Health Effects of Olive Oil and the Mediterranean Diet

A REVIEW OF RECENT SYSTEMATIC LITERATURE REVIEWS

Prepared for Olive Wellness Institute
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Prepared by Nutrition Research Australia

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AIM

The aim of this project was to:

- Search the literature for systematic literature reviews (SLRs) or meta-analyses on olive oil and/or the Mediterranean Diet
- Provide a brief summary of the SLRs for ten health outcomes to be used to update the Olive Wellness Institute (OWI) website

METHODOLOGY

The following methodology was used to obtain all SLRs on olive oil and/or the Mediterranean diet:

- PUBMED and Web of Science databases were searched for studies published from the year 2000 to June 2018.
  - The search was limited from the year 2000, as all previously published reviews would be out dated, and all previous studies would be captured in more recent reviews of the literature.
- Search terms included: Mediterranean diet OR Mediterranean OR Olive oil OR Extra virgin olive oil OR Virgin olive oil OR EVOO OR VOO AND Review OR Systematic review OR Systematic literature review OR SLR OR Meta-analysis OR Meta-analyses.
  - Limited to reviews in English and in humans (children or adults).
- Titles and abstracts were scanned for the following inclusion criteria:
  - Systematic reviews or meta-analysis.
    - Expert/narrative reviews or individual studies were not considered.
  - Reviews focused specifically on the Mediterranean diet or on olive oil (any type)
    - This included reviews that looked at the Mediterranean diet alongside other diets.
  - Any health outcome or related measure (e.g. adherence, cost-effectiveness, etc.).
- Studies were categorised into 14 health outcomes, and ten outcomes were included in this summary report.

Asthma (excluded)	Type 2 diabetes (prevention and management)
Blood pressure	Frailty in the elderly (excluded)
Bone health (excluded)	Inflammation
Cancer risk (excluded)	Metabolic Syndrome
Cardiovascular disease	Mortality (excluded)
Cholesterol and lipids	Rheumatoid arthritis
Cognitive health and impairment	Weight and anthropometric measures
Depression and mental health	

The most recent and relevant review was selected and summarised for each of the ten health outcomes.

Studies were chosen based on:

Diet: Studies specifically on olive oil were prioritised over those on the Mediterranean diet, when available

Publication date: Studies with the most recent publication date

Outcomes: Studies that reported the largest range of measures relevant to the outcomes of interest (i.e. more than one risk factor for cardiovascular disease)

Quantitative assessment: Studies that performed a meta-analysis

Quality of evidence: Highest quality of evidence (i.e. RCTs prioritised over cross-sectional studies)

Impact factor: Studies published in a journal with the highest impact factor of the journal

Citations: When studies had a similar publication date, those with the greatest number of citations

Data were obtained for each paper on:

Study type	Diet or food investigated
Outcomes measured	Population studied
Key study results	Quality assessment

Upon assessment of the review, we provided:

- A one-sentence summary
- A list of its limitations
- The bottom line of what the research means

The other review papers identified via the literature search are listed at the end of each health outcome section.

BLOOD PRESSURE

Health effects of olive oil and the mediterranean diet

BLOOD PRESSURE

EFFECT SIZE

"High phenolic olive oils lead to a small reduction in systolic but not diastolic blood pressure and oxidized LDL compared to low phenolic olive oils, and there was no difference in cholesterol, triglycerides and malondialdehyde."

Hohmann, C.D., et al., Effects of high phenolic olive oil on cardiovascular risk factors: A systematic review and meta-analysis. Phytomedicine, 2015. 22(6): p. 631-40.

What is the effect?

- Reduction in systolic blood pressure
- Reduction in oxLDL-level

To view the full results, visit:

olivewellnessinstitute.org

WHAT IS THE QUALITY OF THE EVIDENCE?

Adults

Studies included both healthy subjects and subjects with heart disease or its risk factors

All studies were from Europe

8 Random controlled trials

Systematic literature and meta-analysis

KEY RESULTS

High phenolic olive oil vs. low phenolic olive oil resulted in:

REDUCTION IN SYSTOLIC BLOOD PRESSURE:
(mean difference = –0.52; CI –0.77, –0.27; p < 0.01) (2 studies)

REDUCTION IN OXLDL-LEVEL
(mean difference = –0.25; CI –0.50, 0.00; p = 005) (4 studies)

NO EFFECT FOR DIASTOLIC BLOOD PRESSURE
(2 studies), malondialdehyde (2 studies), total cholesterol (6 studies), HDL-c (6 studies), LDL-c (6 studies), and TG (6 studies)

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BLOOD PRESSURE

WHAT TO KEEP IN MIND?

Limitations

- 6 of the 8 included studies were conducted in Mediterranean countries, which already use olive oil as the primary source of fat in the diet, and thus these results are only partly applicable to people who have other traditional diets.
- Small number of included studies- only two studies included for some outcomes.
- Due to the small numbers of studies, some outcomes had considerable heterogeneity.

WHAT'S THE BOTTOM LINE?

Some evidence for the positive effects of high phenolic olive oil on reducing systolic blood pressure, but the available data are too limited to draw a solid conclusion.

Future research should specifically focus on the efficacy of high phenolic olive oil in blood pressure reduction, including dose-response trials.

OTHER REVIEWS

Schwingshackl, L., et al., Comparative effects of different dietary approaches on blood pressure in hypertensive and pre-hypertensive patients: A systematic review and network meta-analysis. Crit Rev Food Sci Nutr, 2018: p. 1-14.

Gay, H.C., et al., Effects of Different Dietary Interventions on Blood Pressure: Systematic Review and Meta-Analysis of Randomized Controlled Trials. Hypertension, 2016. 67(4): p. 733-9.

Ndanuko, R.N., et al., Dietary Patterns and Blood Pressure in Adults: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Adv Nutr, 2016. 7(1): p. 76-89.

Nissensohn, M., et al., The Effect of the Mediterranean Diet on Hypertension: A Systematic Review and Meta-Analysis. J Nutr Educ Behav, 2016. 48(1): p. 42-53 e1.

Nordmann, A.J., et al., Meta-analysis comparing Mediterranean to low-fat diets for modification of cardiovascular risk factors. Am J Med, 2011. 124(9): p. 841-51 e2.

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CARDIOVASCULAR DISEASE

Health effects of olive oil and the mediterranean diet

CARDIOVASCULAR DISEASE

EFFECT SIZE

> "Olive oil consumption significantly reduced the risk of cardiovascular disease (CVD) risk and stroke, but not specifically for coronary heart disease (CHD) risk."

Martinez-Gonzalez, M.A., L.J. Dominguez, and M. Delgado-Rodriguez, Olive oil consumption and risk of CHD and/or stroke: a meta-analysis of case-control, cohort and intervention studies. Br J Nutr, 2014. 112(2): p. 248-59.

What is the effect?

24% reduced risk of stroke*

18% reduced risk of CVD*

*For an additional 25 grams of olive oil per day

To view the full results, visit:

olivewellnessinstitute.org

WHAT IS THE QUALITY OF THE EVIDENCE?

No prior CVD diagnosis

All studies were from Mediterranean countries

9 studies

3 case-controls, 5 cohorts and 1 clinical trial

KEY RESULTS

CHD

No significant association between olive oil consumption and the risk of CHD (7 studies).

STROKE

A significant inverse association between olive oil and the risk of stroke (3 studies):

24% reduced risk of stroke for an additional 25 grams of olive oil per day (95 % CI 0·67, 0·86; P<0·001).

CVD

(CHD OR STROKE AS ENDPOINT)

Significant inverse association between olive oil and risk of CVD (n = 9 studies):

18% reduced risk of CVD for an additional 25 grams of olive oil per day (95 % CI 0·70, 0·96; P=0·01).

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CARDIOVASCULAR DISEASE

WHAT TO KEEP IN MIND? Limitations

- Substantial heterogeneity was observed among the studies for CHD.
- There were a small number of studies available, and the different study designs were
- The type of olive oil (e.g. virgin olive oil vs. ordinary refined variety) was not taken into account in most of the studies.
- All studies were conducted in Mediterranean countries and the applicability of these findings to other populations is unknown.
- There was evidence found for publication bias.

WHAT'S THE BOTTOM LINE?

There is evidence for an association between olive oil consumption and reduced risk of cardiovascular disease, and specifically for stroke.

However, no significant protection was found for CHD overall, suggesting that the effect for stroke may be driving the relationship. Further studies that better distinguish between extra virgin olive oil vs. ordinary olive oil with respect the risk of CHD are needed, since the phenolic concentration in extra virgin olive oil is much higher.

OTHER REVIEWS

Dinu, M., et al., Mediterranean diet and multiple health outcomes: an umbrella review of meta-analyses of observational studies and randomised trials. Eur J Clin Nutr, 2018. 72(1): p. 30-43.

Nowson, C.A., et al., The Impact of Dietary Factors on Indices of Chronic Disease in Older People: A Systematic Review. J Nutr Health Aging, 2018. 22(2): p. 282-296.

Sanches Machado d'Almeida, K., et al., Mediterranean Diet and Other Dietary Patterns in Primary Prevention of Heart Failure and Changes in Cardiac Function Markers: A Systematic Review. Nutrients, 2018. 10(1).

Grosso, G., et al., A comprehensive meta-analysis on evidence of Mediterranean diet and cardiovascular disease: Are individual components equal? Crit Rev Food Sci Nutr, 2017. 57(15): p. 3218-3232.

Rosato, V., et al., Mediterranean diet and cardiovascular disease: a systematic review and meta-analysis of observational studies. Eur J Nutr, 2017.

Bloomfield, H.E., et al., Effects on Health Outcomes of a Mediterranean Diet With No Restriction on Fat Intake: A Systematic Review and Meta-analysis. Ann Intern Med, 2016. 165(7): p. 491-500.

Liyanage, T., et al., Effects of the Mediterranean Diet on Cardiovascular Outcomes-A Systematic Review and Meta-Analysis. PLoS One, 2016. 11(8): p. e0159252.

Sayon-Orea, C., S. Carlos, and M.A. Martinez-Gonzalez, Does cooking with vegetable oils increase the risk of chronic diseases?: a systematic review. Br J Nutr, 2015. 113 Suppl 2: p. S36-48.

Sleiman, D., M.R. Al-Badri, and S.T. Azar, Effect of mediterranean diet in diabetes control and cardiovascular risk modification: a systematic review. Front Public Health, 2015. 3: p. 69.

Grosso, G., et al., Mediterranean diet and cardiovascular risk factors: a systematic review. Crit Rev Food Sci Nutr, 2014. 54(5): p. 593-610.

Schwingshackl, L. and G. Hoffmann, Monounsaturated fatty acids, olive oil and health status: a systematic review and meta-analysis of cohort studies. Lipids Health Dis, 2014. 13: p. 154.

Sofi, F., et al., Mediterranean diet and health status: an updated meta-analysis and a proposal for a literature-based adherence score. Public Health Nutr, 2014. 17(12): p. 2769-82.

Psaltopoulou, T., et al., Mediterranean diet, stroke, cognitive impairment, and depression: A meta-analysis. Ann Neurol, 2013. 74(4): p. 580-91.

Rees, K., et al., 'Mediterranean' dietary pattern for the primary prevention of cardiovascular disease. Cochrane Database Syst Rev, 2013(8): p. CD009825.

Sherzai, A., et al., Stroke, food groups, and dietary patterns: a systematic review. Nutr Rev, 2012. 70(8): p. 423-35.

Kastorini, C.M., et al., Mediterranean diet and coronary heart disease: is obesity a link? - A systematic review. Nutr Metab Cardiovasc Dis, 2010. 20(7): p. 536-51.

Sofi, F., et al., Accruing evidence on benefits of adherence to the Mediterranean diet on health: an updated systematic review and meta-analysis. Am J Clin Nutr, 2010. 92(5): p. 1189-96.

Tyrovolas, S. and D.B. Panagiotakos, The role of Mediterranean type of diet on the development of cancer and cardiovascular disease, in the elderly: a systematic review. Maturitas, 2010. 65(2): p. 122-30.

Mente, A., et al., A systematic review of the evidence supporting a causal link between dietary factors and coronary heart disease. Arch Intern Med, 2009. 169(7): p. 659-69.

Roman, B., et al., Effectiveness of the Mediterranean diet in the elderly. Clin Interv Aging, 2008. 3(1): p. 97-109.

Van Horn, L., et al., The evidence for dietary prevention and treatment of cardiovascular disease. J Am Diet Assoc, 2008. 108(2): p. 287-331.

Sofi, F., et al., Adherence to Mediterranean diet and health status: meta-analysis. BMJ, 2008. 337: p. a1344.

Hooper, L., Primary prevention of CVD: diet and weight loss. BMJ Clin Evid, 2007. 2007.

Serra-Majem, L., B. Roman, and R. Estruch, Scientific evidence of interventions using the Mediterranean diet: a systematic review. Nutr Rev, 2006. 64(2 Pt 2): p. S27-47.

Panagiotakos, D.B., et al., Can a Mediterranean diet moderate the development and clinical progression of coronary heart disease? A systematic review. Med Sci Monit, 2004. 10(8): p. RA193-8.

CHOLESTEROL

Health effects of olive oil and the mediterranean diet

CHOLESTEROL & BLOOD LIPIDS

EFFECT SIZE

"Olive oil consumption decreased total cholesterol (TC), LDL cholesterol (LDL-C), and triglycerides (TG) significantly less than other plant oils, and increased HDL cholesterol (HDL-C) significantly more than other plant oils."

Ghobadi, S., et al., Comparison of blood lipid-lowering effects of olive oil and other plant oils: A systematic review and meta-analysis of 27 randomized placebo-controlled clinical trials. Crit Rev Food Sci Nutr, 2018: p. 1-15.

What is the effect?

- Decreased LDL-c
- Increased HDL-c
- Decreased Total Cholesterol
- Decreased Triglycerides

WHAT IS THE QUALITY OF THE EVIDENCE?

10 grams of olive oil per day

Compared to another plant oil as the control

27 Random controlled trials

At least 2 weeks duration

To view the full results, visit: olivewellnessinstitute.org

KEY RESULTS

No effect for Apolipoprotein A (Apo A) or Apolipoprotein B (Apo B)

INCREASE IN HDL-C:

olive oil increased HDL-c significantly more vs. all other plant oils (weighted mean difference [WMD] = 1.37 mg/dl: 95% CI: 0.4, 2.36; P = 0.007) (n = 26 studies)

DECREASED LDL-C:

olive oil decreased LDL-c significantly less vs. other plant oils (WMD= 4.2 mg/dl: 95% CI: 1.4, 7.01; P = 0.003) (24 studies)

DECREASED TOTAL CHOLESTEROL:

olive oil decreased TC significantly less vs. other plant oils (WMD= 6.27 mg/dl: 95% CI: 2.8, 10.6; P = 0.001) (26 studies)

DECREASED TRIGLYCERIDES:

olive oil decreased TG significantly less vs. other plant oils (WMD = 4.31 mg/dl: 95% CI: 0.5, 8.12; P = 0.03) (25 studies) (n = 26 studies)

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CHOLESTEROL

WHAT TO KEEP IN MIND?

Limitations

- The diets consumed during intervention were not controlled and constant among all interventions, with many studies not reporting its energy and macronutrient composition.

WHAT'S THE BOTTOM LINE?

Olive oil was less potent in lowering TC, LDL-C, and TG than other plant oils.

This difference was more evident for PUFAs- rich oils, especially n-3 rich ones. However, time was an important variable. The differences in reduction of TC, LDL-C, and TG compared to other plant oils were not evident in interventions with durations higher than 30 days. Olive oil increased HDL-cholesterol to a greater extent than other plant oils, including in studies longer than 30 days.

OTHER REVIEWS

George, E.S., et al., The effect of high-polyphenol extra virgin olive oil on cardiovascular risk factors: a systematic review and meta-analysis. Crit Rev Food Sci Nutr, 2018: p. 1-138.

Hohmann, C.D., et al., Effects of high phenolic olive oil on cardiovascular risk factors: A systematic review and meta-analysis. Phytomedicine, 2015. 22(6): p. 631-40.

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Serra-Majem, L., B. Roman, and R. Estruch, Scientific evidence of interventions using the Mediterranean diet: a systematic review. Nutr Rev, 2006. 64(2 Pt 2): p. S27-47.

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COGNITIVE HEALTH

Health effects of olive oil and the mediterranean diet

COGNITIVE HEALTH & IMPAIRMENT

EFFECT SIZE

> "A Mediterranean diet reduced the risk of cognitive impairment and dementia, and was associated with improved cognitive functioning."

Petersson, S.D. and E. Philippou, Mediterranean Diet, Cognitive Function, and Dementia: A Systematic Review of the Evidence. Adv Nutr, 2016. 7(5): p. 889-904.

What is the effect?

Possible protective effect for Dementia

Possible protective effect for Cognitive Impairment

To view the full results, visit:

olivewellnessinstitute.org

WHAT IS THE QUALITY OF THE EVIDENCE?

Cognitive function

or cognitive decline (e.g. dementia)

Outcomes measured

5 Random controlled trials

as well as 27 observational studies

KEY RESULTS

DEMENTIA:

6 of 9 studies (2 of 2 cross-sectional and 4 of 7 longitudinal studies found a protective effect, and the other 3 studies did not find a significant association.

COGNITIVE IMPAIRMENT:

7 of 10 studies (3 of 4 cross-sectional, 3 of 5 longitudinal and 1 of 1 RCT) found the Mediterranean diet to be protective, and the other 3 studies did not find a significant association.

NO EFFECT FOR DIASTOLIC BLOOD PRESSURE

(e.g. global cognition and verbal ability): 18 of 23 studies (2 of 3 cross-sectional, 12 of 15 longitudinal and 4 of 5 RCTs) found a significant association for at least one measure, whilst the remaining 5 studies found no significant associations.

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COGNITIVE HEALTH

WHAT TO KEEP IN MIND? Limitations

- Different cognitive function tests were used between studies, making the findings difficult to compare.
- Most studies were observational and did not adjust for important confounders.
- Given that many participants showed signs of memory impairment, the retrospective studies and the use of a Food Frequency questionnaire could give a distorted account of foods eaten.
- It is unclear whether the Mediterranean diet is protective as a whole or through the action of its individual components.
- The same adherence score to a Mediterranean diet can mean a high and low consumption of different foods.
- Nine studies included participants <65 years of age, which could make cognitive decline harder to detect.
- The type of tool used to measure adherence to a Mediterranean diet varied between studies, and 7 studies modified the Mediterranean diet score, which diverges from the traditional Mediterranean diet.

WHAT'S THE BOTTOM LINE?

A Mediterranean diet may improve cognitive performance and be protective for cognitive impairment and dementia; although the majority of the evidence is observational without adjusting for confounders.

More RCTs and large epidemiological studies adjusted for confounders are needed in order to strengthen the empirical evidence for the role of the Mediterranean Diet in cognitive function, as well as the roles of the individual dietary components.

OTHER REVIEWS

Dinu, M., et al., Mediterranean diet and multiple health outcomes: an umbrella review of meta-analyses of observational studies and randomised trials. Eur J Clin Nutr, 2018. 72(1): p. 30-43.

Nowson, C.A., et al., The Impact of Dietary Factors on Indices of Chronic Disease in Older People: A Systematic Review. J Nutr Health Aging, 2018. 22(2): p. 282-296.

Radd-Vagenas, S., et al., Effect of the Mediterranean diet on cognition and brain morphology and function: a systematic review of randomized controlled trials. Am J Clin Nutr, 2018. 107(3): p. 389-404.

Aridi, Y.S., J.L. Walker, and O.R.L. Wright, The Association between the Mediterranean Dietary Pattern and Cognitive Health: A Systematic Review. Nutrients, 2017. 9(7).

Knight, A., J. Bryan, and K. Murphy, The Mediterranean diet and age-related cognitive functioning: A systematic review of study findings and neuropsychological assessment methodology. Nutr Neurosci, 2017. 20(8): p. 449-468.

Loughrey, D.G., et al., The Impact of the Mediterranean Diet on the Cognitive Functioning of Healthy Older Adults: A Systematic Review and Meta-Analysis. Adv Nutr, 2017. 8(4): p. 571-586.

Masana, M.F., et al., n-3 Fatty acids, Mediterranean diet and cognitive function in normal aging: A systematic review. Exp Gerontol, 2017. 91: p. 39-50.

Solfrizzi, V., et al., Relationships of Dietary Patterns, Foods, and Micro- and Macronutrients with Alzheimer's Disease and Late-Life Cognitive Disorders: A Systematic Review. J Alzheimers Dis, 2017. 59(3): p. 815-849.

Wu, L. and D. Sun, Adherence to Mediterranean diet and risk of developing cognitive disorders: An updated systematic review and meta-analysis of prospective cohort studies. Sci Rep, 2017. 7: p. 41317.

Yusufov, M., L.L. Weyandt, and I. Piryatinsky, Alzheimer's disease and diet: a systematic review. Int J Neurosci, 2017. 127(2): p. 161-175.

Cao, L., et al., Dietary Patterns and Risk of Dementia: a Systematic Review and Meta-Analysis of Cohort Studies. Mol Neurobiol, 2016. 53(9): p. 6144-6154.

Hardman, R.J., et al., Adherence to a Mediterranean-Style Diet and Effects on Cognition in Adults: A Qualitative Evaluation and Systematic Review of Longitudinal and Prospective Trials. Front Nutr, 2016. 3: p. 22.

Petersson, S. and E. Philippou, The effects of Mediterranean Diet on cognitive function and dementia: Systematic review of the evidence. Clin Nutr ESPEN, 2016. 13: p. e67.

Singh, B., et al., Association of Mediterranean diet with mild cognitive impairment and Alzheimer's disease: a systematic review and meta-analysis. J Alzheimers Dis, 2014. 39(2): p. 271-82.

Lourida, I., et al., Mediterranean diet, cognitive function, and dementia: a systematic review. Epidemiology, 2013. 24(4): p. 479-89.

Opie, R.S., R.A. Ralston, and K.Z. Walker, Adherence to a Mediterranean-style diet can slow the rate of cognitive decline and decrease the risk of dementia: a systematic review. Nutrition & Dietetics 2013. 70(3): p. 206-217.

Psaltopoulou, T., et al., Mediterranean diet, stroke, cognitive impairment, and depression: A meta-analysis. Ann Neurol, 2013. 74(4): p. 580-91.

Shah, R., The role of nutrition and diet in Alzheimer disease: a systematic review. J Am Med Dir Assoc, 2013. 14(6): p. 398-402.

Sofi, F., et al., Accruing evidence on benefits of adherence to the Mediterranean diet on health: an updated systematic review and meta-analysis. Am J Clin Nutr, 2010. 92(5): p. 1189-96.

Roman, B., et al., Effectiveness of the Mediterranean diet in the elderly. Clin Interv Aging, 2008. 3(1): p. 97-109.

Sofi, F., et al., Adherence to Mediterranean diet and health status: meta-analysis. BMJ, 2008. 337: p. a1344.

MENTAL HEALTH

Health effects of olive oil and the mediterranean diet

DEPRESSION & MENTAL HEALTH

EFFECT SIZE

> "Any high diet quality, including a Mediterranean diet specifically, was associated with a reduction in the incidence of depressive symptoms, but a causal relationship is not yet established."

Molendijk, M., et al., Diet quality and depression risk: A systematic review and dose-response meta-analysis of prospective studies. J Affect Disord, 2018. 226: p. 346-354.

What is the effect?

To view the full results, visit: olivewellnessinstitute.org

WHAT IS THE QUALITY OF THE EVIDENCE?

24 different prospective cohorts

Any dietary pattern or food group

29 studies

Systematic literature and meta-analysis

KEY RESULTS

The highest category of adherence to any high quality diet was associated with a lower depression incidence:

HEALTHY/ PRUDENT DIET

was associated with a 23% reduced depression incidence (OR = 0.77; 95% CI 0.69, 0.84; P < 0.001) (12 studies)

MEDITERRANEAN DIET

was associated with a 25% reduced depression incidence (OR = 0.75; 95% CI 0.67, 0.84; P < 0.001) (5 studies)

PRO-VEGETARIAN DIET

was associated with a 22% reduced depression incidence (OR = 0.78; 95% CI 0.64, 0.93; P < 0.001) (1 study)

TUSCAN DIET

was associated with a 36% reduced depression incidence (OR = 0.64; 95% CI 0.51, 0.77; P < 0.05) (1 study)

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MENTAL HEALTH

WHAT TO KEEP IN MIND? Limitations

- There was considerable heterogeneity found.
- The evidence was from observational studies only, precluding causal relationships.
- Potential confounders were not always taken into account.
- Most studies measured dietary habits in a single assessment, while multiple assessments are more accurate over the long-term.
- Studies used different outcome definitions for depression (e.g. a structured interview vs. antidepressant use).
- An association between diet and depression was no longer found when the analyses controlled for baseline subclinical depressive symptoms. This may indicate the association is due to reverse causation (i.e. persons with less depression are more likely to follow a healthy diet) but, on the other hand, correcting for baseline depressive symptoms could also be an overcorrection, since it may result in cancelling out the effects that the persons diet had in the years before the study started.

WHAT'S THE BOTTOM LINE?

Adherence to high quality diets – regardless whether it was a healthy/ prudent, Mediterranean, pro-vegetarian, or Tuscan diet – was associated with a lower incidence of depressive symptoms in a linear, dose-response fashion.

Adherence to a diet with a low inflammatory index was associated with a lower incidence of depression, suggesting that this may be an important mechanism of action. Adherence to low quality diets and food groups was not associated with higher depression incidence. Further research is needed to establish if these relationships are causal.

OTHER REVIEWS

Rahe, C., M. Unrath, and K. Berger, Dietary patterns and the risk of depression in adults: a systematic review of observational studies. Eur J Nutr, 2014. 53(4): p. 997-1013.

Psaltopoulou, T., et al., Mediterranean diet, stroke, cognitive impairment, and depression: A meta-analysis. Ann Neurol, 2013. 74(4): p. 580-91.

Sanhueza, C., L. Ryan, and D.R. Foxcroft, Diet and the risk of unipolar depression in adults: systematic review of cohort studies. J Hum Nutr Diet, 2013. 26(1): p. 56-70.

Quirk, S.E., et al., The association between diet quality, dietary patterns and depression in adults: a systematic review. BMC Psychiatry, 2013. 13: p. 175.

Roman, B., et al., Effectiveness of the Mediterranean diet in the elderly. Clin Interv Aging, 2008. 3(1): p. 97-109.

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TYPE 2 DIABETES

Health effects of olive oil and the mediterranean diet

TYPE 2 DIABETES

(PREVENTION AND MANAGEMENT)

EFFECT SIZE

> "High olive oil intake was associated with a decreased risk of T2D and improved glucose metabolism in persons with T2D."

Schwingshackl, L., et al., Olive oil in the prevention and management of type 2 diabetes mellitus: a systematic review and meta-analysis of cohort studies and intervention trials. Nutr Diabetes, 2017. 7(4): p. e262.

What is the effect?

16% reduced risk of T2D

Improved glycemic control in persons with T2D

To view the full results, visit:

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WHAT IS THE QUALITY OF THE EVIDENCE?

4 prospective cohort studies

Low quality for T2D risk

29 Random controlled trials

Moderate quality evidence for T2D risk

KEY RESULTS

T2D RISK:

Highest vs. lowest category of olive oil use reduced the risk of T2D by 16%

(RR = 0.84; 95% CI: -0.77 to -0.92; P<0.01) (5 studies)

GLYCEMIC CONTROL: HBA1C

Olive oil resulted in a reduction in HbA1c vs. the control group

(Mean difference = -0.27%; 95% CI -0.03 to -0.17; P<0.01) (22 studies)

GLYCEMIC CONTROL: FASTING PLASMA GLUCOSE

Olive oil resulted in a reduction in fasting plasma glucose vs. control group

(Mean difference = -0.44mmol/L; 95% CI -0.66 to -0.22; P<0.01) (25 studies)

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TYPE 2 DIABETES

WHAT TO KEEP IN MIND?

Limitations

- There was considerable heterogeneity in the trial design, with the number of participants ranging from n=6 to n=215, and the trial length ranging from 2 weeks to 4.1 years.
- The type of olive oil was not always specified.
- There were only a small number of cohort studies available to determine the association with T2D risk (4 studies).

WHAT'S THE BOTTOM LINE?

Olive oil reduced T2D risk and improved measures of glycemic control in people with T2D, at clinically significant levels.

Since improvements in these outcomes have previously been described in individuals adhering to a Mediterranean diet, olive oil may be an important mediating factor in this dietary pattern.

OTHER REVIEWS

Dinu, M., et al., Mediterranean diet and multiple health outcomes: an umbrella review of meta-analyses of observational studies and randomised trials. Eur J Clin Nutr, 2018. 72(1): p. 30-43.

Dow, C., et al., Diet and risk of diabetic retinopathy: a systematic review. Eur J Epidemiol, 2018. 33(2): p. 141-156.

Jannasch, F., J. Kroger, and M.B. Schulze, Dietary Patterns and Type 2 Diabetes: A Systematic Literature Review and Meta-Analysis of Prospective Studies. J Nutr, 2017. 147(6): p. 1174-1182.

Emadian, A., et al., The effect of macronutrients on glycaemic control: a systematic review of dietary randomised controlled trials in overweight and obese adults with type 2 diabetes in which there was no difference in weight loss between treatment groups. Br J Nutr, 2015. 114(10): p. 1656-66.

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Koloverou, E., et al., The effect of Mediterranean diet on the development of type 2 diabetes mellitus: a meta-analysis of 10 prospective studies and 136,846 participants. Metabolism, 2014. 63(7): p. 903-11.

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Esposito, K., et al., Prevention and control of type 2 diabetes by Mediterranean diet: a systematic review. Diabetes Res Clin Pract, 2010. 89(2): p.97-102.

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Kastorini, C.M. and D.B. Panagiotakos, Dietary patterns and prevention of type 2 diabetes: from research to clinical practice; a systematic review. Curr Diabetes Rev, 2009. 5(4): p. 221-7.

INFLAMMATION

Health effects of olive oil and the mediterranean diet

INFLAMMATION

EFFECT SIZE

"Evidence from randomised controlled trials shows olive oil exerts beneficial effects on markers of inflammation and endothelial function."

Schwingshackl, L., M. Christoph, and G. Hoffmann, Effects of Olive Oil on Markers of Inflammation and Endothelial Function-A Systematic Review and Meta-Analysis. Nutrients, 2015. 7(9): p. 7651-75.

What is the effect?

No significant effect for TNF-α or Adiponectin

No significant effect for ICAM-1 or VCAM-1

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WHAT IS THE QUALITY OF THE EVIDENCE?

markers
of inflammation and endothelial function

Diets containing olive oil

28 Random controlled trials

Systematic literature and meta-analysis

KEY RESULTS

The olive oil intervention resulted in:

REDUCTION IN CRP	REDUCTION IN IL-6	INCREASE IN FMD	REDUCTION IN SE-SELECTIN
Mean difference = -0.64; 95% CI -0.96 to -0.31; P<0.0001 (15 studies)	Mean difference = -0.29; 95% CI -0.7 to -0.02; P<0.04 (7 studies)	Mean difference = 0.76; 95% CI 0.27 to 1.24; P<0.002 (8 studies)	Mean difference = -3.16; 95% CI -4.07 to -2.25; P<0.00001 (2 studies)

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INFLAMMATION

WHAT TO KEEP IN MIND?

Limitations

- There was considerable amount of heterogeneity between studies e.g., the length of intervention, amount and type of olive oil used, classification of control and the number of participants.
- Some studies prescribed the intake of olive oil in addition to a baseline
- Mediterranean diet that already consisted of olive oil, which means the absolute quantity of olive oil consumed could not be determined.

WHAT'S THE BOTTOM LINE?

Markers of inflammation (CRP, IL-6) and endothelial function (FMD, sE-Selectin) were improved following interventions with olive oil.

These markers are generally regarded to influence CVD risk and may help to explain the cardio-protective associations of olive oil in observational studies.

OTHER REVIEWS

Mayr, H.L., et al., Mediterranean-type diets and inflammatory markers in patients with coronary heart disease: a systematic review and meta-analysis. Nutr Res, 2018. 50: p. 10-24.

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METABOLIC SYNDROME

Health effects of olive oil and the mediterranean diet

METABOLIC SYNDROME

EFFECT SIZE

"The Mediterranean diet was inversely associated with metabolic syndrome, although the data are limited and come mostly from cross-sectional studies."

Godos, J., et al., Adherence to the Mediterranean diet is inversely associated with metabolic syndrome occurrence: a meta-analysis of observational studies. Int J Food Sci Nutr, 2017. 68(2): p. 138-148.

What is the effect?

Decreased risk of Metabolic Syndrome with a Mediterranean Diet

To view the full results, visit:

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WHAT IS THE QUALITY OF THE EVIDENCE?

Occurrence or risk of

metabolic syndrome

Adherence to a Mediterranean diet

12 observational studies

Systematic literature and meta-analysis

KEY RESULTS

METABOLIC SYNDROME:

The highest adherence to a Mediterranean diet was associated with a 19% decreased risk compared to the lowest adherence (RR: 0.81, 95%CI: 0.71, 0.92) (12 studies).

The protective association was found in both cross-sectional and prospective studies.

INDIVIDUAL COMPONENTS OF THE METABOLIC SYNDROME

(4 studies): High adherence to the Mediterranean diet:

Reduced the risk of high waist circumference (RR = 0.82, 95%CI 0.70, 0.96).

Reduced the risk of high blood pressure (RR = 0.87, 95%CI 0.77, 0.97).

Reduced risk of low HDL-C levels (RR = 0.87, 95%CI 0.77, 1.00).

Null results for triglycerides.

Null results for blood glucose.

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METABOLIC SYNDROME

WHAT TO KEEP IN MIND?

Limitations

- All studies were observational, precluding a causal relationship.
- There was evidence of heterogeneity across the studies.
- There were different dietary scores used to evaluate the adherence to the Mediterranean diet, which may introduce bias.
- Individuals labelled as "highly adherent" to the Mediterranean diet may still have very different dietary patterns with respect to food groups, depending on their geographical region.

WHAT'S THE BOTTOM LINE?

A Mediterranean dietary pattern was associated with a 19% reduced risk of Metabolic syndrome, but the available evidence is limited, coming mostly from cross-sectional studies.

More research from prospective cohorts and clinical trials are required to better understand the association.

OTHER REVIEWS

Garcia, M., et al., The Effect of the Traditional Mediterranean-Style Diet on Metabolic Risk Factors: A Meta-Analysis. Nutrients, 2016. 8(3): p. 168.

Ahluwalia, N., et al., Dietary patterns, inflammation and the metabolic syndrome. Diabetes Metab, 2013. 39(2): p. 99-110.

Esposito, K., et al., Mediterranean diet and metabolic syndrome: an updated systematic review. Rev Endocr Metab Disord, 2013. 14(3): p. 255-63.

Kastorini, C.M., et al., The effect of Mediterranean diet on metabolic syndrome and its components: a meta-analysis of 50 studies and 534,906 individuals. J Am Coll Cardiol, 2011. 57(11): p. 1299-313.

Serra-Majem, L., B. Roman, and R. Estruch, Scientific evidence of interventions using the Mediterranean diet: a systematic review. Nutr Rev, 2006. 64(2 Pt 2): p. S27-47.

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RHEUMATOID ARTHRITIS

Health effects of olive oil and the mediterranean diet

RHEUMATOID ARTHRITIS

EFFECT SIZE

> "There was insufficient evidence to support the use of the Mediterranean Diet for the prevention of rheumatoid arthritis, but it may provide some benefit for the progression of rheumatoid arthritis."

Forsyth, C., et al., The effects of the Mediterranean diet on rheumatoid arthritis prevention and treatment: a systematic review of human prospective studies. Rheumatol Int, 2018. 38(5): p. 737-747.

What is the effect?

No significant association with risk

Significant improvement in clinical parameters

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WHAT IS THE QUALITY OF THE EVIDENCE?

The risk of developing or progression of

rheumatoid arthritis

Prospective study / clinical trials

2 clinical trials

2 prospective studies

A systematic review

KEY RESULTS

RISK OF DEVELOPING RHEUMATOID ARTHRITIS:

No significant association with the Mediterranean diet (2 of 2 studies found no association).

PROGRESSION OF RHEUMATOID ARTHRITIS:

Significant improvements in clinical parameters including pain, physical functioning, swelling, inflammatory markers and/or morning stiffness was reported from a Mediterranean diet intervention in 2 of 2 clinical trials over 3 to 6 months.

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RHEUMATOID ARTHRITIS

WHAT TO KEEP IN MIND?

Limitations

- Only a small number of studies met the inclusion criteria (4 studies out of 12 full-text articles assessed).
- Both the prospective studies were conducted among Americans, whose general dietary habits differ substantially from a traditional Mediterranean diet, and individuals with the highest adherence score may still not resemble the traditional Mediterranean diet.
- All studies had a moderate to high risk of bias.

WHAT'S THE BOTTOM LINE?

There is a promise for the Mediterranean diet in reducing the progression of rheumatoid arthritis, but no evidence for a role in reducing its risk.

The evidence for both outcomes is limited and more studies are required. Well-designed prospective studies are needed to determine the protective role of a Mediterranean diet in preventing rheumatoid arthritis.

OTHER REVIEWS

Smedslund, G., et al., Effectiveness and safety of dietary interventions for rheumatoid arthritis: a systematic review of randomized controlled trials. J Am Diet Assoc, 2010. 110(5): p. 727-35.

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WEIGHT

Health effects of olive oil and the mediterranean diet

WEIGHT AND ANTHROPOMETRIC MEASURES

EFFECT SIZE

"The Mediterranean diet was efficacious for long-term weight loss in overweight or obese individuals compared with low-fat diets, but not compared with other diets (a low carbohydrate diet or the American Diabetes Association diet)."

Mancini, J.G., et al., Systematic Review of the Mediterranean Diet for Long-Term Weight Loss. Am J Med, 2016. 129(4): p. 407-415 e4.

What is the effect?

- Reduction in body weight and BMI
- Reduction in waist circumference

To view the full results, visit:

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WHAT IS THE QUALITY OF THE EVIDENCE?

Primary outcomes measured:

weight loss, BMI, waist circumference

Overweight or obese adults, trying to lose weight

5 Random controlled trials

Mediterranean diet and weight loss over 12 months or more

KEY RESULTS

A Mediterranean diet at 12 months resulted in:

REDUCTION IN BODY WEIGHT =

range of 3.8 to 10.1 kg weight loss vs. pre-intervention.

Significant vs. low-fat diet in 3 of 3 RCTs

Not significant vs. other diets in 2 of 2 RCTs

REDUCTION IN BMI =

mean range of -1.0 to -3.3 kg/m2 decrease vs. pre-intervention

REDUCTION IN WAIST CIRCUMFERENCE =

mean range of -3.5 to -9.3 cm lost vs. pre-intervention

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WEIGHT

WHAT TO KEEP IN MIND?

Limitations

- Only 5 RCTs were included.
- Heterogeneity in design, population, and comparator meant the authors were unable to statistically pool the data across trials.
- 90% of included participants had established cardiovascular disease or type 2 diabetes, meaning the generalisability of the results to the general population with overweight or obesity who are otherwise healthy is unclear.

WHAT'S THE BOTTOM LINE?

The Mediterranean diet resulted in weight loss and a reduction in BMI and waist circumference over the longer-term in overweight or obese individuals.

It was more efficacious than a low fat diet, but not compared to other diets.

OTHER REVIEWS

Anton, S.D., et al., Effects of Popular Diets without Specific Calorie Targets on Weight Loss Outcomes: Systematic Review of Findings from Clinical Trials. Nutrients, 2017. 9(8).

Bendall, C.L., et al., Central obesity and the Mediterranean diet: A systematic review of intervention trials. Crit Rev Food Sci Nutr, 2017: p. 1-15.

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Buckland, G., A. Bach, and L. Serra-Majem, Obesity and the Mediterranean diet: a systematic review of observational and intervention studies. Obes Rev, 2008. 9(6): p. 582-93.

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