No associations between dietary intake of polyunsaturated fatty acids and 10-year (2002-2012) cardiovascular disease risk, in relation to depressive symptomatology; the ATTICA study

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Abstract

Cardiovascular disease (CVD) has not only a detrimental effect on health, but also causes a major economic burden worldwide. Also, CVD and depression are strongly related in a bidirectional way. Polyunsaturated fatty acids (PUFA) have been suggested for their protective role against both CVD and depression, but their potential beneficial effects still remain inconclusive. We investigated whether dietary intake of PUFA, i.e., n-3 and n-6 intake, are associated with 10-year CVD incidence. The analyses were stratified by depression status. In the context of the ATTICA study (2002-2012), 762 adult participants without previous CVD history underwent psychological evaluation through the validated Zung Self-Rating Depression Scale (70 men and 141 women had moderate or severe depression, p for gender difference <0.001) Our findings showed no significant association between dietary intake of PUFA, n-3 and n-6 intake and 10-year CVD incidence in subjects with or without moderate

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or severe depression. Nevertheless, PUFA have an essential role in the formulation of a healthy dietary pattern, while recommendations and health strategies start focusing on the overall quality of diet and not on specific nutrients.

Key words: cardiovascular diseases; depression; polyunsaturated fatty acids; diet

1. Introduction

Cardiovascular disease (CVD) has several direct and indirect implications to the populations, including a major economic burden. In particular, it has been estimated that CVD is responsible for millions of people's lives lost every year, but also costs several billions to healthcare systems, worldwide. According to the latest health statistics of American Heart Association, only in the United States, the total direct costs of CVD are estimated to increase from $396 billion in 2012 to $918 billion in 2030, while the indirect costs due to loss of productivity are expected to increase by 58% during the same time period.[1]. The detrimental effect of CVD on health and quality of life, along with its enormous financial burdens, underline the urgent need for effective and easily applicable health strategies to be formulated.

It is well established that the role of nutrition is crucial in both prevention and treatment of CVD, with polyunsaturated fatty acids (PUFA) still being a topic of intense research. While a meta-analysis of epidemiological studies supports that high a-linolenic acid (ALA; a plant-derived n-3 fatty acid) exposure is associated with a lower CVD risk[2], another meta-analysis of randomized clinical trials showed no overall effect of n-3 fatty acids on CVD events.[3] According to the results of a recent review of randomized clinical trials, there is no clear-cut effect of neither high nor low intake of n-6 fatty acids on several classical CVD risk factors.[4] On the contrary, a meta-analysis of randomized controlled trials revealed a positive relationship of diets rich in specific n-6 fatty acids with non-fatal myocardial infarction and death from coronary heart disease compared to diets high in both n-3 and n-6 fatty acids.[5] Thus, and despite the growing literature, there still remains a controversy over potential benefits of n-3 and n-6 PUFA on CVD risk. Several issues need to be clarified, including favorable daily consumption and blood levels of PUFA, as well as distinction between the exact role of different fatty acids.

While the role of PUFA in heart's health remains to be elucidated, the relationship connecting depression with CVD is clear and strong. The results of a recent meta-analysis of 30 prospective studies showed that depression accounts for a significant increased risk of 30% for coronary heart disease and myocardial infarction. The findings remained statistically significant even after adjustment for potential confounders.[6] Similarly, according to the results of the ATTICA study, depression independently increased the 10-year CVD risk in both genders.[7] Intense and continuous psychological stress experienced by depressed people induces pathophysiological disturbances (i.e., deregulation of the hypothalamic–pituitary–adrenal axis and the sympathetic nervous system, metabolic disorders [8], inflammatory processes, platelet activation [9]), which in turn increase CVD risk. Moreover, depression is associated with a set of lifestyle and behavioral habits which are recognized as CVD risk factors, such as smoking, unhealthy diet, physical inactivity, alcohol use and poor adherence to medication and lifestyle programs.[8]

With the aforementioned in mind, it is evident that depressed patients are in need of useful practices in order to diminish CVD risk, with modifications in lifestyle factors and especially dietary habits to arouse the scientific interest. Herein, we sought to investigate the potential effects dietary

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intake of PUFA (n-3 & n-6) on the 10-year incidence of CVD among Greek adults from the general population, and in relation to their depression status.

2. Participants and methods

2.1 Study's sample

The ATTICA study is a prospective, population-based survey that was carried out in the province of Attica including Athens, a major metropolis. Recruitment of the study participants started in May 2001 and was completed in December 2002, with subjects having been randomly enrolled and stratified by age - gender from the greater area of Athens, according to the 2001 Greece National Population Census. The study design and methodology of the ATTICA study are described thoroughly in the study methodology paper.[10] Basic prerequisite for the recruitment in the ATTICA study was a free CVD history. Moreover, subjects with acute/chronic infections (including common cold or flu-like symptoms), inflammatory disease, dental problems, or recent surgery (within the previous week) and those living in institutions were excluded. A plethora of various variables have been recorded including demographic, lifestyle, behavioral, dietary, clinical and biochemical factors.

Assessment of depression according to validated self-reporting questionnaires was performed in a subsample of 853 participants; however, macro-nutrient consumption was available in 762 [372 women (37 ± 12 years); 390 men (41 ± 10 years)] of them, which consisted the working sample of the present study. This subsample was representative of the total study's sample (i.e., n = 4,042) as far as age, gender and history of CVD risk factors' distribution is concerned (i.e., no significant differences at p = 0.05 were observed). As it has already been reported in previous papers, there was no difference between subjects included in the present analyses and the entire ATTICA study, as regards age, gender, socio-economic status, history of hypertension, diabetes, hypercholesterolemia, as well as smoking, physical activity level and diatery habits (all p's > 0.10).

2.2 Bioethics

The Institutional Ethics Committee approved the ATTICA study protocol and the study was conducted according to the World Medical Association Declaration of Helsinki. All study participants were informed in details about the study protocol and provided a written informed consent.

2.3 Baseline examination

Demographic data of the study participants included age, gender and details about their socioeconomic status (SES) (which was characterized here by the education level; i.e., participants whose education lasted up to 12 years were classified as "Low educated", while those with >12 years as "Middle/Highly educated"). Participants who reported that they smoke at least one cigarette per day at baseline or in the past were defined as current or former smokers, respectively. Weight and height were measured following standard procedures, and obesity was defined as Body Mass Index (BMI) > 29.9 kg/m^2. History of hypertension was defined as average blood pressure levels ≥ 140/90 mmHg, or use of antihypertensive treatment; hypercholesterolemia as total serum cholesterol levels > 200 mg/dl, or use of lipid-lowering treatment; and diabetes mellitus as fasting glucose levels ≥ 126 mg/dl, or use of anti-diabetic treatment. Consumption of 156 foods and beverages (i.e., non-refined cereals and products, vegetables, legumes, fruits, olive oil, dairy products, fish, pulses, nuts, potatoes, eggs, sweets, poultry, red meat and meat products, alcohol, coffee, tea) were measured as an average per week during the past year through a validated semi-quantitative food-frequency questionnaire (FFQ), the EPIC-Greek FFQ that was kindly provided by the Department of Epidemiology Unit of the Athens Medical School.[11] The frequency of consumption was then quantified approximately in terms of the number of times a month a food was consumed. Local and international food composition tables were used to quantify dietary intake of PUFA (overall) as well as n-3, n-6 fatty acids (in g/day). Moreover, the level of adherence to the Mediterranean dietary pattern was assessed

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Table 1. Characteristics of the study's participants by 10-year (2002-2012) follow-up status regarding the development of CVD

	10-year follow-up		
Baseline characteristics	**Cardiovascular Disease**	**No Cardiovascular Disease**	**p**
Age (years)	49 ± 10	38 ± 11	<0.001
Male sex (%)	71%	48%	0.004
Body mass index (Kg/m2)	28 ± 4	25 ± 5	<0.001
Current or former smoker (%)	67%	57%	0.255
Education level (years of school)	12 ± 4	13 ± 3	0.033
Socio-economic status			
Low (%)	52.3%	63.4%	0.194
Middle/High (%)	47.7%	36.6%	
Poly-unsaturated fatty acids (g/day)	14 ± 13	14 ± 11	0.852
n-3 fatty acids (g/day)	0.31 ± 1.01	0.50 ± 1.16	0.262
n-6 fatty acids (g/day)	3.28 ± 10.24	6.01 ± 13.52	0.113
Zung Depression scale, ZDRS (20-80)	36 ± 10	35 ± 7	0.526
Depression status (ZDRS)			
Moderate (%)	26%	33%	0.246
Severe (%)	1%	3%	
Hypertension (%)	45%	24%	0.005
Hypercholesterolemia (%)	48%	28%	0.012
Diabetes mellitus (%)	12%	2.5%	0.008

based on the MedDietScore (MedDietScore range: 0-55; higher score values indicate better adherence to the Mediterranean diet).[12] Physical activity status was assessed by the short form of the International Physical Activity Questionnaire (IPAQ) and participants were classified in two categories, low and moderate/high physical activity status.[13] The validated, Greek translation of the Zung Self-Rating Depression Scale (ZDRS) was used to assess depressive symptomatology.[14, 15]. ZDRS consists of 20 items and covers affective, psychological and somatic symptoms (total score range: 20-80; with higher score values indicating the severity of depressive symptoms); a cut-off score of 45 was applied to dichotomize the participants to two categories, those with and without clinically relevant depressive symptomatology.[14]

2.4 10-year cardiovascular disease incidence assessment

The assessment of CVD incidence was performed during the 10-year follow-up (2011-2012).[16] The investigated CVD outcomes were defined according to the International Coding Disease (ICD) - 10th or 9th version (to ensure continuity ICD-9 coding was also kept, without noted discordant cases between the two coding systems). More specifically, description of the CVD health status of each study participant included information about the development of: (a) myocardial infarction, angina pectoris, other identified forms of ischemia (ICD-9 coding (or 10th edition)) (410-414.9, 427.2,427.6 (I20-I25)); coronary revascularization (414.01) (*i.e.*, coronary artery bypass surgery and percutaneous coronary intervention); (b) heart failure of different types (400.0-404.9, 427.0-427.5, 427.9, 428.-(I50.2-),

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Table 2. **Results from logistic regression model that evaluated the association between PUFA intake and 10-year CVD incidence, by depression status at baseline examination**

Overall sample, *n*=762	**Relative risk**	**95% confidence interval**
Model for PUFA (per g/day)	0.99	0.97-1.03
Model for n-3 (per g/day)	0.99	0.68-1.45
Model for n-6 (per g/day)	0.99	0.96-1.03
Participants with moderate / severe depressive symptomatology, *n* = 211		
Model for PUFA (per g/day)	1.01	0.95-1.06
Model for n-3 (per g/day)	1.87	0.97-3.59
Model for n-6 (per g/day)	1.03	0.98-1.09
Participants without moderate / severe depressive symptomatology, *n* = 551		
Model for PUFA (per g/day)	0.99	0.95-1.03
Model for n-3 (per g/day)	0.74	0.39-1.38
Model for n-6 (per g/day)	0.96	0.90-1.03

All models were adjusted for age, gender, smoking and physical activity status, body mass index, MedDietScore, history of hypertension, hypercholesterolemia, diabetes and family history of CVD of the participants

and chronic arrhythmias (I49.-); (c) development of stroke (430-438 (I63.-)).

2.5 Statistical analysis

We performed unadjusted associations between various anthropometric, demographic and clinical characteristics at baseline and 10-year CVD incidence by using Student's t-test and Pearson chi-square for continuous and categorical variables respectively. Continuous variables are presented as mean values ± standard deviation, while categorical variables are presented as frequencies. Estimates of the relative risks of 10-year CVD development (dependent outcome) was estimated using multiple logistic regression after adjusting for various participant characteristics. IBM SPSS Statistics 23 (IBM PREDICTA Hellas, Inc) was used for all statistical calculations.

3. Results

3.1 Baseline characteristics of the study's participants

According to the baseline examination, 70 men (17.9%) and 141 (37.9%) women were classified as having moderate or severe depressive symptomatology (p for gender difference <0.001). Men and women consumed 2.1 ± 1.4 servings of fish per week (no gender differences, $p = 0.49$); moreover, dietary intake of n-3 FA was, for both genders, 2.6±0.8 g per day (p for gender = 0.72), dietary intake of n-6 FA was 32.9 ± 3.6 g per day for men and 34.6±4.5 g per day for women ($p < 0.001$), and dietary intake of overall PUFA was 6% ± 2% of total energy intake of the participants (p for gender = 0.08). Also, there was no statistically significant difference of dietary intake of PUFA, as well as n-3 and n-6 between patients with moderate and severe depression (all p's > 0.10).

3.2 10-year follow up examination and CVD events

According to the results of the 10-year follow-up, 82 fatal or non-fatal CVD events / 1000 of population have been reported; gender-specific incidence was 117 events / 1000 men and 47 events / 1000 women (p for gender difference 0.004). Participants

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who developed CVD tended to be older (p <0.001), have higher body mass index (p <0.001) and lower education level (p= 0.03) than those who didn't. Hypertension (p= 0.005) and hypercholesterolemia (p= 0.01) were positively associated with the development of CVD. Also, diabetes mellitus was associated with almost 5-fold higher 10-year CVD incidence (p=0.008). Moreover, no statistical associations were found between 10-year CVD incidence and smoking habits, SES and depression status as measured using the Zung Depression Scale (ZDRS). (**Table 1**)

3.3 Association between dietary intake of PUFA and 10-year CVD incidence

There was no significant association between dietary intake of PUFA, as well as n-3 and n-6 FA and CVD risk, after adjusting for age, gender, smoking and physical activity status, body mass index, MedDietScore, history of hypertension, hypercholesterolemia, diabetes and family history of CVD of the participants (**Table 2**). Then, and in order to better control for overall dietary habits, the analysis was stratified by the level of adherence to the Mediterranean diet (i.e., MedDietScore < or > 27/55). Collinearity between dietary intake of PUFA, n-3 and n-6 and MedDietScore was checked and no significant collinearity in the tested models was observed (p> 0.5). After adjusting for the aforementioned factors, no significant associations were observed between dietary intake of PUFA, n-6 FA and CVD risk in both adherers or not adherers to the Mediterranean diet (i.e., data not shown here, all p-values > 0.20, MedDietScore > or < 27/55, respectively). Moreover, dietary intake of n-3 FA was not associated with CVD risk among those who were close to the Mediterranean diet (p= 0.99). However, for those who were away from the traditional Mediterranean diet, dietary intake of n-3 FA was protectively associated with CVD risk, even after adjusting for various potential confounders (Relative Risk per 1 g/day = 0.31, 95%CI 0.13, 0.77).

3.4 Association between dietary intake of PUFA and 10-year CVD incidence, by depression status

Since PUFA intake has been associated by others with both depression status and cardiovascular diseases, the interaction between PUFA and depression on CVD risk was tested here, too; a significant interaction was observed (p= 0.06). Thus, the analysis was classified by depressive symptomatology of the participants. Multi-adjusted analysis revealed that dietary intake of PUFA, n-3 and n-6 were not associated with 10-year CVD incidence in participants with or without moderate or severe depressive symptoms (**Table 2**). All models were adjusted for age, sex, smoking and physical activity status, body mass index, MedDietScore, history of hypertension, hypercholesterolemia, diabetes and family history of CVD.

4. Discussion

Our study adds some extra evidence in the chapter "PUFA and their role in CVD and depression", which still remains puzzling. Specifically, no significant association was found between dietary intake of PUFA, as well as n-3 and n-6 FA and 10-year CVD risk in subjects with or without moderate or severe depression after adjustment for well-established CVD risk factors. These results remind us of the multi-factorial nature of both CVD and depression pathophysiology, which partly explains the lack of associations between dietary intake of PUFA and CVD risk in participants with or without depression.

Despite the great variety of studies investigating the role of PUFA in CVD and depression separately, to our knowledge, there is only one cross-sectional study which focused on PUFA levels in CVD patients stratified by depression status. In this study, patients suffering from moderate depression had lower levels of DHA, n-3 and ration n6/n3 compared to the non-depressed group of patients. [17] Moreover, there is an interesting article testing the hypothesis that PUFA may be a key-factor in treatment of both CVD and depression.[18]

The results of current bibliography focusing on the potential benefit of PUFA intake on depression still remain inconclusive. A recent meta-analysis of randomized placebo-controlled trials showed a benefit of n-3 FA supplementation in major depres-

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sive disorder (MDD) patients. This effect was even more beneficial when eicosapentaenoic acid (EPA) was in higher dose, probably due to its anti-inflammatory properties.[19] Similarly, two studies in Greek population demonstrated that increased dietary intake of PUFA[20] and long-term consumption of fish -main dietary source of long-chain PUFA- was inversely associated with depressive symptomatology. The latter took place in a sample of elderly participants.[21] However, it must be pointed out that those studies were cross-sectional and therefore the depressive symptomatology itself may have influenced the appetite of patients. Moreover, depression is associated with an overall poor quality of diet. Depressed people are not motivated to care much for their well-being and tend to make less healthy dietary choices, which may partly explain the low consumption of PUFA dietary sources.[8] On the other hand, the results of a recent meta-analysis of controlled randomized trials (RCTs) showed that there is lack of sufficient evidence to support the benefit of n-3 FA on MDD and no clinical significance was observed. It is worth mentioning that there is a great heterogeneity between studies and high possibility of publication bias.[22] Also, according to a review of cross-sectional and prospective studies, as well as double-blind, placebo-controlled trials, the results split between positive effects of n-3 FA intake on depression versus the absence of any association, making it difficult to export a safe conclusion.[23]

PUFA are involved in a variety of underlying mechanisms, through which they can exert their potential protective role against depression and CVD. n-3 FA can influence the fluidity of cellular membranes due to their high unsaturation and hence they are assumed to regulate the serotoninergic and dopaminergic neurotransmission, which are impaired in depression.[24] Also, it has been suggested that EPA may attenuate the abnormal function of the hypothalamic-pituitary-adrenal axis (HPA axis) by diminishing the expression of corticotropin releasing factor (CRF). Moreover, n-3 FA may regulate the feedback control of HPA axis either by altering the membrane fluidity or through their inhibitive effect on glycoproteins, which are responsible for the high levels of cortisol in depressed patients.[25] PUFA are widely recognized for their anti-inflammatory role through both direct and indirect mechanisms. Inflammation is an established key factor in the pathogenesis of depression and atherosclerosis, as well as in their bidirectional interaction.[9] Docosohexaenoic acid (DHA) and EPA compete against the production of pro-inflammatory eicosanoids derived from arachidonic acid (AA), through the release of AA from the membrane by phospholipase A2 or by inhibiting enzymes responsible for the synthesis of the n-6 FA derived eicosanoids.[26] Furthermore, there is a recently discovered source of inflammation-resolving mediators derived from EPA and DHA; resolvin E and D from EPA and DHA respectively and protectins, which act in a synergistic way and terminate inflammatory cascades. It is noteworthy that n-3 FA may regulate gene expression of inflammatory molecules by inactivating the nuclear factor-κB (NF-κβ) signal transduction pathway.[25,26] Another important property attributed to n-3 FA is their beneficial effect on vascular endothelium and their inhibitive role in growth and proliferation of vascular smooth muscle cells (VSMs). However, this atheroprotective role is not supported by all human studies, leading to the conclusion that the beneficial effect of n-3 FA on endothelial function may depend on their ability to cause an increase of EPA and DHA levels in endothelial cells.[27] Last but not least, n-3 FA have triglyceride (TG) lowering effects through several mechanisms, including increased clearance of plasma TG, as well as decreased TG synthesis.[26] Despite the involvement of PUFA in a great variety of physiological functions, there still remains considerable dissension within their protective role and the development of both depression and CVD. When evaluating the effectiveness of PUFA intake, we should always have in mind that beneficial effects on biological markers are not necessarily related with clinical end points. Thus, thoughtfulness is needed for the assessment of study results, in order to avoid over-interpreting of biological effects.

On the other hand, investigating the potential

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association between the overall quality of diet and health outcomes seems to be much more promising and worth-mentioning. The Mediterranean diet is without doubt one of the most thoroughly studied dietary patterns and there is accumulating evidence supporting its protective role against CVD risk. According to the results of a recent meta-analysis of prospective studies and randomized clinical trials, the Mediterranean Diet is inversely associated with CVD incidence and mortality.[28] Moreover, adherence to a Mediterranean dietary pattern offers protection against 10-year CVD incidence in Greek population independently of various factors.[29] Interestingly, the beneficial effects of Mediterranean diet remain statistical and clinical significant even in patients who are on a statin.[30]

Our study assessed depressive symptomatology using Zung Self-Rating Depression Scale (ZDRS). Regarding self-reported questionnaires, we should interpret their results with caution, as they cannot substitute for a thorough, clinical interview. However, the ZDRS-Greek translation has been tested and recognized for its validity and suitability to measure depression.[14] Dietary intake of PUFA has been assumed to remain unchanged over years, which may have affected the results to some extent. Also, supplementary intake of PUFA was not taken into account due to lack of accurate data. Nevertheless, this is a prospective study, allowing us to evaluate causal relationships between dietary intake of PUFA and cardiovascular risk.

Our findings indicate that there is no significant association between PUFA, as well as n-3 and n-6 FA intake and 10-year CVD incidence in subjects with or without depressive symptomatology, after adjusting for potential confounders, well-established as CVD risk factors. When referring to nutrition and health outcomes, there is a great variety of factors interacting and influencing each other, which makes it difficult and perhaps less useful to focus the research on specific nutrients. The American Heart Association (AHA) has published recommendations, which promote a healthy lifestyle emphasizing on the improvement of overall diet to diminish CVD risk. One of the AHA "diet goals" is fish consumption, especially oily -main source of long-chain n-3 FA-, at least twice a week.[31] Also, according to an updated review, replacing the energy from saturated fat with PUFA is a cardioprotective approach.[32]

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Περίληψη

Απουσία συσχέτισης μεταξύ της κατανάλωσης πολυακόρεστων λιπαρών οξέων και του δεκαετή (2002-2012) καρδιαγγειακού κινδύνου, σε σχέση με την ύπαρξη καταθλιπτικής συμπτωματολογίας: Μελέτη ΑΤΤΙΚΗ

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Τα καρδιαγγειακά νοσήματα εκτός από τις επιβλαβείς συνέπειες που προκαλούν στην υγεία, δημιουργούν σημαντική οικονομική επιβάρυνση παγκοσμίως. Επίσης, τα καρδιαγγειακά σχετίζονται με την κατάθλιψη και η αλληλεπίδρασή τους είναι αμφίδρομη και ισχυρή. Τα πολυακόρεστα λιπαρά οξέα έχουν μελετηθεί εκτενώς για τον προστατευτικό τους ρόλο έναντι τόσο των καρδιαγγειακών νοσημάτων, όσο και της κατάθλιψης. Όμως, ο πιθανά ευεργετικό τους ρόλος παραμένει ακόμη ασαφής. Στην παρούσα μελέτη, διερευνήθηκε εάν η κατανάλωση πολυακόρεστων λιπαρών οξέων, καθώς επίσης και ξεχωριστά η κατανάλωση ω-3 και ω-6 λιπαρών οξέων σχετίζεται με τον δεκαετή καρδιαγγειακό κίνδυνο σε διαφορετικά επίπεδα καταθλιπτικής συμπτωματολογίας. Στα πλαίσια της μελέτης ΑΤΤΙΚΗ (2002-2012), πραγματοποιήθηκε ψυχομετρική αξιολόγηση σε 764 ενήλικες συμμετέχοντες με τη χρήση έγκυρης κλίμακας αυτό-αξιολόγησης της κατάθλιψης (70 άντρες και 141 γυναίκες βρέθηκαν να έχουν μέτρια ή σοβαρή κατάθλιψη, $p < 0.001$) Τα ευρήματα μας έδειξαν πως δεν υπάρχει καμία στατιστικά σημαντική συσχέτιση μεταξύ της πρόσληψης πολυακόρεστων, καθώς επίσης ω-3 και ω-6 λιπαρών οξέων και της 10ετούς επίπτωσης καρδιαγγειακών νοσημάτων σε άτομα με ή χωρίς μέτρια ή σοβαρή κατάθλιψη. Παρ' όλα αυτά, τα πολυακόρεστα λιπαρά οξέα αποτελούν βασικό στοιχείο στη διαμόρφωση υγιεινών διατροφικών προτύπων, ενώ παράλληλα οι συστάσεις και οι στρατηγικές υγείας έχουν αρχίσει να εστιάζουν στη συνολική ποιότητα της διατροφής και όχι σε μεμονωμένα θρεπτικά συστατικά.

Λέξεις ευρετηρίου: καρδιαγγειακά νοσήματα, κατάθλιψη, πολυακόρεστα λιπαρά οξέα

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References

1. Mozaffarian D, Benjamin EJ, Go AS, et al. Heart Disease and Stroke Statistics-2016 Update: A Report From the American Heart Association. *Circulation* 2016, 133: e38-60
2. Pan A, Chen M, Chowdhury R, et al. α-Linolenic acid and risk of cardiovascular disease: A systematic review and meta-analysis. *Am J Clin Nutr* 2012, 96: 1262-1273
3. Kotwal S, Jun M, Sullivan D, et al. Omega 3 Fatty acids and cardiovascular outcomes: systematic review and meta-analysis. *Circ Cardiovasc Qual Outcomes* 2012, 5:808-818
4. Al-Khudairy L, Hartley L, Clar C, et al. 6 fatty acids for the primary prevention of cardiovascular disease. *Cochrane Database Syst Rev* 2015: CD011094
5. Ramsden CE, Hibbeln JR, Majchrzak SF, et al. n-6 fatty acid-specific and mixed polyunsaturate dietary interventions have different effects on CHD risk: A meta-analysis of randomised controlled trials. *Br J Nutr* 2010, 104: 1586-1600
6. Gan Y, Gong Y, Tong X, et al. Depression and the risk of coronary heart disease: A meta-analysis of prospective cohort studies. *BMC Psychiatry* 2014, 14:371
7. Kyrou I, Kollia N, Panagiotakos DB, et al. Association of depression and anxiety status with 10-year cardiovascular disease incidence among apparently healthy Greek adults: the ATTICA Study
8. Dhar AK, Barton DA. Depression and the Link with Cardiovascular Disease. *Front Psychiatry* 2016, 7: 33
9. Panagiotakos DB, Pitsavos C, Chrysohoou C, et al. Inflammation, coagulation, and depressive symptomatology in cardiovascular disease-free people; the ATTICA study. *Eur Heart J* 2004, 25: 492-499
10. Pitsavos C, Panagiotakos DB, Chrysohoou C, et al. Epidemiology of cardiovascular risk factors in Greece: aims, design and baseline characteristics of the ATTICA study. *BMC Public Health* 2003, 3: 32
11. Katsouyanni K, Rimm EB, Gnardellis C, et al. Reproducibility and relative validity of an extensive semi-quantitative food frequency questionnaire using dietary records and biochemical markers among Greek schoolteachers. *Int J Epidemiol* 1997, 26 Suppl 1: S118-127
12. Panagiotakos DB, Milias GA, Pitsavos C, et al. MedDietScore: a computer program that evaluates the adherence to the Mediterranean dietary pattern and its relation to cardiovascular disease risk. *Comput Methods Programs Biomed* 2006, 83: 73-77
13. Papathanasiou G, Georgoudis G, Papandreou M, et al. Reliability measures of the short International Physical Activity Questionnaire (IPAQ) in Greek young adults. *Hellenic J Cardiol* 2009, 50: 283-294
14. Fountoulakis KN, Iacovides A, Samolis S, et al. Reliability, validity and psychometric properties of the Greek translation of the Zung Depression Rating Scale. *BMC Psychiatry* 2001, 1: 6
15. Biggs JT, Wylie LT, Ziegler VE. Validity of the Zung Self-rating Depression Scale. B*r J Psychiatry* 1978, 132:381-385
16. Panagiotakos DB, Georgousopoulou EN, Pitsavos C, et al. Ten-year (2002-2012) cardiovascular disease incidence and all-cause mortality, in urban Greek population: The ATTICA Study. *Int J Cardiol* 2015, 180: 178-184
17. Chang JP, Chang SS, Yang HT, et al. Polyunsaturated fatty acids (PUFAs) levels in patients with cardiovascular diseases (CVDs) with and without depression. *Brain Behav Immun* 2015, 44:28-31
18. Chang JP, Chen YT, Su KP. Omega-3 Polyunsaturated Fatty Acids (n-3 PUFAs) in Cardiovascular Diseases (CVDs) and Depression: The Missing Link? *Cardiovasc Psychiatry Neurol* 2009, 2009: 725310
19. Mocking RJ, Harmsen I, Assies J, et al. Meta-analysis and meta-regression of omega-3 polyunsaturated fatty acid supplementation for major depressive disorder. *Transl Psychiatry* 2016, 6:e756.
20. Panagiotakos DB, Mamplekou E, Pitsavos C, et al. Fatty acids intake and depressive symptomatology in a Greek sample: an epidemiological analysis. *J Am Coll Nutr* 2010, 29: 586-954
21. Bountziouka V, Polychronopoulos E, Zeimbekis A, et al. Long-term fish intake is associated with less severe depressive symptoms among elderly men and women: the MEDIS (MEDiterranean ISlands Elderly) epidemiological study. *J Aging Health* 2009, 21: 864-880
22. Appleton KM, Sallis HM, Perry R, et al. Omega-3 fatty

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acids for depression in adults. *Cochrane Database Syst Rev* 2015 :CD004692

23. Giles GE, Mahoney CR, Kanarek RB. Omega-3 fatty acids influence mood in healthy and depressed individuals. *Nutr Rev* 2013, 71:727-741
24. Calder P C , Yaqoob P, Harvey D J, et al. Incorporation of fatty acids by concanavalin A-stimulated lymphocytes and the effect on fatty acid composition and membrane fluidity. *Biochem J* 1994, 300(Pt 2): 509-518
25. Grosso G, Galvano F, Marventano S, et al. Omega-3 fatty acids and depression: scientific evidence and biological mechanisms. Oxid Med Cell Longev. 2014;2014:313570.
26. Adkins Y, Kelley DS. Mechanisms underlying the cardioprotective effects of omega-3 polyunsaturated fatty acids. *J Nutr Biochem* 2010, 21: 781-792
27. Jump DB, Depner CM, Tripathy S. Omega-3 fatty acid supplementation and cardiovascular disease. *J Lipid Res* 2012, 53: 2525-2545
28. Grosso G, Marventano S, Yang J, et al. A Comprehensive Meta-analysis on Evidence of Mediterranean Diet and Cardiovascular Disease: Are Individual Components Equal? *Crit Rev Food Sci Nutr* 2015, 3:0
29. Panagiotakos DB, Georgousopoulou EN, Pitsavos C, et al. Exploring the path of Mediterranean diet on 10-year incidence of cardiovascular disease: the ATTICA study (2002-2012). *Nutr Metab Cardiovasc Dis* 2015, 25: 327-335
30. Panagiotakos DB, Georgousopoulou EN, Georgiopoulos GA, et al. Adherence to Mediterranean Diet Offers an Additive Protection Over the Use of Statin Therapy: Results from the ATTICA Study (2002-2012). *Curr Vasc Pharmacol* 2015, 13: 778-787
31. American Heart Association Nutrition Committee, Lichtenstein AH, Appel LJ, et al. Diet and lifestyle recommendations revision 2006: a scientific statement from the American Heart Association Nutrition Committee. *Circulation* 2006, 114: 82-96
32. Hooper L, Martin N, Abdelhamid A, et al. Reduction in saturated fat intake for cardiovascular disease. *Cochrane Database Syst Rev* 2015 :CD011737

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