on specific micronutrients are warranted.

**Fish**

Those with strong adherence to a Mediterranean diet should eat fish regularly. Earlier reviews of diet and stroke strongly suggest an association between fish intake and stroke prevention; findings that are supported by 3 recent meta-analyses.4,6,8 One meta-analysis of 7 prospective cohort studies, published in 2012, found that participants in the highest tertile had a statistically significant reduced risk of ischemic stroke (RR, 0.93; 95% CI, 0.87–0.99) and hemorrhagic stroke (RR, 0.81; 95% CI, 0.70–0.94) than those in the lowest tertile of fish consumption.17 Other meta-analyses examined fish intake by servings per week and found similar statistically significant inverse associations between fish consumption and ischemic stroke, but not hemorrhagic stroke risk.18,19 Fatty fish are a source of omega-3 fatty acids, which may play a role in reducing triglyceride level.17 Interestingly, a meta-analysis of 9 RCTs of omega-3 fatty acid supplements found that the supplements did not significantly decrease the risk of stroke.30 This could indicate that it is the fish itself providing the benefit observed when examining fish intake and stroke risk. In addition, high consumption of fish and other foods recommended in the Mediterranean diet may also be representative of healthier dietary patterns or higher socioeconomic status, which are both associated with better health.17

**Olive Oil**

The consumption of olive oil, which is high in monounsaturated fatty acids, is recommended as part of a Mediterranean diet.14 Previous reviews of diet and stroke found limited evidence to suggest that monounsaturated fats reduce stroke risk; however, these reviews did not examine olive oil separately.4,6 A 2014 meta-analysis of cohort studies of 38,673 participants found that a 25-g increase in olive oil consumption is associated with an 18% reduced risk of stroke (RR, 0.82; 95% CI, 0.70–0.96).20

**Tree Nuts and Peanuts**

In a Mediterranean diet, ≥3 servings of nuts are recommended per week.15 Although previous reviews of diet and stroke did not examine the association between nuts and stroke risk, they did examine the association between nutritional components of nuts and stroke.6,8 Nuts contain high levels of polyunsaturated fatty acids, for which there was insufficient evidence to suggest an association with stroke risk in previous reviews.6,8 These findings are in agreement with a recent meta-analysis

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**Table. Components of the Mediterranean Diet**

<table>
<thead>
<tr>
<th>Food</th>
<th>Meta-Analysis: First Author, Year, Reference</th>
<th>+ (Inverse Association With Stroke Risk)</th>
<th>— (Association With Stroke Risk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruits and vegetables</td>
<td>Hu et al, 2014</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Fish</td>
<td>Chowdhury et al, 2012</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Xun et al, 2016</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Larsson et al, 2011</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Olive oil</td>
<td>Martinez-Gonzalez et al, 2014</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Tree nuts and peanuts</td>
<td>Afshin et al, 2014</td>
<td>Not statistically significant</td>
<td></td>
</tr>
<tr>
<td>Legumes</td>
<td>Afshin et al, 2014</td>
<td>Not statistically significant</td>
<td></td>
</tr>
<tr>
<td>Red and processed meat</td>
<td>Kaluza et al, 2012</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>White meat</td>
<td>Bernstein et al, 2012</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Alcohol</td>
<td>Zhang et al, 2014</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Dairy</td>
<td>Soledamah-Muthu et al, 2011†</td>
<td>Not statistically significant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hu et al, 2014</td>
<td>+</td>
<td></td>
</tr>
</tbody>
</table>

*Pooled analysis found substituting red meat for white meat was associated with decreased stroke risk.
†Examined the association between milk consumption and stroke.
§Total dairy consumption was inversely associated with stroke, but associations between different types of dairy products and stroke varied.
of 3 cohort studies and 1 RCT, which found that consumption of four servings (28.4 g each) of nuts a week had no statistically significant association with stroke risk (RR, 0.89; 95% CI, 0.74–1.05).21

Legumes
In accordance with a Mediterranean diet, ≥3 servings of legumes should be consumed every week.13 Legumes are a rich source of fiber and have a lipid-lowering effect.31 Although a recent meta-analysis of 7 studies reported that a 7-g increase in fiber intake was associated with decreased risk of incident stroke (RR, 0.93; 95% CI, 0.88–0.98), pooled effect estimates of fiber from sources other than fruits and vegetables were not reported because of heterogeneity between studies.32 One previous review of diet and stroke examined soy alone and found insufficient evidence to suggest an association with stroke.8 Similarly, a recent meta-analysis of 6 prospective cohorts found that consumption of 4 servings (100 g each) of legumes a week was not significantly associated with stroke risk (RR, 0.98; 95% CI, 0.84–1.14).21

Red and Processed Meat
Daily consumption of red and processed meats is not recommended in the Mediterranean diet.15 Previous reviews of diet and stroke have found limited evidence supporting an association between red meat consumption and stroke risk.6,8 Stronger evidence was provided by meta-analysis of 6 prospective studies published in 2012, which examined the association between fresh red meat, processed meat, and total red meat intake with stroke risk.32 A 1 serving/d increase in processed meat had a stronger association with stroke risk (RR, 1.13; 95% CI, 1.03–1.24) than fresh red meat (RR, 1.11; 95% CI, 1.03–1.20) and total red meat (RR, 1.11; 95% CI, 1.06–1.16).32 When examined by stroke subtype, a statistically significant association was observed with ischemic but not with hemorrhagic stroke.32 Components of red meat, which may contribute to stroke risk, include saturated fat and sodium in processed meat.32 Previous reviews of diet and stroke found strong evidence to support the association between sodium and stroke,6,7 but there was insufficient evidence to support an association between saturated fat and stroke risk.6,7

White Meat
In the Mediterranean diet, consumption of white meat is preferred instead of red meat.19 In support of this recommendation, a pooled analysis of the Nurse’s Health Study and the Health Professionals Follow-Up Study observed that substituting 1 serving of red meat/d for 1 serving of poultry was associated with decreased risk of stroke (RR, 0.73; 95% CI, 0.61–0.88).23 When poultry consumption was examined by stroke subtype, however, no statistically significant association was observed between poultry intake and incidence of hemorrhagic or ischemic stroke although poultry intake was associated with decreased stroke risk when the subtypes were pooled (RR, 0.87; 95% CI, 0.78–0.97).23 Similarly, a prospective study of 134,290 Chinese participants found no statistically significant associations between poultry intake and hemorrhagic or ischemic stroke mortality.33

Wine
Although red wine is considered a component of the Mediterranean diet, there are few studies that have considered red wine and stroke. Examining alcohol consumption and diet has been controversial when creating recommendations for disease prevention. Although several studies have shown that low or moderate alcohol consumption is associated with decreased risk of cardiovascular disease, the evidence for alcohol and stroke is mixed.24 A 2014 meta-analysis of 15 studies observed a nonlinear, J-shaped association between alcohol intake and stroke risk.35 Compared with nondrinkers, low levels of alcohol consumption (<15 g/d) was associated with reduced risk of stroke (RR, 0.85; 95% CI, 0.75–0.95). Moderate levels (15–30 g/d) of alcohol consumption were not associated with risk of stroke (RR, 1.01; 95% CI, 0.93–1.09); however, high levels (>30 g/d) of daily consumption were associated with increased risk of stroke (RR, 1.20; 95% CI, 1.01–1.43).24 Because of the complicated and differential association by amount of alcohol consumed,24,34 we conclude that there is not strong evidence to place a strong focus on this component of Mediterranean diet. Furthermore, there is little evidence examining red wine specifically for stroke prevention; therefore, consumption of this component should be minimized.

Sweetened Beverages and Foods
Reducing the amount of sweetened foods in the diet has become a matter of intense scrutiny in recent decades. Much of the recent evidence has focused on the role of high sugar diets in leading to obesity and diabetes mellitus, while little has been done in stroke specifically. However, a recent study of Swedish women and men found that consuming ≥2 servings of sugar sweetened beverages was associated with increased risk of ischemic but not of hemorrhagic stroke.35 Similar findings were observed an American cohort study in which consuming soda at least once per day was associated with a 16% increased risk of stroke.36 Although little evidence was available at the time of this review to consider all sweetened foods rather than just sugar sweetened beverages, a meta-analysis did examine the association between glycemic index, glycemic load, and stroke risk.37 The association between glycemic load and incident stroke risk was borderline statistically significant (RR, 1.19; 95% CI, 1.00–1.43), but no statistically significant association was observed between glycemic index and stroke risk.37 One of the limitations of this meta-analysis was that only 3 studies were available for inclusion.

Added Fats
The evidence examining added fats and risk of stroke is a bit more limited. A recent study examined dietary patterns and risk of stroke and found that people who adhered to a dietary pattern that was high in fatty meats and fried foods were at increased risk of stroke (hazard ratio, 1.39; 95% CI, 1.05–1.84).5 However, if we consider individual fats (saturated, trans, and polyunsaturated), there is a large body of evidence,
not always consistent, on each type of fat. The polyunsaturated fats in fish oil, omega-3 fatty acids have been described above in the fish paragraphs. Transfats were associated with a 13% increased risk of stroke (hazard ratio, 1.13; 95% CI, 1.00–1.28) in American men.38 This finding has not always been consistent across studies, possibly because of the changing amounts of transfats in the American diet.38

**Dairy**

Previous reviews have found mixed results on the association between dairy consumption and stroke.4,8 A 2011 meta-analysis of 6 studies observed no association between a 200 mL/d increase in milk consumption and stroke risk.25 A more recent meta-analysis examined the associations between different types of dairy foods and found that different dairy products had distinct associations with stroke. Compared with those who consumed low levels, those who consumed high levels of low fat dairy had a lower risk of stroke (RR, 0.91; 95% CI, 0.85–0.97).26 Consumption of fermented milk was also inversely associated with stroke risk (RR, 0.80; 95% CI, 0.71–0.89) although only a few studies have examined this.26 Other dairy products such as cheese, butter, and cream did not have a statistically significant association with stroke risk.26 On the basis of the evidence, we found that the association between dairy and stroke risk remains unclear; consumption of different types dairy products may have different associations with stroke risk, and additional studies should be conducted.

**Conclusions**

We have reviewed the evidence supporting the use of a Mediterranean-style diet in stroke prevention. Although it is clear that there is a role of diet quality in stroke prevention, it is also clear that there are few trials specifically designed to test the effect on diet on stroke as the primary outcome. This complicates the interpretation of any findings we have presented above for 2 reasons. First, the bulk of the evidence presented above is obtained from prospective studies in which the role of residual confounding cannot be ignored. People who choose to adhere to healthier dietary patterns may also engage in other health-promoting behaviors such as physical activity and may be more likely to maintain a healthy weight. It therefore becomes challenging to determine the direct effect of diet. Second, many of the studies presented in this review were selected for their excellent examination of diet. In many of the studies, stroke subtype was not described. Therefore, we cannot know whether the observed findings are consistent across both hemorrhagic and ischemic strokes. Third, there was a lack of racial and ethnic diversity in many of the epidemiological studies and many racial and ethnic minorities were not well represented. Although there is no evidence to suggest that the association of Mediterranean diet with stroke would differ across races, lack of studies in diverse racial populations limits the generalizability of the evidence presented.

Examining diet quality as a whole rather than focusing on the individual components of diet is becoming increasingly popular. The American Diabetes Association recently modified dietary recommendations for people with diabetes mellitus and stated that there is no 1 dietary pattern that is most efficacious for all people.8 The authors further conclude that personal and cultural preferences need to be considered when designing a nutrition management plan because a variety of dietary patterns, including the Mediterranean diet, have demonstrated health benefits. They went on to describe the beneficial aspects of maintaining an optimal mix of fats, carbohydrates, and protein through whole grains, fruits, vegetables, and protein, while minimizing sodium, sweets, and added fats. This applies to what we have described in this article. When discussing dietary choice with patients, recommendations should focus on the whole diet and not individual subcomponents and also focus on maintaining balance based on personal or cultural preferences.

Few studies have been conducted to rigorously examine diet quality following stroke as a means of improved recovery. One RCT, The Healthy Eating and Lifestyle After Stroke (HEALS) trial was designed to better understand the effects of lifestyle interventions on stroke survivors.39 We look forward to learning the results of this intervention. Future studies are also needed to examine how the dietary components described above may be used for secondary stroke prevention.

A Mediterranean diet pattern is similar to many other recommendations for improved whole diet quality including the Dietary Approaches to Stop Hypertension (DASH)-like eating plan.40 Most recommendations emphasize consumption of legumes, nuts, fruits, vegetables, whole grains and, lean proteins, and suggestion minimizing processed meats, and refined high sugar foods and we have laid out evidence for each component above. There is evidence supporting an association between the Mediterranean diet pattern (both individual foods and full pattern) and decreased stroke risk. Therefore, dietary recommendations for stroke risk reduction should focus on increased consumption of a Mediterranean-style diet.

**Sources of Funding**

Dr Lakkur was supported by T32HL072757 from the National Heart, Lung, and Blood Institute.

**Disclosures**

None.

**References**


Diet and Stroke: Recent Evidence Supporting a Mediterranean-Style Diet and Food in the Primary Prevention of Stroke
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Stroke. 2015;46:2007-2011; originally published online May 12, 2015;
doi: 10.1161/STROKEAHA.114.006306
Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://stroke.ahajournals.org/content/46/7/2007

Data Supplement (unedited) at:
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뇌졸중 일차예방에 지중해식 식이과 식품을 지지하는 최신 근거

**Diet and Stroke**

Recent Evidence Supporting a Mediterranean-Style Diet and Food in the Primary Prevention of Stroke

Sindhu Lakkur, PhD; Suzanne E. Judd, PhD, MPH

*(Stroke. 2015;46:2007-2011.)*

매년 75,000명 가량 뇌졸중이 발생하며, 이는 미국 장기장애의 주된 원인이다. 1 2010년의 뇌졸중으로 인한 비용은 365억 달러였으며, 임금손실과 더불어 가장 많은 비용으로 증가할 것으로 예상된다. 1 미국 인구의 고령화에 따라 뇌졸중을 원천적으로 예방할 대상을 규명하는 것이 공공의료에 있어 대단히 중요하다. 식이의 질이 뇌졸중의 위험을 직접적으로 낮추는 데에도 높은 유익이 있기 때문에 식이와 뇌졸중 예방의 선택 사항으로 제안된다. 2

식이가 혈압과 콜레스테롤에 미치는 영향을 기반으로, 최근의 코크란 고찰에서 식습관을 중재하는 것이 뇌졸중의 위험을 19%까지 낮출 수 있다고 추산했다. 3 혈압이나 콜레스테롤 뿐 아니라, 식이가 인슐린저항성, 염증, 혈전증, 내피기능, 산화작용 등의 다른 기전을 통해 뇌졸중의 위험을 높일 수 있다. 4 식이와 뇌졸중 위험도를 기술할 때, 영양소, 식품, 식품군, 식습관을 고려할 수 있다. 4-8 식이를 수량화하기 위해 사용되는 숱한 방법들은 식습관 중재의 면에서 혼란을 야기할 수 있는데, 왜냐하면 많은 연구들이 다른 연구와 상반된 결과를 보이기 때문이다. 최근, 영양학적 권고를 간단하고 명료하게 하는 데도, 식이 변화를 위한 국가적 권장사항의 중점으로 식습관에 대한 접근방법을 박하고 있다. 9 사실 많은 연구에서 간단히 지중해식 식이를 권장하고 있다. 10

지중해식 식이와 뇌졸중 예방

최근 12개의 연구를 메타분석한 결과로서도 지중해식 식이는 뇌졸중 위험을 감소시켰다 (risk ratio [RR], 0.71; 95% confidence interval [CI], 0.57–0.89). 13 이는 Prevención con Dieta Mediterránea (PREDIMED) trial을 포함하여 세 개의 연구를 더 본격화한 2014년의 두 번째 체계적 메타분석에서도 확인되었다 (RR, 0.68; 95% CI, 0.58–0.79). 14 Prevencion con Dieta Mediterranea(PREDIMED) trial은 첫 번째 대규모, 다기관, 무작위성 임상연구로 지중해식 식이의 심혈관질환의 원천예방을 시험하고자 했다. 15 이 연구가 특별히 뇌졸중을 시험하고자 설계된 것은 아니지만, 식습관 중재가 뇌졸중 위험을 줄이는 데 미치는 영향이 심혈관질환에 대한 영향보다 더 컸다. 뇌졸중의 위험도는 0.61 (95% CI, 0.44–0.86)이고 심근경색은 0.77 (95% CI, 0.52–1.15)이었다. 이 연구에서 지중해식 식이로 견과류와 땅콩, 신선한 과일, 계소, 생선, 콩류, 흰 육류, 포도주의 섭취를 권장했다. 15 탄산음료, 상업용 제과 제품, 스프레드 지방(spread fats), 빵은 육류, 가공육의 섭취는 반대했다. 15

이러한 결과를 좀 더 잘 이해하고 확장하기 위해, 뇌졸중의 위험 면에서 지중해식 식이의 각 성분들의 근거를 평가할 것이다(Table). 만약 지중해식 식이의 특정 성분으로 인해 이 식습관을 절차히 지키는 것과 뇌졸중 위험 감소 사이의 연관성이 유발된다면, 뇌졸중 위험 감소를 위해 좀더 선별적으로 식이에 대한 권장 사항을 제공할 수 있을 것이다. 2012년까지 이루어진 여러 개의
고찰에서 식이와 뇌졸중 예방이 주제로 다루어졌다.4,6-8 그러나, 2012년 이후 여러 메타분석과 체계적 고찰에서는 대단히 폭넓은 식이 요소와 뇌졸중 간의 연관성을 검토했다. 이번 고찰에서는, 지중해식 식이에서 추천되거나 지양하도록 하는 음식이라는 시각으로, 식이와 뇌졸중 예방을 다룬 가장 최근의 포괄적인 연구들을 분석하였다.

과일과 채소
지중해식 식이에서는 하루 5회 분량 이상의 과일과 채소를 섭취해야 한다.15 식이와 뇌졸중에 대한 이전 고찰에서 과일, 채소 섭취와 뇌졸중 예방과의 연관성을 강력히 제안하였고,4,8 최근의 세 개 메타분석에서도 이를 지지하는 결과를 보였다.6,15 2012년에 발표된 7개의 전향적 코호트 연구를 메타분석한 논문에서는 식이섭량과 더 나아가 칼로리 적절 및 식이 섭취의 관계가 뇌졸중 위험에 미치는 영향은 메타분석에서 잘 평가되지 않았으며, 명백한 이와 연결을 교정하는 것은 소개양성이가 충분한 인구집단에서 관찰된 것과 비교했을 때 뇌졸중 위험과 다른 연관관계가 가질 가능성이 있어야 할 것이다.5,27

과일과 채소에는 지질 과산화를 감소시키는 소량영양소와 항산화제가 풍부하다. 그러나, 항산화제 보충제(엽산, 베타카로틴, 셀레늄, 비타민 B6, 비타민 B12, 비타민 C, 비타민 D, 비타민 E)의 무작위실험을 메타분석한 결과에서 식품을 통해 비타민C를 섭취한 경우에서만 통계적으로 유의하게 뇌졸중 위험과 역의 상관관계를 보였으며 보충제 섭취는 관계 없었다.28,29 이는 일부 소개양성은 보충제가 아닌 식품으로 섭취할 때 뇌졸중 위험 감소와 강한 연관관계를 가졌다는 의미는 보충제의 효과가 미미할 수 있다는 가능성이 있다. 식이와 뇌졸중 발생의 각기 다른 시기에 투여된 보충제는 아마도 각기 다른 효과를 가질 것이다.28 또한, 소개양성 식이집단에서 소개양성의 보충이 뇌졸중 위험에 미치는 영향은 메타분석에서 잘 평가되지 않았으며, 명백한 이와 연결을 교정하는 것은 소개양성이가 충분한 인구집단에서 관찰된 것과 비교했을 때 뇌졸중 위험과 다른 연관관계가 가질 가능성이 있어야 할 것이다.5,27

생선
지중해식 식이를 철저히 지키려면 생선을 정기적으로 먹어야 한다. 식이와 뇌졸중에 대한 초기 고찰에서는 생선 섭취와 뇌졸중 예방과의 연관성을 강력히 제안하였고,4,8 최근의 세 개 메타분석에서도 이를 지지하는 결과를 보였다.6,15 2012년에 발표된 7개의 전향적 코호트 연구를 메타분석한 논문에서는 식이섭량과 더 나아가 칼로리 적절 및 식이 섭취의 관계가 뇌졸중 위험에 미치는 영향은 메타분석에서 잘 평가되지 않았으며, 명백한 이와 연결을 교정하는 것은 소개양성이가 충분한 인구집단에서 관찰된 것과 비교했을 때 뇌졸중 위험과 다른 연관관계가 가질 가능성이 있어야 할 것이다.5,27

올리브유
단일불포화지방산이 풍부한 올리브유의 섭취는 지중해식 식이의 일부로 권장된다.11 식이와 뇌졸중에 대한 이전 고찰에서 단일불포화지방산이 뇌졸중 위험을 낮추는 것을 시사하는 결과가 발견되었다. 그러나, 이들 연구에서는 올리브유를 따로 분석하지는 않았다.11 총 38673명을 분석한 고호트 연구들의 2014년 메타
분석에서 올리브유 섭취가 25g 증가할 때 뇌졸중의 위험은 18% 감소하였다 (RR, 0.82; 95% CI, 0.70–0.96). \(^\text{20}\)

**견과류와 받동**

지중해식 식이에서는 3주에 3회 분량 이상의 견과 섭취를 권장한다. 식이와 뇌졸중에 대한 이전 연구에서 견과와 뇌졸중의 위험 간의 관계를 분석하는 것이 없었지만, 견과의 영양성분과 뇌졸중 간의 연관성에 대해서는 분석하였다. \(^\text{4,6}\) 견과는 고도불포화지방산을 다양 함유하고 있으며, 이전 고갈에서 뇌졸중 위험도와의 연관성 을 시사하기에 근거가 불충분하다. \(^\text{4,6}\) 이러한 결과는 3개의 코호트연구와 하나의 무작위선정을 메타분석한 최근의 연구에서 1주에 4회 분량(각 28.4g)의 견과를 섭취하는 것이 뇌졸중 위험도와 통계적으로 유의한 연관성을 보이지 않았다는 결과 (RR, 0.89; 95% CI, 0.74–1.05)와 일치한다. \(^\text{21}\)

콩류 지중해식 식이에 따르면, 매주 3회 분량 이상의 콩류를 섭취해야 한다. \(^\text{15}\) 콩류는 식이섬유를 많이 함유하고 있으며, 지질강하효과를 가진다. \(^\text{31}\) 7개 연구를 메타분석한 최근 결과에서 식이섬유 섭취량을 7g 증가시켰다는 것이 뇌졸중 위험 감소와 관련된다고 하였으나 (RR, 0.93; 95% CI, 0.88–0.98), 과일, 채소 외의 다른 음식으로 섭취한 식이섬유의 통합 효과추정치(pooled effect estimates)는 각 연구들의 이질성으로 인해 보고하지 않았다. \(^\text{32}\) 이전의 식이와 뇌졸중 연구에서 콩만을 분석했는데, 뇌졸중과의 연관성을 시사하기엔 근거가 부족하였다. \(^\text{8}\) 비슷하게, 최근 6개의 전향적 코호트연구를 메타분석한 결과, 1주에 4회 분량(각 100g)의 콩류를 섭취한 경우 뇌졸중의 위험도와의 관련성은 통계적으로 유의하지 않았다 (RR, 0.98; 95% CI, 0.84–1.14). \(^\text{23}\)

**붉은 육류와 가공육**

붉은 육류와 가공육을 매일 섭취하는 것은 지중해식 식이에 권장되지 않는다. \(^\text{15}\) 식이와 뇌졸중에 대한 고찰에서 붉은 육류 섭취와 뇌졸중 간의 연관성은 제한적인 근거를 확인하였다. \(^\text{4,6,8}\) 2012년에 발표된 6개의 전향적 연구를 메타분석한 논문에서 식이와 뇌졸중의 위험간의 관계를 분석하였지만, 분량을 하루 1회 분량 더 섭취하는 경우 (RR, 1.13; 95% CI, 1.03–1.24)가 신선한 붉은 육류 (RR, 1.11; 95% CI, 1.03–1.20)와 총 붉은 육류 섭취 정도의 영향 (RR, 1.13; 95% CI, 1.03–1.24)과 비교해서 뇌졸중 위험도가 더 강한 연관성을 보였는데, \(^\text{24}\) 붉은 육류 섭취량에도 불구하고 뇌졸중 위험도와의 연관성은 통계적으로 유의하지 않았다 (RR, 0.85; 95% CI, 0.75–0.96). 중간 정도 양의 음주량의 경우 (하루 15g 미만)은 뇌졸중의 위험도가 낮았고 (RR, 1.01; 95% CI, 0.93–1.09), 그러나 많은 양의 음주를 하는 경우 (하루 30g 초과) 뇌졸중의 위험성이 증가하였다 (RR, 1.20; 95% CI, 1.01–1.43). \(^\text{24}\) 주류 섭취량별로 복잡하고 차이가 나는 연관성을 지니고, \(^\text{24,34}\) 본 연구에서는 지중해식 식이의 일부로 뇌졸중 위험을 높이는 주요한 근거가 없었다. \(^\text{24}\) 또한, 붉은 육류 섭취에 대한 뇌졸중 희생자 사망률과 관련이 없었다. \(^\text{33}\)

**포도주**

붉은 포도주가 지중해식 식이의 구성요소로 생각되고 있지만, 붉은 포도주와 뇌졸중을 고려한 연구는 거의 없다. 음주와 식이의 연구는 질병 예방을 위한 권장사항을 제시하기에는 논란이 많다. 여러 연구에서 소량 또는 중간 정도의 음주가 심혈관질환의 위험을 낮춘다고 하였으며, 음주와 뇌졸중의 연관성 맥락의 점검이다. \(^\text{23}\) 15개의 연구를 메타분석한 2014년 연구결과에서 음주량과 뇌졸중 위험간의 비선형, J형 연관관계를 확인하였다. \(^\text{24}\) 음주를 하지 않는 사람과 비교해서 적은 양의 음주를 하는 사람 (하루 15g 미만)은 뇌졸중의 위험도가 낮았고 (RR, 0.85; 95% CI, 0.75–0.96), 중간 정도 양의 음주량의 경우 (하루 15–30g) 뇌졸중의 위험과 관련이 없었다 (RR, 1.01; 95% CI, 0.93–1.09), 그러나 많은 양의 음주를 하는 경우 (하루 30g 초과) 뇌졸중 위험성이 증가하였다 (RR, 1.20; 95% CI, 1.01–1.43). \(^\text{24}\) 주류 섭취량별로 복잡하고 차이가 나는 연관성을 지니고, \(^\text{23,34}\) 본 연구에서는 지중해식 식이의 일부로 뇌졸중 위험을 높이는 주요한 근거가 없었다. \(^\text{23}\) 또한, 붉은 육류 섭취에 대한 뇌졸중 희생자 사망률과 관련이 없었다. \(^\text{33}\)

**설탕 첨가 음료와 식품**

식이에서 설탕을 첨가한 음식의 양을 줄이는 것은 최근의 연구에서 권장받고 있는 것이지지만, 설탕을 첨가한 음식의 양을 줄이는 것은 최근의 연구에서 권장받고 있는 것이지지만, 설탕을 첨가한 음료의 양을 줄이는 것은 최근의 연구에서 권장받고 있는 것이지지만, 설탕을 첨가한 음료의 양을 줄이는 것은 최근의 연구에서 권장받고 있는 것이지만, 설탕을 첨가한 음료의 양을 줄이는 것은 최근의 연구에서 권장받고 있는 것이지만, 설탕을 첨가한 음료의 양을 줄이는 것은 최근의 연구에서 권장받고 있는 것이지만, 설탕을 첨가한 음료의 양을 줄이는 것은...
본 연구에서는 뇌졸중의 예방에 대해 지중해식 식이를 시행할 것을 지지하는 근거를 검토하였다. 식이의 질이 뇌졸중 예방에 역할을 한다는 것은 분명하지만, 일차예방로 뇌졸중에 대한 식이의 효과를 시사하기 위해 특별히 설계된 연구가 거의 없다는 것도 분명하다. 이 두가지 이유로 인해 현재까지의 결과들에 대한 변수의 영향을 평가할 수 없는 전향적 연구에서 얻었다. 더 건강한 식습관과 따르는 사람들이 아마도 운동과 같은 다른 건강 증진 활동에도 참여할 것이며, 아마도 좀 더 건강한 체중을 유지할 것이다. 이는 식이의 적절적 효과를 규명하는데 제한점이 될 수 있다. 허혈성 뇌졸중의 위험도 간의 연관성은 통계적으로 유의하지 않았다. 이 메타분석의 한계점 중 하나는 단지 세 개의 연구만 포함시킬 수 있다는 점이다.

결론
본 연구에서는 뇌졸중의 예방에 대해 지중해식 식이를 시행할 것을 지지하는 근거를 검토하였다. 식이의 질이 뇌졸중 예방에 역할을 한다는 것은 분명하지만, 일차예방으로 뇌졸중에 대한 식이의 효과를 시사하기 위해 특별히 설계된 연구가 거의 없다는 것도 분명하다. 이 두 가지 이유로 인해 현재까지의 결과들에 대한 변수의 영향을 평가할 수 없는 전향적 연구에서 얻었다. 더 건강한 식습관과 따르는 사람들들은 아마도 운동과 같은 다른 건강 증진 활동에도 참여할 것이며, 아마도 좀 더 건강한 체중을 유지할 것이다. 이는 식이의 적절적 효과를 규명하는데 제한점이 될 수 있다. 허혈성 뇌졸중의 위험도 간의 연관성은 통계적으로 유의하지 않았다. 이 메타분석의 한계점 중 하나는 단지 세 개의 연구만 포함시킬 수 있다는 점이다.
Sources of Funding

Dr Lakur was supported by T32HL072757 from the National Heart, Lung, and Blood Institute.

Disclosures

None.

References


Key Words: diet ■ Mediterranean ■ prevention & control ■ stroke