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Quality, but not cost, of diet is associated with 5-year incidence of CVD: the ATTICA study

Konstantinos Vlismas[1], Demosthenes B Panagiotakos[1,*†], Christos Pitsavos[2], Christina Chrysohoou[2], Yannis Skoumas[2], Marietta Sitara[1], John Yfantopoulos[3], Vassilios Stavrinos[1] and Christodoulos Stefanadis[2]

[1]Department of Nutrition Science – Dietetics, Harokopio University, Athens, Greece: [2]First Cardiology Department, School of Medicine, University of Athens, Athens, Greece: [3]National Centre for Social Research, Athens, Greece

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Abstract

Objective: The aim of the present work was to calculate the current cost of the Mediterranean diet in Greece and to evaluate the role of diet cost in the development of cardiovascular events after a 5-year follow-up.
Design: Cross-sectional. Cost of diet was measured in €/week based on common Greek dietary choices, while baseline dietary habits were assessed through a semi-quantitative FFQ (Greek-EPIC). The Mediterranean Diet Score (MedDietScore) was applied to assess overall adherence to this pattern using scores of eleven food variables and alcohol, according to the principles of the Mediterranean diet.
Setting: Five-year follow-up of the ATTICA study, a nutrition and health survey of a representative, free-living sample of the Greek population resident in the province of Attica, where Athens is a major metropolis.
Subjects: From 2001 to 2002, 1514 men and 1528 women (aged >18 years) without known CVD were enrolled. In 2006, the 5-year follow-up was performed.
Results: The weekly cost of participants' diets varied from 5·35 to 83·57 €/week in men (mean 25·45 (SD 6·80) €/week) and from 10·89 to 55·49 €/week in women (mean 25·63 (SD 6·30) €/week). Diet cost was correlated marginally to MedDietScore ($r = 0·060$, $P = 0·05$) as well as being associated with history of hypercholesterolaemia (mean (SD), yes *v.* no: 24·90 (5·73) *v.* 25·82 (6·95) €/week, $P = 0·027$), physical activity (mean (SD), yes *v.* no: 26·42 (6·90) *v.* 24·82 (6·20) €/week, $P < 0·001$) and current smoking (mean (SD), yes *v.* no: 24·99 (6·40) *v.* 25·98 (6·70) €/week, $P = 0·017$). No significant association was found between diet cost and 5-year incidence of CVD (hazard ratio = 1·021, 95 % CI 0·965, 1·081). However, adherence to the traditional Mediterranean diet was inversely associated with the development of CVD (relative risk per 1-unit increase in MedDietScore = 0·92, 95 % CI 0·89, 0·94) after adjustment for various potential confounders including diet cost.
Conclusions: Quality but not cost of the diet is associated with the development of CVD.

Keywords
Diet cost
Cardiovascular
Mediterranean

It is well documented in the literature that health is influenced by socio-economic status (SES) and that differences in socio-economic indicators underlie many health disparities. The various socio-economic indicators are generally related to chronic diseases, with socio-economically disadvantaged groups experiencing higher mortality and morbidity rates for CHD, non-insulin-dependent diabetes mellitus, stroke, some cancers, obesity and other diseases[1–4]. Socio-economic indicators also illustrate strong associations with main determinants of health, such as quality of the environment and health-related attitudes, including smoking, physical inactivity and dietary habits[5,6]. Many studies have reported healthier dietary patterns among subjects with higher SES, especially in developed countries. Thus, people with greater affluence than others exhibit a higher consumption of vegetables, fruit and fibre products and a lower consumption of fatty meats and added fats[7–9].

In general, the causal mechanisms which probably explain the inverse relationship between SES and either diet or health are difficult to investigate because of the complex nature of the possible related factors. Among these factors is diet cost, which is generally considered a determinant of food choice that is closely related to SES[9].

† Correspondence address: 46 Paleon Polemiston Street, Glyfada, 16674 Athens, Greece.

*Corresponding author: Email D.b.Panagiotakos@usa.net

Diet cost is usually expressed as either the total cost per unit of energy (e.g. €/$ per 1000 kcal or €/$ per MJ) or the cost of purchasing the diet (€/$ per d/week/month)[10]. Many studies have shown that people follow unhealthy food patterns due to the high diet cost of healthier food choices[11,12]. Although true in many cases, it should be taken into account that the majority of people tend to choose food based on palatability as well[13] and thus cost may have a secondary role in the final decision of the consumer. In any case, diet cost seems to play an important role in health status and so it is unfortunate that there are very few studies in the literature that have investigated the role of diet cost in relation to disease outcomes[10].

The Mediterranean diet has been widely reported as a lifestyle option found to be protective for health and quality of life[14,15]. The main characteristics of the Mediterranean diet is that it is based on the consumption of foods of non-animal origin such as pasta, rice, pulses and fresh vegetables (including wild greens), with extended everyday use of olive oil as the main source of total fat intake as well as moderate consumption of red wine[14–17]. Many studies have highlighted the numerous health benefits of the Mediterranean diet, including inverse relationships with CVD[18,19] and metabolic syndrome[20,21].

However, as the specific role of diet cost in the development of disease has rarely been evaluated, the aim of the present work was to estimate the current cost of the Mediterranean diet and to explore the relationship of diet cost and 5-year incidence of CVD in a Greek population.

Methods

Study design and participants

The ATTICA study started as a nutrition and health survey of the Greek population (during 2001–2002), and the first follow-up was performed in 2006. The sampling was carried out in the region of Attica, of which Athens is the major metropolis, which includes 78 % urban and 22 % rural areas. The procedure anticipated enrolling only one participant per household; it was random, multistage and based on the age (five age groups) and gender (males, females) distribution of the Attica region (twenty-seven stages were used according to the census of 2001). People with any clinical evidence of CVD or living in institutions were excluded from the sampling procedure. During the enrolment period, 4056 inhabitants from the above area responded to a call from the study's research group; of them, 117 were excluded because of history of CVD and another 897 finally declined to participate. Thus, 3042 were enrolled in the study (75 % participation rate); 1514 of the participants were men and 1528 were women. All participants were interviewed by trained personnel[22].

Bioethics

The study was approved by the ethics committee of the Department of Cardiology of Athens Medical School.

Baseline measurements

The baseline evaluation included information about several sociodemographic characteristics (age, gender, mean annual income, years of school), personal and family history of hypertension, hypercholesterolaemia and diabetes, family history of CVD, and dietary and other lifestyle habits such as smoking status and physical activity. The assessment of nutritional habits was based on a detailed, reproducible, validated semi-quantitative FFQ (the Greek-EPIC questionnaire)[23] that was kindly provided by the Nutrition Unit of Athens Medical School. In order to describe overall diet, composite scores necessary for the evaluation of epidemiological associations were used. A modified version of the Mediterranean Diet Score (MedDietScore) was applied (range 0–55)[24] that is based on the rationale of the Mediterranean dietary pyramid[17]. Higher values of this score indicate better adherence to the Mediterranean diet. Smokers were defined as those who were smoking at least one cigarette per day during the past year or had recently stopped smoking (less than 1 year); the rest of the participants were defined as current non-smokers. For the ascertainment of physical activity status the International Physical Activity Questionnaire (IPAQ) was used[25]. The IPAQ is an index of weekly energy expenditure computed using frequency (times per week), duration (in minutes per time) and intensity of sports or other habits related to physical activity (in expended energy per time). BMI was calculated as weight (in kilograms) divided by the square of standing height (in metres). Obesity was defined as BMI greater than 29·9 kg/m^2. Arterial blood pressure (three recordings) was measured at the end of the physical examination with the participant in sitting position. All participants had been resting for at least 30 min. Participants whose average blood pressure levels were greater than or equal to 140/90 mmHg or were under antihypertensive medication were classified as having hypertension. Hypercholesterolaemia was defined as total cholesterol level greater than 200 mg/dl or use of lipid-lowering agents. Diabetes mellitus (type 2) was defined according to the American Diabetes Association diagnostic criteria (i.e. participants whose fasting blood glucose level was greater than 125 mg/dl were classified as having diabetes). Further details about the aims and procedures of the ATTICA epidemiological study may be found elsewhere[22].

Calculation of diet cost

Prices used in the calculation of total diet cost were obtained from two large supermarkets in Athens metropolitan area and four local fruit and vegetable street markets (held weekly in neighbourhoods). It should be mentioned that there is a small variation in prices within supermarkets or within street markets in Athens. Greek people tend to purchase a lot from these markets, especially fruit and vegetables as they are considered to be fresher and originated directly from the production.

Since prices differ among different types of fruit, red meat, pulses and seafood, we took the most characteristic types from each food group based also on food choices given in a published traditional Greek menu[15]. The types of food were obtained from the Mediterranean Food Pyramid and median values were calculated according to different markets and different types of food (Table 1, Fig. 1). Seasonal variation in price was not taken into account as the calculation of diet cost took place in summer of 2009. To determine the total cost of the Mediterranean diet we first calculated the median cost per serving of that specific food type and then multiplied it by the weekly consumption frequency of servings of that food group. The serving sizes used were based on the dietary guidelines for adults in Greece[17]. Total cost of the diet was equal to the sum of all food types in €/week (Table 2).

Table 1 List and median retail prices of selected foods used to calculate Mediterranean diet cost as well as the total diet cost of the ATTICA study participants

Mediterranean Pyramid Food group	Selected food	Median retail price (€/kg unless otherwise stated)
Red meat	Lamb, beef, pork (fresh)	8·49
Sweets	Raisins, *pasteli* (sesame bar), *halva* (tahini-based), honey	5·95
Eggs	Chicken eggs	0·26/egg
Potatoes	Fresh potatoes	0·75
Pulses, nuts	Beans, lentils, chickpeas	3·06
Olives	Black olives	7·12
Poultry	Whole fresh chicken	4·09
Fish	Red mullet, sardine, sea bream, sea bass, squid, octopus	7·94
Dairy products	Fresh milk	1·34 €/litre
Fruits	Orange, apple, banana, watermelon, melon, peach, grapes	1·21
Olive oil	Extra virgin olive oil	5·40 €/litre
Vegetables	Green beans, tomatoes, lettuce, cabbage, green peppers, wild greens, spinach, cucumber, onions, courgette	0·96
Non-refined cereals and products	Brown rice, pasta	2·69
Red wine	Red local wine	2·66 €/litre

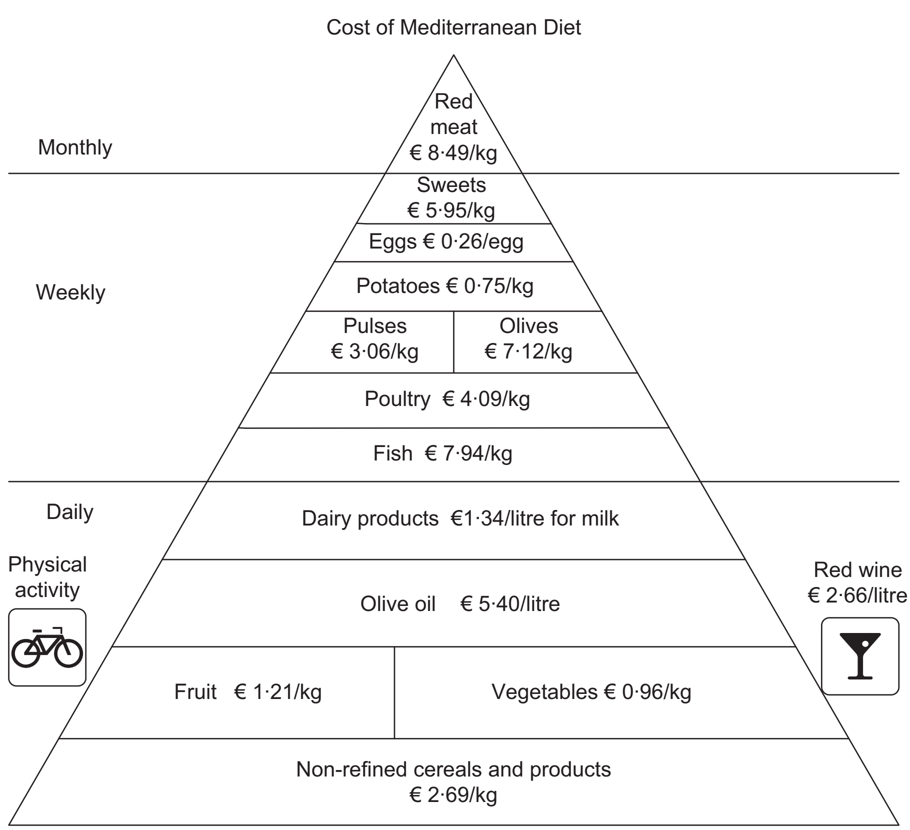

Fig. 1 The Mediterranean Diet Food Pyramid and its approximate cost in Athens, Greece (summer 2009); median of selected retail prices (€/kg unless otherwise stated)

Table 2 Analysis of the Mediterranean diet cost calculation

Food type	Recommended intake	Weekly intake (servings unless otherwise stated)	Quantity (g unless otherwise stated)	Median of selected retail prices (€/kg unless otherwise stated)	Median cost/serving	Weight of 1 serving (g unless otherwise stated)	Total cost (€/week)
Red meat	4 servings/month	1	60	8·49	0·51	60	0·51
Sweets	3 servings/week	3	75	5·95	0·15	25	0·45
Eggs	3 servings/week	3	3 eggs	0·26/egg	0·26	1 egg	0·78
Potatoes	3 servings/week	3	300	0·75	0·075	100	0·23
Pulses	3–4 servings/week	4	360	3·06	0·275	90	1·10
Poultry	4 servings/week	4	240	4·09	0·245	60	0·98
Fish	5–6 servings/week	6	360	7·94	0·476	60	2·86
Dairy products	2 servings/d	14	3·36 ml	1·34 €/litre for milk	0·321	240 ml of milk	4·50
Olive oil	7 tsp/d	49	245 ml	5·40 €/litre		1 tsp = 5 ml	1·32
Olives	3 servings/week	3	90	7·12	0·214	30	0·64
Fruits	3 servings/d	21	2100	1·21	0·121	1 fruit (100 g)	2·54
Vegetables	6 servings/d	42	4200	0·96	0·096	100	4·03
Non-refined cereals	8 servings/day	56	3360	2·69 for rice and pasta	0·1614	half a cup (50–60 g) of cooked rice or pasta	9·03
Red wine	120 ml/d	7	840 ml	2·66 €/litre		120 ml	2·23

Current cost of Mediterranean diet = 31·2 €/week.

Five-year follow-up

During 2006, the ATTICA study's investigators performed the 5-year follow-up. In order to participate in the follow-up examination all participants were contacted through telephone calls (80 % of the participants) or in their residence when the telephone number was unavailable. Of the 3042 initially enrolled participants, 1012 men and 1035 women were found alive at the time of the follow-up, while thirty-two (2·1 %) men and twenty-two (1·4 %) women had died during the 5-year period. The rest of the participants (i.e. 941) were lost to follow-up (69 % participation rate; Fig. 2). Of the individuals who did not participate in the re-examination, 75 % were not found because of missing or wrong addresses and telephone numbers, and the rest declined to be re-examined (Fig. 2). No significant differences were observed between those who were lost to follow-up and the rest of the participants regarding sex ($P = 0·99$), age ($P = 0·78$), years of school ($P = 0·67$), presence of hypertension ($P = 0·12$), diabetes ($P = 0·27$), hypercholesterolaemia ($P = 0·12$) and dietary habits as evaluated by the modified MedDietScore ($P = 0·28$).

Death from any cause was ascertained through death certificates from regional register offices. The study investigators performed a detailed clinical evaluation in the rest of the participants using accurate medical records that included information about: (i) the development of CHD (including myocardial infarction, angina pectoris, other identified forms of ischaemia, WHO International Classification of Diseases 10th edition (ICD-10) codes 410–414·9, 427·2 and 427·6; heart failure of different types and chronic arrhythmias, WHO ICD-10 codes 400·0–404·9, 427·0–427·5, 427.9) or development of stroke (WHO ICD-10 codes 430–438); (ii) the development of hypertension, hypercholesterolaemia and diabetes; (iii) the assessment of body weight and height; and (iv) lifestyle habits, including physical activity and smoking status, as well as consumption of various food groups and beverages.

Statistical analysis

Descriptive statistics (i.e. means and standard deviations, or frequencies) are used to present participants' characteristics. The time to a CVD event was recorded on an annual basis. Incidence rates were calculated as the ratio of the number of new cases to the number of people who participated in the follow-up. Associations between total diet cost (TDC) and main socio-economic, dietary and demographic factors were performed using Pearson's or Spearman's correlation (in the case of normally or not distributed variables) and the *t* test. Normality was graphically tested using P–P plots; TDC was normally distributed. The hazard ratios (HR; and their 95 % confidence intervals) of developing a CVD event during the 5-year period, according to the participants' TDC and other baseline characteristics, were estimated using Cox proportional hazards models. Interactions between TDC and diet score, as well as other covariates, were tested in all models. Deviance residuals were used to evaluate the models'

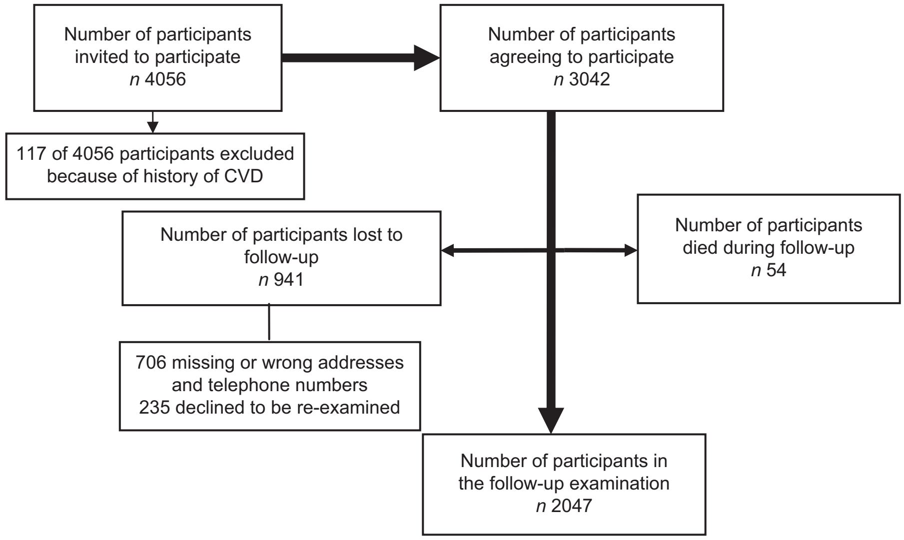

Fig. 2 Flow chart of participants in the ATTICA study

goodness-of-fit. All reported P values are based on two-sided tests and compared with a significance level of 5 %. The SPSS statistical software package version 14·0 (SPSS Inc., Chicago, IL, USA) was used for all statistical calculations.

Results

Diet cost

The cost of participants' diet (i.e. TDC) varied between 5·35 and 83·57 €/week in men (mean 25·45 (SD 6·80) €/week) and between 10·89 and 55·49 €/week in women (mean 25·63 (SD 6·30) €/week). Positive correlations were found between TDC, MedDietScore ($r = 0{\cdot}060$, $P = 0{\cdot}05$) and energy intake ($r = 0{\cdot}665$, $P < 0{\cdot}001$); similarly, associations were also observed with history of hypercholesterolaemia (mean (SD), yes *v.* no: 24·90 (5·73) *v.* 25·82 (6·95) €/week, $P = 0{\cdot}027$), physical activity status (mean (SD), yes *v.* no: 26·42 (6·90) *v.* 24·82 (6·20) €/week, $P < 0{\cdot}001$) and current smoking (mean (SD), yes *v.* no: 24·99 (6·40) *v.* 25·98 (6·70) €/week, $P = 0{\cdot}017$). No relationships were found with years of school ($r = -0{\cdot}032$, $P = 0{\cdot}30$), annual income ($r = -0{\cdot}012$, $P = 0{\cdot}727$), age ($r = -0{\cdot}019$, $P = 0{\cdot}54$), sex ($P = 0{\cdot}65$), obesity (mean (SD), yes *v.* no: 25·61 (6·90) *v.* 25·53 (6·50) €/week, $P = 0{\cdot}88$), history of hypertension (mean (SD), yes *v.* no: 25·69 (6·80) *v.* 25·43 (6·40) €/week, $P = 0{\cdot}58$) and diabetes mellitus (mean (SD), yes *v.* no: 24·22 (6·00) *v.* 25·59 (6·60) €/week, $P = 0{\cdot}17$). Moreover, we calculated quartiles of the TDC and compared the consumption of food groups between the highest and the lowest TDC quartile. The analysis revealed that people who spent more on their diet consumed more fish, legumes, cereals, fruits, salads and meat (all $P < 0{\cdot}001$) compared with those in the lowest quartile.

We also calculated the current cost of the traditional Mediterranean diet, as can be seen in Fig. 1. The cost was calculated based on the median prices of different types of food from different places of purchase (supermarkets and local markets; see Table 1) and was dependent on the serving size and food groups of the Mediterranean Food Pyramid (Fig. 1). For example, median price of vegetables was estimated from the retail price of ten different vegetables selected based on season and common consumption perception. Based on these prices the current cost of the Mediterranean diet was calculated at 31·2 €/week per person (Table 2). For calculation purposes the median of dairy products did not include cheese and yoghurt, as their exact contribution to total consumption cannot be estimated price-wise and in quantification. Similarly for the pulses and nuts food group where pulses are the major contributors of the group consumption, nuts were excluded and only pulses were taken into account to calculate the median. Including cheese, yoghurt and nuts would give misleading results, probably elevating median prices as they are a lot more expensive. In addition, cheese and milk were measured in different units, one being liquid and the other solid; thus the calculation of one 'common' median would be a mistake. In the final calculation of the TDC, wine and olive oil were not included: (i) wine was excluded as total alcohol consumption is obtained from the FFQ, comprising not only wine but also different types of alcohol such as beer and spirits; (ii) olive oil was excluded because in the FFQ its use is calculated as a proportion of the population and not quantified individually. At this point it should be noted that the mean diet cost of both men and women of the ATTICA study was lower than the Mediterranean diet cost (all $P < 0{\cdot}001$).

Total diet cost and 5-year incidence of CVD

To further evaluate the association between cost of diet and 5-year incidence of CVD we applied survival analysis (Table 3). In particular, three nested models were estimated.

Table 3 Results from Cox proportional hazards models that evaluated the cost of individuals' diet in relation to 5-year incidence of CVD

	Hazard ratio	95 % CI
Model 1		
Age (per 1 year)	1·072	1·058, 1·086
Gender (males *v.* females)	1·646	1·170, 2·316
Obesity (yes *v.* no)	1·394	0·977, 1·990
Physical activity (yes *v.* no)	0·839	0·596, 1·181
Current smoking (yes *v.* no)	1·106	0·755, 1·620
Hypertension (yes *v.* no)	1·304	0·917, 1·856
Diabetes mellitus (yes *v.* no)	1·786	1·204, 2·649
Hypercholesterolaemia (yes *v.* no)	1·312	0·939, 1·834
Family history of CVD (yes *v.* no)	0·938	0·659, 1·335
Model 2		
Age (per 1 year)	1·055	1·011, 1·102
Gender (males *v.* females)	1·517	0·650, 3·540
Obesity (yes *v.* no)	3·294	1·533, 7·074
Physical activity (yes *v.* no)	0·847	0·386, 1·859
Current smoking (yes *v.* no)	1·136	0·528, 2·442
Hypertension (yes *v.* no)	1·187	0·543, 2·594
Diabetes mellitus (yes *v.* no)	2·226	0·835, 5·937
Hypercholesterolaemia (yes *v.* no)	2·405	1·074, 5·385
Family history of CVD (yes *v.* no)	0·745	0·343, 1·618
Total diet cost (per 1€)	1·021	0·965, 1·081
Model 3		
Age (per 1 year)	1·052	0·990, 1·117
Gender (males *v.* females)	2·799	0·819, 9·561
Obesity (yes *v.* no)	3·494	1·093, 11·171
Physical activity (yes *v.* no)	1·372	0·423, 4·448
Current smoking (yes *v.* no)	0·439	0·127, 1·515
Hypertension (yes *v.* no)	1·169	0·386, 3·535
Diabetes mellitus (yes *v.* no)	0·939	0·156, 5·640
Hypercholesterolaemia (yes *v.* no)	7·286	1·766, 30·056
Family history of CVD (yes *v.* no)	1·532	0·495, 4·739
Total diet cost (per 1€)	1·007	0·927, 1·095
Financial status (very good *v.* good)	0·389	0·204, 0·743

In model 1, only clinical and lifestyle variables were taken into account. It was shown that age, male gender and diabetes mellitus were positively associated with 5-year incidence of CVD. In model 2 the TDC variable was included, but there was no association with 5-year incidence of CVD (HR = 1·021, 95 % CI 0·965, 1·081). Also, no association between TDC and 5-year incidence of CVD was observed when a financial status variable was included in the model (HR = 1·007, 95 % CI 0·927, 1·095).

Regarding overall dietary habits, the MedDietScore that evaluates adherence to the traditional Mediterranean diet was inversely associated with the development of CVD (relative risk per 1-unit increase in MedDietScore = 0·92, 95 % CI 0·89, 0·94) after adjustment for physical activity status, obesity status, smoking habits, sex, history of hypertension, hypercholesterolaemia, diabetes, CVD and diet expenses of the participants, but the relationship became insignificant when age was also included in the model. Thus, the analysis was stratified by various age groups. It was discovered that only people aged 35–65 years exhibited greater adherence to the Mediterranean diet that was inversely associated with CVD incidence (relative risk per 1-unit increase in MedDietScore = 0·94, 95 % CI 0·90 0·97, after several adjustments), while no significant associations were observed between younger or older adults (*P* for homogeneity between odds ratios <0·001).

Discussion

In the present work we studied the association between cost of diet and 5-year incidence of CVD events in a representative, free-living sample of the Greek inhabitants from the region of Attica. Overall, no significant association was found between TDC and incidence of CVD events. Moreover, while TDC was associated with health indicators such as hypercholesterolaemia, education, financial status and diet quality (expressed as MedDietScore), significant associations were found only with MedDietScore, hypercholesterolaemia, physical activity and current smokers. Nevertheless, greater adherence to the Mediterranean diet was inversely associated with CVD incidence, irrespective of TDC of the participants.

Regarding the current cost of the Mediterranean diet in Greece, it was calculated at 31·2 €/week which works out at 124·8 €/month per person. Comparing that with the Greek minimum wage of 681 €/month according to EUROSTAT published data[26], the proportion of food cost to the minimum wage is about 18·3 %. This proportion is close to the European average of 22 % for the percentage of disposable income spent on food[27]. The difference may be due to an under-representation of cost due to the methodological limitations mentioned above. Moreover, according to the calculations, the Mediterranean diet is more expensive than the mean diet cost reported by the participants. This may suggest that it could be too expensive for at least a large proportion of the population.

In Europe food prices tend to vary among countries; specifically, price levels indicate that food is cheaper in Eastern Europe whereas it is more expensive in Western Europe, especially the Nordic countries and Ireland. Price differences across countries are distinctive as food prices in one of the most expensive countries, Norway, are about 2·9 times as high as in the least expensive, Bulgaria[28].

Therefore the cost of the Mediterranean diet would increase in Western Europe where, for example, fruit and vegetables price levels are well above the European average in most countries. In the USA, the US Department of Agriculture has created a cost-effective healthy diet that meets Recommended Dietary Allowances and the Pyramid Guidelines[29] called The Thrifty Food Plan. The diet cost in June 2009 was estimated at $39·00/week for a male person aged 19–50 years and $34·50/week for a female person of the same age[29], which is not very far from our calculations given that the current exchange rate of Euros to US dollars is approximately 1·4.

In addition, while TDC was associated with various health indicators, significant associations were found with MedDietScore (an indicator of diet quality), hypercholesterolaemia, physical activity and current smokers. The association between TDC and MedDiet-Score was a positive one but not so strong in terms of effect size, meaning that a higher-quality diet would tend to cost more, which agrees with many studies regarding diet cost and quality[30]. It was also shown in our study that the diet of people with hypercholesterolaemia costs slightly but significantly less than the diet of people without this condition, which could be explained by the fact that energy-dense foods that have higher fat and lipid content (a risk factor for hypercholesterolaemia) are accessible to consumers at a lower cost than 'healthier' diets lower in energy density and rich in vegetables and fruit[30,31]. In addition, we found that sedentary people tend to pay less for their diet than physically active people and smokers pay significantly less than non-smokers, but these results are considered inconclusive.

Nevertheless, when TDC was related to 5-year incidence of CVD events no significant association was found (Table 3). In the latter, the comparison was controlled for age, gender, obesity, physical activity, current smoking, hypertension, diabetes mellitus, hypercholesterolaemia and family history of CVD events. No association was found even after including financial status in the model. The lack of association between TDC and CVD may reflect the relatively weak association between diet cost and quality, which is likely to be the link between diet cost and health.

Recent findings by Drewnowski and Eichelsdoerfer[32] show that the Mediterranean diet can be a valuable tool in the management of the obesity epidemic as it exhibits nutritional characteristics that are widely acceptable in cultural and social terms. Our findings complement the above as TDC was not associated with financial status, showing that the Mediterranean diet can be adopted without taking financial parameters (e.g. income) into account, although further research is required to confirm such results.

Moreover, taking into account that the cost of the Mediterranean diet is higher than the cost of the total diet, the observed insignificant association between TDC and financial status may suggest that factors other than available funds determine people's dietary choices. This may be also related to the fact that people with very low income are not well represented, and it is these people for whom the cost of a better-quality diet may be most prohibitive.

Despite the lack of association between diet cost and CVD incidence, greater adherence to the Mediterranean diet was associated with lower 5-year CVD incidence, especially among middle-aged people. A wide body of scientific evidence relates diet and incidence of CVD[33–35]. There is also increasing scientific evidence that diets high in consumption of fruits, vegetables, legumes and whole grains, which also include fish, nuts and low-fat dairy products, have protective health effects. The traditional Mediterranean diet, whose principal source of fat is olive oil, includes these dietary characteristics and there is also some evidence that it can be applicable to other dietary cultures and cuisines[36]. For the last 30 years many investigators have recognized the beneficial role of this diet on CVD, metabolic disorders and several types of cancer[37–40].

Study limitations

There are some limitations that need to be acknowledged and addressed regarding the current work. First, part of the study was based on a cross-sectional design, which limits causal inferences. A second limitation is that low-income people were generally not well represented because data from the homeless or unemployed are difficult to obtain. Another possible limitation concerns the extent to which the findings can be generalized beyond the population studied. Moreover, some foods (cheese, yoghurt and nuts) were not included in the total cost of the Mediterranean diet because of the large price variability of these products. Finally, as seasonal variation in cost was not taken into account since the calculation of diet cost was undertaken in the summer months (when prices of fruits and vegetables are lower), the annual cost of the diet could be underestimated.

Conclusion

Our results show that diet quality, but not diet cost, is associated with 5-year incidence of CVD in a free-living, population-based sample from Greece. Moreover, the estimated actual cost of the Mediterranean diet seems to be rational for a middle-income household. This may provide policy makers with an excellent tool as it can be exploited as an efficient strategy to reduce the food-related disease burden.

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