

Original Article

Adherence to a Mediterranean diet and cardio-metabolic risk in postmenopausal women by body composition

Betül Gülşen Atalay PhD¹, Özlem Özpak Akkuş PhD¹, Yasemin Yapıcı MD²

¹Department of Nutrition and Dietetics, Faculty of Health Sciences Mersin, Toros University, Turkey

²Physical Medicine and Rehabilitation, Mersin City Training and Research Hospital, Mersin, Turkey

Background and Objectives: To evaluate whether cardio-metabolic risk data in obese postmenopausal women are affected by adherence to the Mediterranean diet (MedDiet). **Methods and Study Design:** This cross-sectional study was conducted in 89 pre-obese and obese postmenopausal women (PMW) aged 40-75 years with a Body Mass Index (BMI) value ≥ 25 kg/m². Demographic characteristics, health status, anthropometric measurements, physical activity status, nutritional habits, lipid profile, some biochemical results and cardiovascular risk predictor (CVRP) data were collected by face-to-face interviews. **Results:** In this study, a negative correlation was found between CVRP and a Mediterranean diet score (MEDI-LITE) scores in pre-obese and obese PMW ($p=0.008$, $p=0.02$, respectively). Total cholesterol levels of the obese women were found to be negatively correlated with MEDI-LITE scores ($p=0.002$). VLDL-cholesterol ($p=0.04$, $p=0.008$, respectively) and triglyceride levels ($p=0.002$, $p=0.003$, respectively) of the pre-obese and obese women were negatively correlated with MEDI-LITE scores. According to the logistic regression analysis, the variables affecting CVRP negatively in our study were age, smoking, and salt use, while the variables affecting CVRP positively were MEDI-LITE score and omega-3 fatty acid consumption. **Conclusions:** In this study, it was observed that the increase in the MedDiet adherence score of the pre-obese and obese women in the postmenopausal period had favourable effect on lipid profile and CVRP. It is considered that adhering to the MedDiet in pre-obese and obese PMW can be recommended as an effective strategy to prevent the increased risk of cardiovascular disease due to advanced age, menopause, and high BMI values.

Key Words: postmenopause, cardio-metabolic risk, obesity, MEDI-LITE score, mediterranean diet

INTRODUCTION

One of the main factors increasing morbidity and mortality in the postmenopausal period is the increase in cardiovascular disease incidences. The increase in cardiovascular diseases is partly associated with advancing age and partly with the fact that cardiovascular risk factors are adversely affected by the disappearance of the protective effects of estrogen.¹ Postmenopausal women have higher blood pressure and low-density lipoprotein (LDL) cholesterol levels than men and also they have higher and more often multiple concurrent atherosclerotic risk factors.² Weight gain is one of major concern in this lifespan and it has been reported that menopause is associated to approximately 2 kg of weight gain.³ Although the increase in body mass index (BMI) during this period is probably more related to women's age than to menopause itself, increased abdominal subcutaneous and visceral fat with menopause is associated with an increased incidence of metabolic syndrome, diabetes mellitus, and cardiovascular disease.² In postmenopausal women compared to premenopausal women, it has been observed that there is an increase in total body fat, especially in the distribution of android fat.⁴ During menopause, a decrease in estrogen levels has been associated with the loss of lean body mass and an increase in fat mass.⁵ The longitudinal Study of Women's Health Across the Nation study showed that the

mean lean body mass loss during menopause is 0.5% per year and fat mass increases 1.7% per year.⁶ Body composition changes in this population are associated with an increased risk of coronary heart disease, potentially affecting women's health as a whole. According to data from the National Health and Nutrition Examination Survey (NHANES), participants with low lean body mass and high fat mass have been shown to have the highest risk of mortality due to cardiovascular diseases.⁷ The Framingham heart study evaluated the relationship between the degree of obesity and cardiovascular disease in a total of 5,209 men and women who were followed for 26 years. In this study, it was stated that obesity is an independent risk factor, and it was shown that body weight is a determining factor for the presence of coronary artery disease due to its association with age, blood pressure, smoking, serum cholesterol, and glucose intolerance.⁸ In

Corresponding Author: Dr Betül Gülşen Atalay, Department of Nutrition and Dietetics, Faculty of Health Sciences Mersin, Toros University, Turkey 33140.

Tel: +903243253300; Fax: +903243253301

Email: betul.atalay@toros.edu.tr

Manuscript received 25 October 2021. Initial review completed 15 March 2022. Revision accepted 22 March 2022.

doi: 10.6133/apjcn.202206_31(2).0017

the Framingham heart study, it was reported that the most effective dietary profile in reducing serum cholesterol levels in postmenopausal women was higher intake of plant-derived protein and complex carbohydrates, and less fat intake.⁹

There is a long-held understanding that diet plays an important role in the etiology of many chronic diseases, thus contributing to geographic differences in morbidity and mortality rates caused by chronic diseases in different countries and populations worldwide.¹⁰ Diet can regulate inflammation, a process involved in all stages of atherothrombosis.¹¹ In particular, starting with ecological data in the context of the Seven Countries study in the 1960s, the Mediterranean diet (MedDiet) has long been studied for its potential beneficial effects on a variety of chronic disease outcomes.¹² In a cohort study of elderly people in rural Greece they found that a one unit increase in a diet score, devised a priori on the basis of eight desirable key features of the traditional common diet in the Mediterranean region, was associated with a statistically significant 17 % reduction in overall mortality.¹³ With greater adherence to the MedDiet, various observational studies have demonstrated longer lifespan and good quality of life, as well as reduced mortality and morbidity caused by cardiovascular diseases and other nutrition-related diseases.^{14,15} In a study evaluating the relationship between adherence to the MedDiet and dyslipidemia in a cohort of adults in the Mediterranean area in Italy, it was shown that the incidence of dyslipidemia decreased as the higher adherence to the MedDiet.¹⁶ The essential concept of the MedDiet is that this is not a set of changes to our usual diet dictated by scientific experiments. It is a set of food habits and recipes enjoyed traditionally by the ordinary people of Mediterranean countries who have been found to have lower rates of coronary and other chronic diseases than the most scientifically developed countries, for example, USA, UK and Germany.¹⁷ In the study of Truswell and Noah, in which they evaluated the traditional eating habits of 18 countries with a coast on the Mediterranean, including Turkey, they emphasized that there are differences as well as similarities in the traditional eating habits of the countries, and that nutritionists should consider these differences when defining MedDiet modules.¹⁸ Adherence to the principles of the traditional MedDiet, as operationalized in the diet score used, is likely to be associated with lower overall mortality.¹⁹ The traditional MedDiet involves a high intake of plant-based foods, predominantly fruits and vegetables, cereals and whole grain breads, beans, nuts, and seeds. It includes locally grown, fresh, and seasonal unprocessed foods. While fresh vegetables and fruits are consumed daily and in large amounts, concentrated sugars or honey are consumed in lower amounts several times a week. The MedDiet includes olive oil as the main course ingredient and source of fat, low to moderate amounts of cheese and yogurt, low amounts of red meat and higher amounts of fish, and low to moderate amounts of red wine with main meals.²⁰

In peri- and post-menopausal women, long-term high adherence to MedDiet may reduce cardiovascular risk, and the incidence of cardiovascular events and deaths. Short-term high adherence to MedDiet may improve vasomotor symptoms, improve cardiovascular risk factors such as blood pressure and cholesterol levels.²¹

The aim of this study was to evaluate whether cardio-

metabolic risk data in obese postmenopausal women are affected by adherence to the MedDiet.

METHODS

This cross-sectional study was conducted in a hospital (identifiers were removed for blind peer review) in 89 pre-obese and obese women aged 40-75 years with a BMI score of 25 kg/m² or over, and who were postmenopausal (amenorrhea lasting more than one year). Women who were pregnant and lactating, those with heart failure, chronic kidney failure, and liver disease, those with bowel disease (Crohn's, irritable bowel syndrome, and short bowel syndrome), those not in an age range of 40-75 years, those with BMI <25 kg/m², and those who did not accept to participate in the study were not included. Data were collected using a questionnaire administered via face-to-face interviews. The following data were analyzed: women's demographic characteristics, health status (diagnosed disease, co-morbidities, menopausal status, medicine used), anthropometric measurements (height, weight, BMI), physical activity status, information on nutritional habits, lipid profile and some biochemical results (serum total cholesterol, HDL-cholesterol, LDL-cholesterol, VLDL-cholesterol, triglyceride, vitamin D, calcium, phosphorus, parathyroid hormone (PTH)), and the cardiovascular risk predictor (CVRP) (triglyceride/HDL cholesterol ratio).²²

Women's body weight was measured and recorded with a weighing instrument with an accuracy of ± 0.1 . Women's height was measured and recorded by the dietitian with a stadiometer. While taking height measurements, the women's feet were together and their heads were in the Frankfurt plane (bottom border of the eye and the top border of the ear canal were on the same line).²³ BMI values were calculated with the formula of body weight (kg)/height (m)². According to the ranges determined by the World Health Organization, BMI values were classified as 25-29.9 kg/m² as pre-obese and 30 kg/m² and over as obese.²⁴ In order to determine the food consumption status, one-day food consumption records taken with the 24-hour recall method. Energy and nutritional elements taken with the daily diet were analyzed using the "Computer Assisted Nutrition Program, Nutrition Information Systems Package Program (BEBIS)" developed for the Turkish population. MedDiet adherence were assessed using the Mediterranean diet score (MEDI-LITE), a validated food frequency questionnaire.²⁵ Food consumption frequency and MedDiet adherence as assessed by the MEDI-LITE score, have been widely used, approved, and recommended for use in clinical studies.^{26,27}

With the MEDI-LITE score, daily and weekly food intakes are assessed with nine questions about the foods recommended in the MedDiet. The highest consumption of fruits, vegetables, grains, legumes, fish, and olive oil is expressed with 2 points, the moderate consumption with 1 point, and the lowest consumption with 0 points. On the other hand, 2 points correspond to the lowest consumption of meat and meat products, dairy products and alcohol, while 1 point represents the moderate consumption, and 0 points the highest consumption. The final score obtained ranges from 0 (low adherence to the MedDiet) to

18 (high adherence to the MedDiet). Especially milk and dairy product consumption should not exceed 180 g per day, and meat and meat products should not exceed 80 g per day.²⁶

The type of exercise (endurance, balance, strength and flexibility), frequency (per week, per day), and duration were questioned in determining the physical activity status of the individuals.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The study was approved by the Turkey's Health Ministry (Approval number: 2020-05-19T13_15_24) and Toros University Clinical Research Ethics Committee (Approval number: (≠66, 18/05/2020). Informed consent was obtained from all individual participants included in the study.

Statistical analysis

The data obtained in the study were evaluated with the SPSS 15.0 package program. Appropriate descriptive values are given for qualitative and quantitative variables. Qualitative variables are expressed as numbers (n) and percentage (%), while quantitative variables are expressed as mean and standard deviation ($\bar{X}\pm SD$). The conformity of the variables to the normal distribution was examined using visual (histogram and probability graphs) and analytical methods (Kolmogorov-Smirnov/Shapiro-Wilk tests). Between two independent groups, a difference test between two means (Student's t-test or non-parametric Mann-Whitney-U test) was used for continuous variables, and non-parametric Spearman correlation analysis was used to determine correlations between numerical variables. A logistic regression analysis test was used to evaluate the variables thought to affect the cardiovascular risk factor. A value of $p < 0.05$ was considered statistically significant.

RESULTS

In this study, 46.1% of the postmenopausal women were classified as pre-obese and 53.9% as obese. Demographic and clinical characteristics of the women are shown in Table 1.

There was no statistically significant difference between the cardiovascular risk predictor (CVRP) values of pre-obese and obese women. On the other hand, obese women had higher serum PTH values ($p=0.005$) and lower vitamin D levels ($p=0.01$) than pre-obese women (Table 2).

In order to evaluate the relationship of low vitamin D and high PTH levels with nutritional habits in obese women, the women's 24-hour food consumption data were assessed. In terms of the BMI classification, there was a difference between women in terms of daily energy (kcal/day) ($p=0.001$), carbohydrate (gr/day) ($p=0.002$), and fat (gr/day) ($p=0.001$) intakes, and there was no difference in terms of the consumption of other nutrients (vitamins soluble in fat or water, minerals, fiber, and cholesterol). There was no statistically significant difference between MEDI-LITE scores of the women according to the BMI classification. (Table 2).

When the lipid profile of the women was evaluated, a negative correlation was found between the CVRP values of the pre-obese and obese women and the MEDI-LITE scores ($r=-0.411$, $p=0.008$, $r=0.327$, $p=0.02$, respectively). While the total cholesterol levels of the obese women were negatively correlated with the MEDI-LITE score ($r=-0.443$, $p=0.002$), the VLDL cholesterol levels of the pre-obese and obese women ($r=-0.321$, $p=0.04$, $r=0.379$, $p=0.008$, respectively) and their triglyceride levels ($r=-0.462$, $p=0.002$, $r=0.416$, $p=0.003$, respectively) showed a negative correlation with the MEDI-LITE score. No correlation was found between age, BMI, blood pressure, and biochemical parameter measurements (serum calcium, vitamin D, and PTH) and CVRP values of the women ($p > 0.05$) (Table 3).

According to the logistic regression analysis, the variables affecting CVRP negatively in our study were age,

Table 1. Demographic and clinical results

Variable	Value
Age, (mean±SD), year	55.07±6.14
BMI, (mean±SD) kg/m ²	31.23±4.28 (25.15-44.12)
BMI Classification, kg/m ² (%)	
Pre-obese (25 - < 29.99 kg/m ²)	41 (%46.1)
Obese (≥ 30 kg/m ²)	48 (%53.9)
Systolic blood pressure (mmHg), (mean±SD),	12.78±1.22
Diastolic blood pressure (mmHg), (mean±SD),	8.77±1.08
Current smokers, (%)	1.3
Cigarette (mean±SD), count/day	2.21±6.52
Duration of smoking (mean±SD), year	2.99±8.10
Physically active, (%)	14.6
Activity duration, (mean±SD), hour/week	0.84±2.12
Activity frequency, (mean±SD), day/week	0.21±0.73
Prescription medicine use, (%)	61.8
Family history of heart disease, (%)	57.3
Co-morbidity, n	
Diabetes mellitus	24
Hypertension	13
Other	6

SD: standard deviation.

Table 2. Biochemical parameters and evaluation of nutrient intakes of postmenopausal women

Biochemical parameters	Pre-obese (n=41)	Obese (n=48)	<i>p</i>
BMI (kg/m ²)			
Cardiovascular Risk Predictor (triglyceride/HDL-cholesterol ratio)	3.35±2.89	4.28±3.37	0.06
Total Cholesterol (mg/dL)	206 ±41.9	200±34.6	0.39
LDL Cholesterol (mg/dL)	118±35.7	111±30.5	0.50
HDL Cholesterol (mg/dL)	56.3±14.2	50.9±10.5	0.11
VLDL Cholesterol (mg/dL)	30.9±37.8	18.8±22.7	0.14
Triglyceride (mg/dL)	165±106	194±115	0.15
25(OH)D ₃ (ng/dL)	27±14	19.8±12.3	0.01*
Parathyroid hormone level (pg/mL)	53±23.6	71±30.6	0.005**
Daily consumption of nutrients calculated via 24-hour food consumption			
Energy (kcal/day)	1493±374	1774±390	0.001**
Protein (g/day)	59.4±16.4	63±17.3	0.52
Carbohydrate (g/day)	177±43.1	210±52.4	0.002**
Fat (g/day)	58.2±72.7	21.3±20.6	0.001**
Fiber (g/day)	17.7±8.57	18.6±4.99	0.10
Cholesterol (mg/day)	352±215	375±251	0.93
MEDI-LITE score	10.1±2.01	10.1±1.96	0.79

Mann-Whitney-U test, **p*<0.05, ***p*<0.01.

Table 3. Correlation between the MED-LITE score and lipid profile in postmenopausal women

Variables	Pre-obese (n=41)		Obese (n=48)	
	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>
MEDI-LITE Score				
Cardiovascular Risk Predictor (triglyceride/HDL-cholesterol ratio)	-0.411	0.008**	-0.327	0.02*
Total cholesterol (mg/dL)	-0.009	0.95	-0.443	0.002**
VLDL cholesterol (mg/dL)	-0.321	0.04*	-0.379	0.008**
Triglyceride (mg/dL)	-0.462	0.002**	-0.416	0.003*

Spearman's correlation analyses, **p*<0.05, ***p*<0.01.

smoking, and salt use, while the variables affecting CVRP positively were MEDI-LITE score and omega-3 fatty acid consumption (Table 4).

DISCUSSION

Menopause is a process defined as the permanent end of the menstrual cycle. Estrogen level, which decreases with the end of the menstrual cycle, is also listed among the factors that cause both body weight gain and an increased risk of cardiovascular disease in women.²⁸

In postmenopausal women, with increasing age, there is a decrease in muscle mass and an increase in body fat tissue, and this causes an increase in the prevalence of obesity.²⁹ Although it has been reported in large-scale studies that the main predictor of the increase in body weight and obesity is aging and that menopause has an indirect effect, it has been suggested that decreasing estrogen levels in this period may be associated with increased visceral adipose tissue and cause obesity.^{30,31} In a study conducted by Sowers et al in postmenopausal women for a period of 6 years, it was shown that there was a 10% increase in body fat mass and a 1% decrease in skeletal muscle mass in postmenopausal women compared to their premenopausal periods, after the adjustment for chronological age.³² Obesity is an independent risk factor for cardiovascular diseases. In addition, it is argued in some studies that the decrease in estrogen, which helps to prevent the atherothrombotic process in cardiovascular diseases, may also be a risk factor.³³ However, there exist studies claiming otherwise.^{34,35} In the Framingham heart study, which is one of the important studies evaluating

the risk of cardiovascular disease in obesity, it is emphasized that each 1 kg/m² increase in BMI increases the cardiovascular risk by 7% in postmenopausal women.³⁶ Serum triglyceride and cholesterol values are widely used as predictors of the cardiovascular risk, and generally increased LDL-cholesterol and fasting triglyceride levels are taken as a basis. It is argued that the triglyceride and HDL-cholesterol ratio is a superior atherogenic index compared to other lipid parameters and ratios.²² It was found that 53.9% of the postmenopausal women participating in this study were obese, and 46.1% were pre-obese. The CVRP values of the women in the obese group were higher than the that of the other group; however, this difference was not statistically significant.

In this study, it was determined that, as the BMI value of the individuals participating in the study increased, serum vitamin D levels decreased in accordance with the literature. Obesity, which is an important risk factor for cardiovascular diseases, often occurs together with vitamin D deficiency.³⁷ The relationship between obesity and vitamin D is bidirectional and it is not certain which mechanism affects the other.³⁸ The increased amount of adipose tissue in obesity prevents the activation of vitamin D by increasing the amount of stored vitamin D, and in this case, there is an increase in body weight with the stimulation of lipogenesis caused by the increase in intracellular calcium in adipocytes.³⁹ In a study conducted in obese and pre-obese adults in New Zealand, a relationship was found between decreased serum 25(OH)D₃ level and increased body weight and waist circumference.⁴⁰ Similarly, Lagunova et al conducted a study in 2126 individu-

Table 4. Regression analysis between CVRP and other determinants in postmenopausal women

Variables	Regression analysis (Adjusted R ² value=0.445, <i>p</i> =0.001**)		
	Coeff.	95% CI	<i>p</i>
Age, (year)	0.242	0.223 to 0.027	0.01*
MEDI-LITE score	-0.275	-0.756 to -0.130	0.006**
Smoking, n	0.288	0.859 to 4.304	0.004**
Yes (13)			
No (76)			
Salt consumption behavior, n	0.190	0.074 to 1.281	0.02*
None (18)			
Little use (17)			
Normal use (48)			
Over-use (6)			
Diastolic Blood Pressure, (mmHg), (mean±SD)	-0.193	-1.149 to 0.019	0.06
Comorbidity, n	-0.173	-2.35 to 0.163	0.08
Tea consumption behavior (count/day), n	0.059	-1.44 to 2.92	0.5
None (5)			
1-4 tea cups (47)			
5-10 tea cups (34)			
≥10 tea cups (14)			
Energy, kcal	-1.89	-0.092 to 0.062	0.7
Carbohydrate, g	0.741	-0.268 to 0.361	0.77
Protein, g	0.067	-0.296 to 0.321	0.93
Fat, g	1.777	-0.438 to 0.950	0.46
Omega-3 fat acid, g	-0.243	-1.60 to -0.186	0.01*
Cholesterol, g	0.119	-0.002 to 0.005	0.35
Soluble fiber, g	-0.239	-0.501 to 0.030	0.08
Insoluble fiber, g	0.179	-0.072 to 0.357	0.18

**p*<0.05, ** *p*<0.01.

als and found a negative correlation between BMI values and serum 25(OH)D₃ levels.⁴¹

In this study, according to the logistic regression analysis, it was found that advanced age, smoking, and salt use negatively affected the CVRP values, whereas omega-3 fatty acid consumption positively affected it. Inflammatory, oxidative, thrombotic, and vascular factors play an important role in cardiovascular diseases and lipoprotein metabolism.⁴² Omega-3 fatty acids reduce the risk of cardiovascular disease by lowering plasma triacylglycerols and blood pressure, improving vascular reactivity, and reducing inflammation.⁴³ Observational and clinical studies have shown that consumption of omega-3 fatty acids, which have an anti-inflammatory effect, has a negative effect on cardiovascular risk.^{44,45} Contrary to these studies, it was found that the use of omega-3 fatty acids did not cause a change in the incidence of cardiovascular events in the STRENGTH study, which was conducted in 4 years with participants from different countries.⁴⁶ Smoking is associated with increased levels of multiple inflammatory markers, including C-reactive protein, interleukin-6, and tumor necrosis factor alpha.⁴⁷

The MedDiet is a diet model characterized by consumption of fruits, vegetables, whole grain breads and cereals, legumes, oilseeds, and processed products, reduced consumption of sweet and red meat, increased consumption of fish and olive oil, and moderate consumption of wine.⁴⁸ The MedDiet has lower calories and higher antioxidant content than other diet models.^{49,50} A general analysis of the studies involving individuals consuming the MedDiet shows that the MedDiet prevents obesity,^{51,52} but it is not clear whether this positive effect is due to low calorie intake or the nutrients contained in the di-

et.^{52,53} In this study, it was observed that the MedDiet adherence assessed by MEDI-LITE scores in pre-obese and obese postmenopausal women participating in the study did not differ between the groups (*p*>0.05). This result, which is different from the literature, can be interpreted as the fact that this study is an observational study without energy restriction. In clinical studies, it has been shown that the consumption of these nutrients that make up the MedDiet together and in recommended amounts has a protective effect on cardiovascular diseases by reducing inflammation, which is effective in all atherothrombotic processes, thanks to the high antioxidant content it contains.^{15,54} According to the 5-year-long PREDIMED study, which had a high participation rate and 57% of the participants were postmenopausal women, it was observed that the MedDiet was superior to the low-fat diet in protection against cardiovascular diseases, and it was determined that those who consumed the MedDiet had a lower incidence of cardiovascular disease than those who consumed the low-fat diet.⁵⁵ The Lyon diet heart study showed that increased adherence to the MedDiet is consistently associated with lower cardiovascular risk.⁵⁶ Adherence to the MedDiet has been shown to be associated with lower serum triglyceride, total, and LDL-cholesterol levels in a cross-sectional study and an intervention study in healthy middle-aged women.^{57,58} In another study conducted with postmenopausal women in Sicily, the women participating in the study were taught the MedDiet and cooking methods suitable for this diet, and they were asked to practice it at home for one year. At the end of the study, it was emphasized that women who adopted the MedDiet had a clear tendency towards loss of body weight, a strong decrease in serum chole-

terol levels, and an increase in quality of life.⁵⁹ A systematic review of 30 randomized controlled trials indicated that data on the efficacy of the MedDiet in reducing and managing the risk of cardiovascular disease contained uncertainty in terms of statistical heterogeneity; however, it was emphasized that it is a diet that can be recommended to improve health and reduce the burden of cardiovascular disease in women.⁶⁰ In this study, it was determined that the score of adherence to the MedDiet was negatively correlated with serum triglyceride, total cholesterol, VLDL cholesterol levels, and CVRP, supporting the literature, and it was an important variable that positively affected CVRP according to the logistic regression analysis.

Our study has some limitations that should be acknowledged. First of all, because it is a cross-sectional study, its causality could not be evaluated. Second, we had a small and heterogeneous study population. Randomized controlled studies with more participants are warranted.

Conclusion

In this cross-sectional study, it was seen that the increase in the MedDiet adherence score in pre-obese and obese women in the postmenopausal period had a favourable effect on the lipid profile and the CVRP values. Based on the present results, it is thought that adherence to the MedDiet in pre-obese and obese postmenopausal women can be recommended as an effective strategy to prevent the increased risk of cardiovascular disease caused by advanced age, menopause, and high BMI values.

AUTHOR DISCLOSURES

The authors state no conflict of interest. There are no financial supports provided.

REFERENCES

- Menopause transition and cardiovascular disease risk: Implications for timing of early prevention: A scientific statement from the American Heart Association. *Circulation*. 2020;22;142:e506-32. doi: 10.1161/CIR.0000000000000912.
- Feldman RD. Heart disease in women: Unappreciated challenges, GPER as a new target. *Int J Mol Sci*. 2016;17:760. doi:10.3390/ijms17050760.
- Sowers M, Zheng H, Tomey K, Karvonen-Gutierrez C, Jannausch M, Li X, Yosef M, Symons J. Changes in body composition in women over six years at midlife: ovarian and chronological aging. *J Clin Endocrinol Metab*. 2007;92:895-901. doi: 10.1210/jc.2006-1393.
- Trémollières FA, Pouilles JM, Ribot CA. Relative influence of age and menopause on total and regional body composition changes in post-menopausal women. *Am J Obstet Gynecol*. 1996;175:1594-600. doi: 10.1016/s0002-9378(96)70111-4.
- Rolland YM, Perry HM 3rd, Patrick P, Banks WA, Morley JE. Loss of appendicular muscle mass and loss of muscle strength in young postmenopausal women. *J Gerontol A Biol Sci Med Sci*. 2007;62:330-5. doi: 10.1093/gerona/62.3.330.
- Greendale GA, Sternfeld B, Huang M, Han W, Ruppert K, Cauley JA et al. Changes in body composition and weight during the menopause transition. *JCI Insight*. 2019;4:e124865. doi: 10.1172/jci.insight.124865.
- Srikanthan P, Horwich TB, Tseng CH. Relation of muscle mass and fat mass to cardiovascular disease mortality. *Am J Cardiol*. 2016;117:1355-60. doi: 10.1016/j.amjcard.2016.01.033.
- Hubert HB, Feinleib M, McNamara PM, Castelli WP. Obesity as an independent risk factor for cardiovascular disease: a 26-year follow-up of participants in the Framingham Heart Study. *Circulation*. 1983;67:968-77. doi: 10.1161/01.cir.67.5.968.
- Posner BM, Cupples LA, Miller DR, Cobb JL, Lutz KJ, Agostino RBD. Diet, menopause, and serum cholesterol levels in women: the Framingham Study. *Am Heart J*. 1993;125:483-9. doi: 10.1016/0002-8703(93)90030-d.
- World Health Organization Study Group. Diet, nutrition and the prevention of chronic diseases. WHO Technical Report Series 916. 2003 [cited 2021/09/17]. Available from: http://apps.who.int/iris/bitstream/handle/10665/42665/WHO_TRS_916.pdf;jsessionid=BE8A39E874F7BA0B9648C4555B292C21?sequence=1.
- Eilat-Adar S, Goldbourt U. Nutritional recommendations for preventing coronary heart disease in women: evidence concerning whole foods and supplements. *Nutr Metab Cardiovasc Dis*. 2010;20:459-66. doi: 10.1016/j.numecd.2010.01.011.
- Keys A, Menotti A, Karvonen MJ, Aravanis C, Blackburn C, Dontas AS et al. The diet and 15-year death rate in the Seven Countries Study. *Am J Epidemiol*. 1986;124:903-15. doi: 10.1093/oxfordjournals.aje.a114480.
- Trichopoulos A, Kouris-Blazos A, Wahlqvist ML, Gnardellis C, Lagiou P, Polychronopoulos E et al. Diet and overall survival in elderly people. *BMJ*. 1995;311:1457-60. doi: 10.1136/bmj.311.7018.1457.
- Buckland G, González CA, Agudo A, Vilardell M, Berenguer A, Amiano P et al. Adherence to the Mediterranean diet and risk of coronary heart disease in the Spanish EPIC Cohort Study. *Am J Epidemiol*. 2009;170:1518-29. doi: 10.1093/aje/kwp282.
- Fung TT, Rexrode KM, Mantzoros CS, Manson JE, Willett WC, Hu FB. Mediterranean diet and incidence of and mortality from coronary heart disease and stroke in women. *Circulation*. 2009;119:1093-100. doi: 10.1161/CIRCULATIONAHA.108.816736.
- Platania A, Zappala G, Mirabella MU, Gullo C, Mellini G, Beneventano G et al. Association between Mediterranean diet adherence and dyslipidaemia in a cohort of adults living in the Mediterranean area. *Int J Food Sci Nutr*. 2018;69:608-18. doi: 10.1080/09637486.2017.1389860.
- Keys A. Coronary heart disease in seven countries. 1970. *Nutrition*. 1997;13:250-2; discussion 249, 253. doi: 10.1016/s0899-9007(96)00410-8.
- Noah A, Truswell AS. There are many Mediterranean diets. *Asia Pac J Clin Nutr*. 2001;10:2-9. doi: 10.1046/j.1440-6047.2001.00198.x.
- Kouris-Blazos A, Gnardellis C, Wahlqvist ML, Trichopoulos D, Lukito W, Trichopoulos A. Are the advantages of the Mediterranean diet transferable to other populations? A cohort study in Melbourne, Australia. *Br J Nutr*. 1999;82:57-61.
- Willett WC, Sacks F, Trichopoulos A, Drescher G, Ferroluzzi A. Mediterranean diet pyramid: a cultural model for healthy eating. *Am J Clin Nutr*. 1995;61:1402-6. doi: 10.1093/ajcn/61.6.1402S.
- Cano A, Marshall S, Zolfaroli I, Bitzer J, Ceausu I, Chedraui P et al. The Mediterranean diet and menopausal health: An EMAS position statement. *Maturitas*. 2020;139:90-7. doi: 10.1016/j.maturitas.2020.07.001.

22. Gaziano JM, Hennekens CH, O'Donnell CJ, Breslow JL, Burin JE. Fasting triglycerides, high-density lipoprotein, and risk of myocardial infarction. *Circulation*. 1997;96:2520-5. doi: 10.1161/01.cir.96.8.2520.
23. Baysal A, Aksoy M, Besler HT, Bozkurt N, Keçecioglu S, Pekcan G et al. *Diyet el kitabı*. 5. Baskı. Ankara: Hatiboğlu yayinevi; 2008.
24. WHO (2021) [cited 2021/08/02]. Available from: <https://www.who.int/data/gho/data/themes/topics/topic-details/GHO/body-mass-index>.
25. Sofi F, Macchi C, Abbate R, Gensini GF, Casini A. Mediterranean diet and health status: an updated meta-analysis and a proposal for a literature-based adherence score. *Public Health Nutr*. 2014;17:2769-82. doi: 10.1017/S1368980013003169.
26. Sofi F, Dinu M, Pagliai G, Marcucci R, Casini A. Validation of a literature-based adherence score to Mediterranean diet: the MEDI-LITE score. *Int J Food Sci Nutr*. 2017;68:757-62. doi: 10.1080/09637486.2017.1287884.
27. Kastorini CM, Milionis HJ, Esposito K, Giugliano D, Goudevenos JA, Panagiotakos DB. 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;57:1299-313. doi: 10.1016/j.jacc.2010.09.073.
28. Pardhe BV, Ghimire S, Shakya J, Pathak S, Shakya S, Bhetwal A et al. Elevated cardiovascular risks among postmenopausal women: a community based case control study from Nepal. *Biochem Res Int*. 2017;2017:3824903.
29. Beaufre B, Morio B. Fat and protein redistribution with aging: metabolic consideration. *Eur J Clin Nutr*. 2000;54:48-53. doi: 10.1155/2017/3824903.
30. Sternfeld B, Wang H, Quesenberry CP, Abrams B, Sowers MF, Greendale A et al. Physical activity and changes in weight and waist circumference in midlife women: findings from the study of Women's Health Across the Nation. *Am J Epidemiol*. 2004;160:e912-922. doi: 10.1093/aje/kwh299.
31. Tokgöz VY, Öge T. The Association of body mass index with platelets, leukocytes and C-reactive protein values in postmenopausal women. *Osmangazi Journal of Medicine* 2020;42:311-7. doi: 10.20515/otd.621431.
32. Sowers MF, Zheng H, Tomey K, Jannausch M, Symons J, Li X et al. Changes in body composition in women over six years at midlife: ovarian and chronological aging. *J Clin Endocrinol Metab*. 2007;92:895-901. doi: 10.1210/jc.2006-1393.
33. Rosano GM, Panina G. Oestrogens and the heart. *Therapie*. 1999;54:381-5.
34. Sowers JR. Diabetes mellitus and cardiovascular disease in women. *Arch Intern Med*. 1998;158:617-21. doi: 10.1001/archinte.158.6.617.
35. Navarrete JG, Ibieta G, Concha M, Garces P, Robles I, Vera-Calzaretta A et al. Coronary artery disease in pre and postmenopausal women. The influence of type 2 diabetes mellitus. *Revista Medica de Chile*. 2020;148:145-50. doi: 10.4067/s0034-98872020000200145.
36. Wilson PWF, D'Agostino RB, Sullivan L, Parise H, Kannel WB. Overweight and obesity as determinants of cardiovascular risk: the Framingham experience. *Arch Intern Med*. 2002;162:1867-72. doi: 10.1001/archinte.162.16.1867.
37. Palomer X, González-Clemente JM, Blanco-Vaca F, Mauricio D. Role of vitamin D in the pathogenesis of type 2 diabetes mellitus. *Diabetes Obes Metab*. 2008;10:185-97. doi: 10.1111/j.1463-1326.2007.00710.x.
38. Earthman CP, Beckman LM, Masodkar K, Sibley SD. The link between obesity and low circulating 25-hydroxyvitamin D concentrations: considerations and implications. *Int J Obes (Lond)*. 2012;36:387-96. doi: 10.1038/ijo.2011.119.
39. Turhan-İyidir Ö, Eroğlu-Altınova A. Vitamin D ve diyabetes mellitus (Vitamin D and diabetes mellitus). *Journal of the Society of Endocrinology and Metabolism of Turkey*. 2012;16:89-94. doi: 10.4274/Tjem.1968.
40. Pittas AG, Harris SS, Stark PC, Hughes BD. The effects of calcium and vitamin D supplementation on blood glucose and markers of inflammation in non-diabetic adults. *Diabetes Care*. 2007;30:980-6. doi: 10.2337/dc06-1994.
41. Lagunova Z, Porojnicu AI, Lindberg F, Hexeberg S, Moan J. The dependency of vitamin D status on body mass index, gender, age and season. *Anticancer Res*. 2009;7:3713-20.
42. Nicholls SJ, Lincoff AM, Garcia M, Bash D, Ballantyne CM, Barte PJ et al. Effect of high-dose omega-3 fatty acids vs corn oil on major adverse cardiovascular events in patients at high cardiovascular risk: The STRENGTH randomized clinical trial. *JAMA*. 2020;324:2268-80. doi: 10.1001/jama.2020.22258.
43. Breslow JL. n-3 Fatty acids and cardiovascular disease. *Am J Clin Nutr*. 2006;83:77-82. doi: 10.1093/ajcn/83.6.1477S.
44. Del Gobbo LC, Imamura F, Aslibekyan S, Marklund M, Virtanen JK, Wennberg M et al. Cohorts for heart and aging research in genomic epidemiology (CHARGE) fatty acids and outcomes research consortium (FORCE). W-3 polyunsaturated fatty acid biomarkers and coronary heart disease: pooling Project of 19 cohort studies. *JAMA Intern Med*. 2016;176:1155-66. doi: 10.1001/jamainternmed.2016.2925.
45. Bhatt DL, Steg PG, Miller M, Brinton EA, Jacobson TA, Ketchum SB et al. REDUCE-IT Investigators. Cardiovascular risk reduction with icosapent ethyl for hypertriglyceridemia. *N Engl J Med*. 2019;380:11-22. doi: 10.1056/NEJMoa1812792.
46. Mozaffarian D, Lemaitre RN, King IB, Song X, Huang H, Sacks FM et al. Plasma phospholipid long-chain w-3 fatty acids and total and cause-specific mortality in older adults: a cohort study. *Ann Intern Med*. 2013;158:515-25. doi: 10.7326/0003-4819-158-7-201304020-00003.
47. Ambrose JA, Barua RS. The pathophysiology of cigarette smoking and cardiovascular disease: an update. *J Am Coll Cardiol*. 2004;43:1731-7. doi: 10.1016/j.jacc.2003.12.047.
48. Trichopoulos A, Costacou T, Bamia C, Trichopoulos D. Adherence to a Mediterranean diet and survival in a Greek population. *N Engl J Med*. 2003;348:2599-608. doi: 10.1056/NEJMoa025039.
49. Knuops KTB, De Groot GM, Kromhout D, Perrin AE, Moreiras-Varela O, Menotti A et al. Mediterranean diet, lifestyle factors, and 10-year mortality in elderly European men and women: the HALE Project. *JAMA*. 2004;292:1433-9. doi: 10.1001/jama.292.12.1433.
50. De Lorgeril M, Salen P, Martin JL, Monjaud I, Delaye J. Mediterranean diet, traditional risk factors, and the rate of cardiovascular complications after myocardial infarction: final report of the Lyon Diet Heart Study. *Circulation*. 1999;99:779-85. doi: 10.1161/01.cir.99.6.779.
51. Sofi F, Dinu M, Pagliai G, Cesari F, Gori AM, Sereni A et al. Low-calorie vegetarian versus mediterranean diet for reducing body weight and improving cardiovascular risk profile: CARDIVEG study (Cardiovascular prevention with vegetarian diet). *Circulation*. 2018;137:1103-13. doi: 10.1161/CIRCULATIONAHA.117.030088.
52. Bendall CL, Mayr HL, Opie RS, Bes-Rastrollo M, Itsiopoulos C, Thomas CJ. Central obesity and the mediterrian diet: a systemic review of intervention trials. *Crit Rev Food Sci Nutr*. 2018;58:3070-84. doi: 10.1080/10408398.2017.1351917.

53. Estruch R, Martínez-González MA, Corella D, Salas-Salvadó J, Fitó M, Fiol M et al. Effect of a high-fat mediterrian diet on bodyweight and waist circumference: a prespecified secondary outcomes analysis of the PREMIEDD randomised controlled trial. *Lancet Diabetes Endocrinol.* 2019;7:e6-e7. doi: 10.1016/S2213-8587(19)30074-9.
54. Carter SJ, Roberts MB, Salter J, Eaton CB. Relationship between Meditterian diet score and atherothrombotic risk: Findings from The Third National Health and Nutrition Examination Survey (NHANES III), 1988-1994. *Atherosclerosis.* 2010;210:630-6. doi: 10.1016/j.atherosclerosis.2009.12.035.
55. Estruch R, Ros E, Salas-Salvadó J, Covas MI, Corella D, Aros F et al. Primary prevention of cardiovascular disease with a mediterranean diet supplemented with extra-virgin olive oil or nuts. *N Engl J Med.* 2018;378:e34. doi: 10.1056/NEJMoal800389.
56. De Lorgeril M, Renaud S, Mamelle N, Salen P, Martin JL, Guidollet J et al. Mediterranean alpha-linolenic acidrich diet in secondary prevention of coronary heart disease (Published correction appears in *Lancet* 1995 March 18; 345(8951):738. *Lancet.* 1994;343(8911):1454-9. doi: 10.1016/s0140-6736(94)92580-1.
57. Panagiotakos DB, Pitsavos C, Chrysohoou C, Skoumas J, Stefanadis C. Status and management of blood lipids in Greek adults and their relation to sociodemographic, lifestyle and dietary factors: the ATTICA Study: blood lipids distribution in Greece. *Atherosclerosis.* 2004;173:353-61. doi: 10.1016/j.atherosclerosis.2003.12.031.
58. Lapointe A, Goulet J, Couillard C, Lamarche B, Lemieux S. A nutritional intervention promoting the Mediterranean food pattern in associated with a decrease in circulating oxidized LDL particles in healthy women from the Que bec City metropolitan area. *J Nutr.* 2005;135:410-5. doi: 10.1093/jn/135.3.410.
59. Castagnetta L, Granata OM, Cusimano R, Ravazzolo B, Liquori M, Polito M et al. The mediet project. *Ann N Y Acad Sci.* 2002;963:282-9. doi: 10.1111/j.1749-6632.2002.tb04119.x.
60. Rees K, Takeda A, Martin N, Ellis L, Wijesekara D, Vepa A, Das A, Hartley L, Stranges S. Mediterranean-style diet for the primary and secondary prevention of cardiovascular disease. *Cochrane Database Syst Rev.* 2019;3:CD009825. doi: 10.1002/14651858.CD009825.pub3.