Mediterranean Eating Pattern

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IN BRIEF The Mediterranean-style eating pattern (MEP) has long been touted as a healthful way of eating. However, the health benefits of the eating pattern and key elements contributing to those benefits are still being researched. In people with type 2 diabetes, the majority of studies report that the MEP improves glycemic control and cardiovascular risk factors. In people at risk for diabetes, the majority of studies report a protective effect of the MEP against the development of type 2 diabetes. Although more research is needed to determine whether study results can be achieved outside the Mediterranean geographical region, and especially in the United States, the high-quality individual foods and combinations of foods included in the MEP can be recommended as a healthful eating approach.

The Mediterranean-style eating pattern (MEP) has been of interest since the 1950s, when research conducted by Dr. Ancel Keys found that individuals living in the Mediterranean region of the world had lower rates of coronary heart disease (CHD) (1). More recent studies continue to demonstrate benefits of the MEP on reducing cardiovascular events (2) and improving survival from CHD (3). Health benefits of the MEP also include improvements in glycemic control and reductions in the incidence of type 2 diabetes (4). The MEP was included in the most recent American Diabetes Association (ADA) nutrition position statement (5) and was also included in a joint scientific statement from the ADA and the American Heart Association (6) because of the level of evidence (B-level) supporting its ability to improve glycemic control and cardiovascular risk factors.

Before delving into the research on the benefits of the MEP, it is important to understand the complexity of this eating pattern. There is no one MEP; rather, there are many definitions of MEP as practiced in the 18 countries that border the Mediterranean Sea. However, all of these countries have eating patterns focused on high-quality food choices and limited processed foods. Eating patterns that traditionally have been considered MEPs have the following common characteristics, which individually or in combination improve cardiometabolic health (7,8):

- Plant-based: abundant in fruits and vegetables; breads and other forms of cereals; and beans, nuts and seeds
- Minimally processed: originally, the MEP was an eating pattern of the poor and, as such, it includes locally grown, seasonally fresh foods
- Limited sweets: fresh fruits are the typical daily dessert, with sweets based on nuts and made with olive oil
- High-quality fats: olive oil is the primary source of fat, and total intake is moderate (30%) to high (40%) of total energy intake

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TABLE 1. Outcomes From Implementation of the MEP in People With Diabetes

Study	Population/Study Duration (Completion Rate)	Interventions (Type of Study)	Reported Dietary Intake	Outcome
Toobert, 2003 (11)	*n* = 279 women with type 2 diabetes/ 6 months (88%)	MLP vs. UC (RCT)	Not reported	MLP vs. UC: A1C ↓ 0.4% vs. no change (SS); BMI ↓ 0.37 vs ↑ 0.2 kg/m^2 (SS); lipids: NS changes
Esposito, 2009 (9)	*n* = 215 people with newly diagnosed type 2 diabetes/ 4 years (57%)	Low-CHO (<50% kcal) MEP vs. LF diet (<30% kcal); 1,500 kcal/day for women, 1,800 kcal/ day for men (RCT)	MEP: CHO intake 41–44% kcal; LF: CHO intake 51–54% kcal	MEP vs. LF (4-year): A1C ↓ 0.9 vs. ↓ 0.5% (SS); ↑ insulin sensitivity, ↑ HDL-C, ↓ TG, all SS; diabetes medications 40 vs. 70%, SS; no weight difference
Ellhayany, 2010 (10)	*n* = 259 people with type 2 diabetes/ 12 months (75%)	Low-CHO (35% kcal) MEP vs. Trad MEP (50–55% CHO) vs. 2003 ADA (50% CHO); 20 kcal/kg (RCT)	Mean reported kcal similar (~2,300 kcal); CHO: ADA 45.4%, Trad 45.2%, Low-CHO 41.9%	Mean weight loss 8.3 kg (NS between groups); A1C: Low-CHO ↓ 2 vs. ADA ↓ 1.6% (SS); HDL ↑ 3.9 mg/dL (SS); TG and LDL-C: all SS ↓
Itsiopoulos, 2011 (12)	*n* = 27 people with type 2 diabetes/2 weeks on each diet (100%)	Ad libitum MEP vs. usual diet (crossover RCT)	Not reported	MEP: A1C ↓ from 7.1 to 6.8% (SS); NS difference in weight and lipids
Toobert, 2011 (13)	*n* = 280 Latina women with type 2 diabetes/ 24 months (61.4%)	MLP (cultural adaptation of program in Toobert, 2003 (11) vs. UC (RCT)	Not reported	MLP and UC: NS changes in A1C and CHD risk score

CHO, carbohydrate; HDL-C, HDL cholesterol; LDL-C, LDL cholesterol; LF, low fat; NS, nonsignificant; RCT, randomized clinical trial; SS, statistically significant; TG, triglycerides; Trad, traditional; UC, usual care.

- Low to moderate dairy intake: mainly cheese and yogurt
- Protein: red meats and eggs are consumed in small amounts and with low frequency; seafood intake varies, with moderate amounts of fish; traditionally, this was primarily a function of a country's distance from the sea
- Alcohol: wine is consumed in low to moderate amounts with meals
- Herbs and spices: used instead of salt to add flavor to foods

Recent interest in the MEP has aligned with a focus on high-quality foods and eating patterns that are lower in carbohydrate. As a result, two researchers added low-carbohydrate (<50% of daily calories) to the definition of MEP used in their studies (given the high intake of monounsaturated fats and lower intake of saturated fats) (9,10). However, in one of these studies (9), actual average carbohydrate intake reported over a 4-year time period was ~44% of total kcal. This is similar to what people with diabetes in the United States report: an average of ~45% of daily calories from carbohydrate, which is considered moderate carbohydrate intake (5).

Benefits of the MEP in Diabetes Management

In people with type 2 diabetes, the MEP is reported to improve glycemic control and cardiovascular disease (CVD) risk factors (4,6). Table 1 summarizes studies on the MEP (9–13). These studies were a minimum of 12 weeks in length and conducted only in subjects with type 2 diabetes. No studies have been reported in people with type 1 diabetes.

Two studies implementing the MEP were performed outside of the Mediterranean region. The first was a Mediterranean Lifestyle Program (MLP; *n* = 163) compared to usual care (*n* = 116) in postmenopausal women (11). The MLP included an MEP low–saturated fat diet, stress management training, exercise, group support, and smoking cessation. The program was delivered by a team of health professionals and included a 2.5-day retreat, followed by 4-hour weekly meetings for 6 months. Although the participants were taught an MEP, of equal importance was the emphasis on physical activity, stress management, and group support. In the 6-month follow-up, improvements in glycemic control, BMI, and quality of life and a nonsignificant change in lipids versus usual care were reported. The second was a cultural adaptation

of the MLP called ¡Viva Bien!, which was implemented in a diverse sample of Latina women with type 2 diabetes and compared to usual care (13). There were no significant improvements in A1C or weight in either group at 24 months. However, there were improvements in some psychosocial outcomes in the MLP group.

Individuals following an energy-restricted MEP experienced improvements in glycemic control and some CVD risk factors (9,10). In an additional 2-year follow-up (14) to the previous 4-year follow-up (9), a higher rate of diabetes remission and delayed need for diabetes medication was also reported from the MEP compared to the low-fat diet (14).

Of interest is a 2015 meta-analysis of MEP eating patterns (15). The meta-analysis included nine studies with 1,178 people with diabetes (five of these studies are included in Table 1; the other four were <12 weeks or not specific to diabetes). Compared to control diets, the MEP led to significantly greater reductions of A1C (mean difference ~0.3%). Although significant, changes in the following were small: fasting insulin (–0.55 µU/mL), body weight (–0.29 kg), total cholesterol (–5.4 mg/dL), triglycerides (–25.7 mg/dL), and HDL cholesterol (+2.3 mg/dL).

Prevention of Diabetes

The MEP is also reported to have a protective effect against the development of type 2 diabetes. A meta-analysis identified one clinical trial and nine prospective cohort studies with 136,846 participants from various regions of the world that have evaluated the effect of the MEP and prevention of type 2 diabetes (16). Higher adherence to the MEP was associated with a 23% reduced risk of developing diabetes irrespective of geographical region but seemed to be more prominent among participants with previous gestational diabetes and those at high risk for CVD or diabetes.

In contrast, a study published in 2016 examined the association between a modified MEP and cardiorespiratory fitness in young adulthood and the odds of developing prediabetes or diabetes by middle age in the CARDIA study (17). Participants (n = 3,358) were from four U.S. study centers. The authors reported that a higher cardiorespiratory fitness in young adulthood, but not the modified MEP, was associated with lower odds of prediabetes or diabetes 25 years later. The modified MEP was not statistically significant for lowering the odds of prediabetes or diabetes after controlling for fitness.

Of importance are two studies conducted in Spain (18,19). In the PREDIMED-Reus (Prevención con Dieta Mediterránea-Reus) nutrition intervention randomized trial, implementation of non–energy-restricted traditional MEPs supplemented with either extra virgin olive oil (1 L/week) or mixed nuts (30 g/day) were compared to a low-fat diet among individuals without diabetes but at high cardiovascular risk (18). After a follow-up of 4 years, when the two MEP groups were combined and compared to the low-fat control group, the incidence of diabetes was reduced by 52%. Diabetes risk reduction occurred in the absence of significant changes in body weight or physical activity. It is encouraging to note that changing foods eaten may substantially reduce diabetes risk even without weight loss.

In a large, prospective cohort study, 13,380 Spanish university graduates without diabetes at baseline were followed for a median of 4.4 years. Participants with the highest adherence to a traditional MEP had the lowest risk of developing diabetes (19). Among participants with the highest adherence to the eating pattern, there was a high prevalence of risk factors for diabetes, such as older age, higher BMI, family history of diabetes, and hypertension; therefore, they would be expected to have a higher incidence of diabetes. However, these higher-risk participants with better adherence to the eating pattern had a lower risk of diabetes, leading the researchers to conclude that the MEP has substantial potential for prevention.

Another meta-analysis evaluated prospective cohort studies with different healthful dietary patterns (MEP and DASH [Dietary Approaches to Stop Hypertension]) and prevention of type 2 diabetes (20). A total of 21,372 cases of diabetes, from 18 studies with 20 cohorts, in four world regions were identified. The risk of diabetes did not appreciably change based on geography (United States, Europe, or Asia), the duration of follow-up (≤10 or >10 years), or type of diet. The researchers concluded that both the MEP and DASH eating patterns are equally and consistently associated with a 20% reduced risk of future type 2 diabetes.

Possible Mechanisms for MEP Benefits

Research on the MEP suggests that it has many cardiometabolic benefits. However, the reason for these benefits is complex. Research on the characteristics of the MEP suggests that the benefits are derived (in descending order) from plant foods (vegetables, fruit, nuts, and legumes), alcohol intake, and reduced meat consumption (21). Of note in this study, olive oil was not captured in the results. Other studies suggest that benefits are derived from key fat sources, such as alpha-linolenic acid (3) or olive oil and nuts (2,8). The benefits may be a result of individual foods or the combination of foods (8). Eating more high-quality foods (e.g., fruits, vegetables, whole grains, olive oil, and seafood) may reduce inflammation and result in improved insulin sensitivity in the peripheral tissues and improved endothelial function at the vascular level (4). Many of the individual foods also have benefits. For example, research suggests that both quality and quantity of carbohydrate and fat matter in relationship to postprandial glucose response, in

particular, extra virgin olive oil, may attenuate the early postprandial glucose response observed when a meal has a high glycemic index (22). More research is needed to further define the individual or synergistic effects of the components of the MEP.

Real-World Implementation of the MEP

As noted in the 2013 ADA nutrition therapy recommendations, MEP studies in people with diabetes have primarily been conducted in the Mediterranean region (5). Thus, several questions remain to be answered: Can the study results be duplicated in other populations with differing cultural food and eating patterns? Can other populations adhere to the eating pattern as consistently as is done in the Mediterranean region? Can individuals with diabetes in the United States adopt the MEP for the long term? Do studies need to control for caloric intake to determine whether energy restriction versus eating pattern is contributing to positive health outcomes? Regardless of these remaining questions, however, it appears that even modifying eating habits to more closely reflect this type of eating pattern would be beneficial and can be encouraged.

Perhaps of primary importance for people with type 2 diabetes is placing emphasis on choosing high-quality food choices and focusing on total energy intake and portion sizes. Evidence from effectiveness studies of nutrition therapy interventions for people with type 2 diabetes strongly supports the importance of reducing energy intake (23). The majority of reported diabetes prevention studies also implemented reduced energy intake. However, eating patterns such as the MEP can also be implemented for healthful eating in a reduced energy eating plan. To accomplish this, similar recommendations exist from a variety of sources (24,25) and include:

- Replace butter and margarine with healthful oils such as olive or canola oil. Use these oils for cooking, dip bread in flavored olive oil, or lightly spread olive oil on whole-grain breads.
- Eat protein foods such as skinless chicken and turkey, fish, beans, nuts, and other plant-based protein sources. Eat fish at least once or twice each week. Fresh or water-packed tuna, salmon, trout, mackerel, and herring are good choices. Substitute fish and poultry for red meat. When red meats are eaten, choose lean cuts and keep portions small (about the size of a deck of cards).
- Aim for three to five servings of vegetables per day.
- Choose whole-grain breads and cereals, as well as whole-grain pasta and rice products.
- Season meals with herbs and spices rather than salt.
- Snack on nuts or seeds instead of snack foods. Keep almonds, cashews, pistachios, and walnuts on hand for quick snacks. Choose natural peanut butter rather than the kind with added hydrogenated fat. Try tahini (sesame seed paste) as a dip or spread for bread.
- Enjoy fruit for dessert.
- Eat small portions of cheese or yogurt.
- If you drink alcohol, limit it to moderate consumption with a meal (no more than one glass for women or two glasses for men).

People with or at risk for diabetes can be reminded that a healthful regimen is as much about lifestyle as diet. Eat well, eat slowly, eat less, eat with others, and savor what you eat. Be physically active. Manage stress. And—very importantly—enjoy life!

Summary

Research has confirmed the health benefits of the MEP for individuals at risk of or with diabetes. The MEP is consistent with nutrition recommendations to choose more high-quality foods and limit foods that are high in sodium, sugar, and unhealthful fats. The real benefits of the MEP may be derived from the synergistic effects of the combination of foods more than from the individual foods eaten. More research is needed on the MEP in populations outside of the Mediterranean region, and a consistent definition and application of the MEP in research would help to ensure comparability of findings across studies.

Duality of Interest

No potential conflicts of interest relevant to this article were reported.

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DASH Eating Plan: An Eating Pattern for Diabetes Management

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IN BRIEF The DASH (Dietary Approaches to Stop Hypertension) eating plan is an acceptable eating pattern for people who have diabetes. In addition to promoting blood pressure control, this eating pattern has been shown to improve insulin resistance, hyperlipidemia, and even overweight/obesity. This balanced approach promotes consumption of a variety of foods (whole grains, fat-free or low-fat dairy products, fruits, vegetables, poultry, fish, and nuts) and is appropriate for the entire family.

The U.S. Department of Agriculture (USDA) has described several food patterns designed to help people follow the recommendations set forth in its Dietary Guidelines. Specifically, three food patterns have been developed: the Healthy U.S.-Style Pattern, the Healthy Vegetarian Pattern, and the Healthy Mediterranean-Style Pattern. The