



Available online at www.sciencedirect.com

ScienceDirect

journal homepage: <http://www.journals.elsevier.com/hellenic-journal-of-cardiology/>



ORIGINAL ARTICLE

Lifestyle and health determinants of cardiovascular disease among Greek older adults living in Eastern Aegean Islands: An adventure within the MEDIS study



Alexandra Foscolou^a, Evangelos Polychronopoulos^a,
Efstratia Paka^a, Stefanos Tyrovolas^{a,b}, Vassiliki Bountziouka^a,
Akis Zeimbekis^c, Dimitra Tyrovola^a, Dilek Ural^d,
Demosthenes Panagiotakos^{a,*}

^a Department of Nutrition and Dietetics, School of Health Science and Education, Harokopio University, Athens, Greece

^b Parc Sanitari Sant Joan de Déu, Fundació Sant Joan de Déu, CIBERSAM, Universitat de Barcelona, Barcelona, Spain

^c Health Center of Kalloní, General Hospital of Mitilini, Mitilini, Greece

^d Koc University School of Medicine, Istanbul, Turkey

Received 7 April 2016; accepted 29 September 2016

Available online 16 November 2016

KEYWORDS

Eastern Aegean islands;
Gökçeada;
Cardiometabolic risk;
Older adults

Abstract *Objective:* The aim of the present study was to evaluate lifestyle and health determinants of cardiovascular disease (CVD) risk among Greek elderly residents living in Eastern Aegean islands, in both Greece and Turkey.

Methods: Under the context of the MEDIS study, 724 older adults (aged 65 to 100 years) from 8 Eastern Aegean Sea Greek islands ($n = 100$ living in Samothrace, 142 in Lesbos, 150 in Limnos, 76 in Ikaria, 52 in Kassos, 149 in Rhodes and Karpathos) and from Turkey ($n = 55$ older adults of Greek origin living on Gökçeada Island) were voluntarily recruited. Overall cardiometabolic risk was measured as the sum (range 0–4) of four common CVD risk factors (hypertension, diabetes, dyslipidemia and obesity).

Results: Greek islanders had higher CVD scores compared to Greeks of Gökçeada (1.9 ± 1.1 vs 1.4 ± 1.0 risk factors / participant, $p < 0.001$). Further analysis revealed that the diet of Greek islanders was similar to the traditional Mediterranean diet; however, these individuals demonstrated 2-times higher odds (95% CI, 1.04–3.87) for having hypertension, 1.53-times higher

* Corresponding author. Prof. Demosthenes B. Panagiotakos, 46 Paleon Polemiston St., Glyfada, 166 74, Attica, Greece. Tel.: +30 210 9603116; fax: +30 210 9600719.

E-mail address: d.b.Panagiotakos@usa.net (D. Panagiotakos).

Peer review under responsibility of Hellenic Society of Cardiology.

odds (95% CI, 0.66–3.54) for having diabetes, 3.29-times higher odds (95% CI, 1.58–6.81) for having hypercholesterolemia; whereas they had 0.78-times lower odds (95% CI, 0.40–1.52) for being obese, compared to elderly Greek adults living on Gökçeada.

Conclusions: Overall, CVD risk seems to be low among Eastern Aegean Islanders; certain differences in CVD risk factors exist between Greek islanders and their counterparts living in Gökçeada, and those differences may be attributed to various environmental, cultural and lifestyle factors.

© 2016 Hellenic Society of Cardiology. Publishing services by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

The percentage of the population who are old increases rapidly, and by 2050 their number is expected to exceed 2 billion worldwide. Since the financial crisis, European countries have necessarily reduced state expenditures for healthcare, and the results of that action are becoming more and more evident. Additionally, psychological problems have increased tremendously, resulting in an increased incidence of severe depression, other mental illnesses, and higher rates of suicide.^{1–3} Superimposed on this sociopolitical climate is the inevitable physiological changes of aging, including alterations on the cardiovascular system.⁴

Moreover, people from some regions tend to live longer than others; some regions are characterized as “Blue Zones” because of their specific land morphology and the longevity of their residents.^{5,6} While the exact determinants of longevity remain unclear, successful aging constitutes an important aspect. On Ikaria island, a Greek island in the Eastern Aegean Sea, inhabitants live exceptionally longer than the majority of the Greek mainland population.^{6,7} It is reported that this fact is due to the residents’ general lifestyle, which includes regular daily exercise, a healthy plant-based diet, low rates of smoking, opportunities to socialize, and strong family bonds and values.^{5,6,8,9} It could be assumed that all the islands around Ikaria, i.e., the Greek and Turkish islands of the Eastern Aegean Sea, have common lifestyle features that give residents the opportunity to live longer, more healthy lives.

Mediterranean countries, including the islands of the Aegean Sea, are known as “a crossroads of civilizations” due to their geographical location. The interactions among people of various ethnic and cultural backgrounds over the centuries have gradually shaped the present culture and lifestyle of the Mediterranean people. Furthermore, the present food culture of the Mediterranean is the result of the combination of the two different civilizations- the Christian civilization from the South and the Islamic one from the East.¹ Nutrition and dietary choices vary between countries and also among people within the same country. This diversity is linked to the culture, nationality, religion, socio-financial conditions, and climate of each Mediterranean country.¹⁰

Given the aging of the population, it is crucial to study and understand how older adults could live longer, healthier lives and enjoy a higher quality of life. The aim of

the present study was to evaluate lifestyle and health determinants of CVD risk of Greek older adults living in Eastern Aegean islands, in Greece and Turkey.

2. Methodology

The Mediterranean Islands study (MEDIS) is an ongoing, large-scale, multinational project in the Mediterranean region, and aims to explore the association of lifestyle habits, psychosocial characteristics, and environmental conditions on cardiometabolic factors among older (>65 years), permanent residents of the Mediterranean region.

2.1. The MEDIS Study’s sample

The MEDIS is a population-based, multi-national observational study. During 2005–2015, a multi-stage (i.e., stratified by Mediterranean country), convenience sampling was applied to voluntarily enroll 2749 older residents of 22 Mediterranean islands: Republic of Cyprus, Malta Republic, Sardinia and Sicily in Italy, Mallorca and Menorca in Spain and 16 Greek islands (Mitilini, Samothraki, Cephalonia, Crete, Corfu, Limnos, Ikaria, Syros, Naxos, Zakynthos and Salamina, Kassos, Rhodes and Karpathos, and Tinos) and the rural region of east Mani (a Greek peninsula), as well as Gökçeada Island in Turkey.

For the present study, information from 315 men, aged 75±7.5 years and 409 women, aged 73±7 years from Mitilini (n=142), Samothraki (n=100), Ikaria (n=76), Limnos (n=150), Kassos (n=52), Rhodes and Karpathos (n=149), as well as n=55 older adults with Greek origin living in Gökçeada island were analyzed. The analysis was stratified into two main groups, i.e., people from the Greek Aegean islands and those from Gökçeada Island, to compare their habits and health condition. Mitilini, Samothraki, Ikaria and Limnos are located in the North-Eastern Aegean Sea, whereas Kassos, and Rhodes and Karpathos are located in the South-Eastern Aegean Sea; however, all of these islands are located very close to the Asia Minor coast, and comprise the Eastern Aegean Sea islands. Gökçeada island is an area of 279 km² located in the Aegean Sea, stretching North to South along the Near East coastline; according to the 2014 census, it has a total population of 8,644 people, including 300 Greeks who differ culturally from the primarily Turkish population. The main occupations of the residents are livestock, apiculture, cultivation of cereals and olive trees,

fishing, and tourism (<https://en.wikipedia.org/wiki/Imbros>). According to the design of the study, individuals who resided in assisted-living centers, had a clinical history of cardiovascular disease (CVD) or cancer, or had left the island for a considerable period of time during their life (i.e., >5 years), were not included in the study; these exclusion criteria were applied because the study aimed at assessing lifestyle patterns that were not subject to modifications due to existing chronic health care conditions or by environmental factors, other than living milieu.

A group of health scientists (physicians, dietitians, public health nutritionists and nurses) with experience in field investigation collected all of the required information using a quantitative questionnaire and standard procedures.

2.2. Bioethics

The study followed the ethical considerations provided by the World Medical Association (52nd WMA General Assembly, Edinburgh, Scotland, October 2000). The Institutional Ethics Board of Halkopio University approved the study design (16/19-12-2006). Participants were informed of the aims and procedures of the study and gave their consent prior to being interviewed.

2.3. Evaluation of clinical characteristics

All of the measurements taken in the different study centers were standardized. Weight and height were measured using standard procedures to attain body mass index (BMI) scores (kg/m^2); obesity was defined as $\text{BMI} > 29.9 \text{ Kg}/\text{m}^2$. Diabetes mellitus (type 2) was determined by fasting plasma glucose tests and was analyzed in accordance with the American Diabetes Association diagnostic criteria [glycated hemoglobin $\text{A1C} \geq 6.5$ or fasting blood glucose levels greater than $126 \text{ mg}/\text{dl}$, or 2-h plasma glucose $> 200 \text{ mg}/\text{dl}$ during an oral glucose tolerance test-(OGTT), or a random plasma glucose $> 200 \text{ mg}/\text{dl}$ or by history of previously established diagnosis of diabetes]. Participants who had blood pressure levels $> 140/90 \text{ mmHg}$ or used antihypertensive medications were classified as hypertensive. Fasting blood lipids levels (HDL-cholesterol, LDL-cholesterol and triglycerides) were also recorded and hypercholesterolemia was defined as total serum cholesterol levels $> 200 \text{ mg}/\text{dl}$ or the use of lipid-lowering agents according to the NCEP ATPIII guidelines.¹¹ The coefficient of variation for the blood measurements was less than 5%.

2.4. Evaluation of lifestyle and socio-demographic characteristics

Dietary habits were assessed through a semi-quantitative, validated and reproducible food-frequency questionnaire.¹² To evaluate the level of adherence to the Mediterranean diet, the MedDietScore (range 0-55) was used.¹³ Higher values for this diet score indicate greater adherence to the Mediterranean diet. Basic socio-demographic characteristics such as age, sex, employment status, adequate annual income (defined as $> 9.000\text{€}$ per person),

as well as lifestyle characteristics, such as smoking habits and physical activity status, were also recorded. Current smokers were defined as smokers at the time of the interview, while physical activity was evaluated in MET-minutes per week, using the shortened, translated and validated into Greek, version of the self-reported International Physical Activity Questionnaire (IPAQ).¹⁴ Individuals who reported at least 3 MET-minutes were classified as physically active. Symptoms of depression during the previous month were assessed using the validated Greek version (also translated into all the cohort's languages) of the shortened, self-report Geriatric Depression Scale (GDS) (range 0-20).¹⁵

Further details about the MEDIS study protocol have been extensively published elsewhere.^{16,17}

2.5. Statistical analysis

Continuous variables are presented as the mean \pm SD or otherwise stated, and categorical variables as frequencies. Comparisons of continuous variables between groups were performed using the independent samples t-test or the Mann-Whitney U test, depending on the distribution of the data; associations between categorical variables were tested using the Pearson's chi-square test. Binary logistic regression was used to evaluate the association between participants' characteristics (i.e., age, sex, physical activity, adherence to the Mediterranean diet, smoking habits, depression) and presence of cardiometabolic factors (hypertension, diabetes mellitus, hypercholesterolemia, obesity). The results are expressed as odds ratios and the 95% confidence intervals. Ordinal logistic regression was also used to evaluate the association between the participants' lifestyle characteristics (i.e., physical activity status, smoking habits, adherence to Mediterranean diet and depressive symptomatology) and overall CVD risk score measured as the sum of risk factors: history of hypertension, diabetes, hypercholesterolemia and obesity (range 0-4). SPSS software (version 20) was used for all calculations (SPSS Inc., Chicago, IL, USA).

3. Results

In [Table 1](#) basic socio-demographic, lifestyle and clinical characteristics of the participants are presented. Residents of the Greek islands were less likely to be retired, as approximately 38% of them reported to be still working, and had lower income levels. In addition, fewer people from Gökçeada were living alone. Furthermore, smoking was less frequent among Greek inhabitants in Gökçeada compared to their counterparts living in Greek islands. The level of adherence to the Mediterranean diet was 34 ± 4 for those from the Greek islands, whereas for those living in Gökçeada, the level of adherence was 33 ± 2 ($p = 0.003$). The burden of the common CVD risk factors (i.e., hypertension, diabetes, hypercholesterolemia and obesity) tends to be higher among residents of the Greek Aegean islands. Moreover, islanders of the Greek Aegean Sea had higher depression scores, when compared to their Greek counterparts on Gökçeada Island.

Table 1 Lifestyle, psychosocial and clinical characteristics of the MEDIS study participants.

	Overall sample (n = 724)	Greek Aegean Islands (n=669)	Gökçeada island (n=55)	p
Age (years)	74 ± 7	74 ± 7	75 ± 8	0.51
Men, %	44	43	51	0.25
Retired, %	64	62	80	0.008
Adequate financial status, %	11	11	20	<0.001
Living alone, %	24	24	22	0.81
Physical activity, %	43	43	43	0.96
Smoking habit, %	11	11	9.1	0.60
Daily tea consumption, %	55	52	73	<0.001
MedDietScore (range 0-55)	34 ± 4	34 ± 4	33 ± 2	0.003
Body Mass Index (Kg/m ²)	29 ± 5	29 ± 5	29 ± 4	0.05
Obesity, %	43	43	41	0.78
History of hypertension, %	66	67	55	0.06
History of diabetes, %	25	25	20	0.42
History of hypercholesterolemia, %	54	56	34	0.002
Geriatric Depression Scale (range 0–20)	1.4 ± 3	1.5 ± 3.1	1 ± 1.8	0.26

3.1. Area of residence and dietary habits

In [Table 2](#) the MedDietScore index and a breakdown of its components is presented. Consumption of olive oil and fruits was very high; likewise, vegetables, cereals, legumes and potatoes were frequently consumed by Eastern Aegean Sea islanders. On the other hand, fish, full fat dairy products, poultry and meat were less consumed by Greeks of this area. Both groups of older islanders reported similar consumption of meat and processed meat ($p=0.77$); however, Greeks of Gökçeada had higher consumption of cereals ($p<0.001$), fruit ($p<0.001$), vegetables ($p<0.001$), fish ($p<0.001$), poultry ($p=0.009$) and olive oil ($p=0.002$), compared to those of the Greek East Aegean islands. In contrast, Greeks from East Aegean islands reported higher consumption of potatoes ($p<0.001$), full fat dairy products ($p<0.001$) and alcohol ($p=0.001$), than those of Gökçeada. Overall, Greeks of the Greek Eastern Aegean islands had higher level of adherence to the Mediterranean diet compared to their

counterparts of the Gökçeada island (34 ± 4 vs 33 ± 2 , $p=0.003$).

3.2. Assessing of cardiometabolic risk

The CVD risk score of the overall sample was 1.8 ± 1.1 ; Greek islanders had higher score compared to their counterparts of Gökçeada island (1.9 ± 1.1 vs 1.4 ± 1.0 risk factors / participant, $p<0.001$). In [Table 3](#) are presented the results from logistic regression models that evaluated the association between lifestyle and psychological determinants (i.e., physical activity, smoking habits, MedDietScore and depressive symptomatology) and the prevalence of certain CVD risk factors. Regarding the overall sample, one unit increase in depression scale is associated with 3% higher odds for obesity. This finding is constant between the two areas, as shown by the results of the stratified analysis by region ([Table 3](#)).

Adjusting for age, sex, physical activity, smoking habits, MedDietScore and Geriatric Depression Scale (GDS), those

Table 2 Decomposition of the Mediterranean dietary pattern (i.e., MedDietScore), by MEDIS study region.

	Overall sample (n = 724)	Greek Aegean Islands (n=669)	Gökçeada island (n=55)	p
Cereals (score 0 – 5)	3.23 ± 0.6	3.21 ± 0.6	3.35 ± 0.4	< 0.001
Potatoes (score 0 – 5)	3.08 ± 0.8	3.09 ± 0.8	3.00 ± 0.4	< 0.001
Fruit (score 0 – 5)	4.50 ± 0.9	4.50 ± 0.9	4.80 ± 0.6	< 0.001
Vegetables (score 0 – 5)	3.54 ± 1.3	3.44 ± 1.3	4.76 ± 0.5	< 0.001
Legumes (score 0 – 5)	3.09 ± 0.8	3.09 ± 0.8	3.05 ± 0.5	0.049
Fish (score 0 – 5)	2.80 ± 0.8	2.78 ± 0.8	2.96 ± 0.7	< 0.001
Meat and processed meat (score 0 – 5)	1.97 ± 0.8	1.96 ± 0.8	2.07 ± 0.8	0.77
Poultry (score 0 – 5)	2.17 ± 0.7	2.05 ± 0.5	2.27 ± 0.8	0.009
Full fat Dairy (score 0 – 5)	2.36 ± 1.4	2.40 ± 1.3	2.00 ± 2.0	< 0.001
Olive oil (score 0 – 5)	4.82 ± 0.7	4.80 ± 0.8	4.98 ± 0.1	0.002
Alcohol (score 0 – 5)	0.54 ± 1.3	0.58 ± 1.3	0.26 ± 0.8	0.001
MedDietScore (0 – 55)	34 ± 4	34 ± 4	33 ± 2	0.003

Table 3 Results from logistic regression models that evaluated the association between lifestyle determinants (exposure factors) on CVD risk factors, i.e., history of diabetes mellitus, hypertension, hypercholesterolemia and obesity (dependent outcomes).

		Diabetes	Hypertension	Hypercholesterolemia	Obesity
<i>Overall sample</i>	Age (1 yr)	0.99 (0.97 – 1.02)	1.02 (1.00 – 1.05)	0.96 (0.94 – 0.99)	0.97 (0.95 – 1.00)
	Sex (m/f)	0.92 (0.62 – 1.35)	0.5 (0.35 – 0.71)	0.55 (0.39 – 0.77)	0.46 (0.33 – 0.65)
	Physical activity (y/n)	0.83 (0.57 – 1.2)	0.81 (0.58 – 1.13)	1.36 (0.98 – 1.88)	0.69 (0.5 – 0.96)
	Smoking habits (y/n)	0.54 (0.27 – 1.06)	0.70 (0.42 – 1.18)	0.52 (0.31 – 0.89)	0.62 (0.36 – 1.09)
	MedDietScore (per 1/55)	1.04 (1.00 – 1.09)	0.99 (0.95 – 1.03)	0.99 (0.95 – 1.03)	0.98 (0.94 – 1.02)
	GDS (per 1/20)	0.99 (0.93 – 1.05)	0.93 (0.88 – 0.98)	0.99 (0.94 – 1.05)	1.03 (0.98 – 1.08)
	<i>Eastern Aegean Islanders living in Greek Islands</i>	Age (1 yr)	0.99 (0.97 – 1.02)	1.02 (1.00 – 1.05)	0.97 (0.94 – 0.99)
Sex (m/f)		0.93 (0.63 – 1.39)	0.52 (0.36 – 0.75)	0.55 (0.39 – 0.79)	0.45 (0.32 – 0.65)
Physical activity (y/n)		0.9 (0.62 – 1.32)	0.83 (0.59 – 1.18)	1.34 (0.96 – 1.88)	0.67 (0.48 – 0.94)
Smoking habits (y/n)		0.5 (0.25 – 1.02)	0.77 (0.45 – 1.31)	0.48 (0.28 – 0.83)	0.56 (0.31 – 1.02)
MedDietScore (per 1/55)		1.04 (0.99 – 1.09)	0.99 (0.95 – 1.04)	0.99 (0.95 – 1.03)	0.98 (0.94 – 1.02)
GDS (per 1/20)		0.99 (0.93 – 1.05)	0.94 (0.89 – 0.99)	0.99 (0.94 – 1.05)	1.03 (0.97 – 1.08)
<i>Greek Gökçeada Islanders</i>		Age (1 yr)	1.00 (0.85 – 1.16)	1.13 (0.98 – 1.31)	0.97 (0.87 – 1.07)
	Sex (m/f)	0.77 (0.07 – 7.73)	0.52 (0.09 – 3.13)	0.56 (0.1 – 3.19)	0.49 (0.1 – 2.31)
	Physical activity (y/n)	Not estimated	0.37 (0.06 – 2.23)	1.7 (0.37 – 7.83)	1.07 (0.25 – 4.51)
	Smoking habits (y/n)	1.53 (0.06 – 36.53)	Not estimated	2.94 (0.25 – 34.53)	2.75 (0.24 – 32.07)
	MedDietScore (per 1/55)	1.17 (0.85 – 1.62)	0.75 (0.54 – 1.03)	0.94 (0.69 – 1.29)	0.95 (0.71 – 1.28)
	GDS (per 1/20)	0.93 (0.44 – 1.94)	0.55 (0.28 – 1.06)	0.89 (0.56 – 1.42)	0.96 (0.65 – 1.43)

Results are presented as Odds Ratios and their corresponding 95% CI; Not estimated due to lack of sufficient data. GDS: Geriatric Depression Scale.

living in the Greek Aegean islands had 2 times higher odds (95% CI, 1.04 – 3.87) for having hypertension, 1.53 times higher odds (95% CI, 0.66 – 3.54) for having diabetes mellitus, 3.29 times higher odds (95% CI, 1.58 – 6.81) for having hypercholesterolemia and 0.78 times higher odds (95% CI, 0.4 – 1.52) for being obese, compared to those living in Gökçeada.

Ordinal logistic regression analysis revealed an inverse relationship between CVD risk score and age (Beta=-0.02, p=0.04) in Eastern Aegean islanders, i.e., the older the participant the lower the burden of CVD risk factors; in contrary, male sex (Beta=0.80, p<0.001) and smoking habits (Beta=0.83, p=0.001) were positively associated with CVD risk score. No other factors, physical activity status, MedDietScore or depression level was associated with CVD risk factors' burden (all p's >0.20).

4. Discussion

The present study revealed that overall CVD risk seems to be low among Eastern Aegean Islanders, i.e., on average less than 2 of the common risk factors per participant; however, certain differences may exist between Greek islanders and their counterparts living in Gökçeada, which may be attributed to various environmental, cultural and lifestyle factors. Many people in this area exercise regularly as part of their daily routine, and few older adults smoke. Additionally, they have low rates of depression symptoms, as expressed by the geriatric depression scale, which may indicate better mental health and happiness. Moreover, they were devoted to a healthy diet similar to the Mediterranean diet; their nutrition was based primarily on fruits, vegetables, olive oil, cereals, and legumes, with less emphasis on the consumption of meat

products. They also consumed small quantities of alcohol daily. Furthermore, Eastern Aegean islanders enjoyed satisfactory health with few cardiometabolic risk factors (fewer than 2 per participant). This is a very interesting finding, as cardiovascular disease is the leading cause of death around the world.¹⁸ Compared with the older inhabitants of the Greek Eastern Aegean islands, the older Greeks of Gökçeada seem to have had a better lifestyle profile, as expressed by financial status, smoking habits, physical activity, depression, and most importantly by the percentage of people suffering from obesity, diabetes mellitus, dyslipidemia and hypertension. On the other hand, older residents of the Greek Eastern Aegean islands seem to have had better dietary habits, as expressed by the MedDietScore. This was predominantly due to their lifestyle differences. The percentage of the population who were retired was higher in Gökçeada, which allowed them to give priority to achieving a more healthy lifestyle without the stress adding by working or by the financial crisis that is currently impacting their peers in the Greek Eastern Aegean islands. A number of Eastern Aegean Sea islanders' characteristics, such as low rates of smoking, daily physical activity, and healthy eating habits, are among those that contribute to longevity.^{19,20} Daily physical activity is an important contributor to longevity and healthy aging as it helps protect the cardiovascular, the respirational and the musculoskeletal systems.²¹ Moreover, the overall sample of Eastern Aegean islanders scored an average of 34 on the MedDietScore, while the scores of the two groups (Gökçeada islanders vs residents of Greek islands) were very similar and ranged from 33 to 34; this demonstrated that both groups had moderate to good adherence to the Mediterranean diet. It has been proved that better adherence to the Mediterranean diet is associated with longevity.^{22–24}

Researchers support that the factors that influence longevity and healthy aging are not clear, and as a consequence, the definition of longevity is complex.²⁵ However, it is said that lifespan may be determined by environmental and genetic factors, as well as attitudes.²⁶ The best example is Ikaria, an island of the Eastern Aegean Sea, that is generally recognized for its high percentage of centenarians.²⁷ The land morphology and climate of this island are similar to that of the surrounding islands. Furthermore, Greek older residents of this region share the same Greek culture, though those living in Gökçeada may have altered some customs. It is common for people who were born and raised in a different country, or even under different conditions, to maintain the customs of earlier years, perhaps with some necessary adjustments.²⁸ Studies investigating the low all-cause mortality despite the high cardiovascular disease risk of older Greek-born Australians have reported that their Greek roots are apparent even though they live in a different country from that of their parents. They have a diet very similar the Mediterranean diet in other words adherence to the Mediterranean diet serves as a protective factor against genetically pre-determined risk and saves their lives. Greek-born Australians had low risk of death regardless of whether they were obese or had cardiovascular disease risk factors.²⁹ Additionally, adherence to a diet similar to the Mediterranean diet could have longevity benefits not only Greek-born Australians but also those with Anglo-Celtic origins.³⁰ Moreover, a similar phenomenon occurs among those of Japanese origin born in either Brazil or

Japan. Brazilian-born Japanese individuals have altered their dietary habits, as well as their traditional customs, due to the lack of certain goods or the availability of others. Therefore, the prevalence of some dietary-related diseases varies by country of origin and residence.³¹ Interactions between western and south-eastern European civilizations could alter various nutritional or lifestyle habits, causing individuals to adopt a more westernized diet over a Mediterranean one, or to fail to achieve smoking cessation; this could cause higher than expected rates of cardiovascular diseases in some regions.³² For example, some differences in tea consumption have been observed between the older residents of the Greek islands of the Eastern Aegean Sea and those of Gökçeada. This fact is mostly owing to the strong tradition of tea and coffee consumption in Turkey. The results of MEDIS study regarding long-term tea consumption and the prevalence of diabetes mellitus in the aged islanders of the Mediterranean Sea, showed that moderate tea consumption (either black or green) in quantities of 1 – 2 cups per day was associated with 70% lower likelihood of having diabetes mellitus among the older adults, regardless of age, sex, smoking, physical activity, dietary habits and other clinical characteristics. Furthermore, the same study showed that long-term tea consumption (over 30 years) is related to reduced prevalence of diabetes among older people on the Mediterranean islands.^{33,34} Moreover, a meta-analysis of 18 prospective studies revealed that green tea consumption (one more cup per day) — is related to a 5% lower mortality risk due to cardiovascular disease. Thus, green and black tea has an inversely proportional relation to cardiovascular diseases and cancers.³⁵

It is well known that smoking is responsible for increased incidence of many diseases. The low prevalence of smoking among Greek islanders is encouraging for their health and quality of life. In Greece, it is estimated that 45% of Greeks are smokers and as a consequence, the percentage of people who are exposed to second-hand smoke is probably larger.³⁶ The proper function of body and mind, and the ability to enhance this functions through the prevention of disease between the ages of 65 and 80 have crucial significance for the quality of life and the ability to remain independent after age 80.³⁷ Results of the MEDIS study (2009) showed that the prevalence of diabetes mellitus in some Mediterranean islands, including islands of the Eastern Aegean Sea, is increasing.¹⁷ Hypertension is the most frequently appearing risk factor among the older adults, not only in the present study but also in the general population. The prevalence of hypertension is the same in Eastern European countries as it is in Western European countries and in the United States of America.³⁸ In addition, it is regarded as one of the most important risk factors for cardiovascular and renal diseases. Finally, a study investigating the interactions between diet, lifestyle, genetics, and the cardiovascular and metabolic characteristics in the Turkish population demonstrated, significant correlations between nutritional habits, genetics, and some cardiometabolic diseases.³⁹

4.1. Limitations

Among the limitations of the study, the fact that this is a cross-sectional survey limits the possibility for causal

relationships. In addition, the sample of Gökçeada was small and consisted only of individuals of Greek origin. Additionally, this study utilized self-reported questionnaires, which are often biased.

4.2. Conclusions

Overall CVD risk seems to be low among Eastern Aegean Islanders; certain differences exist between Greek islanders and their counterparts living in Gökçeada, that may be attributed to various environmental, cultural and lifestyle factors. Lifestyle habits, such as nutritional habits, physical engagement, and smoking cessation, seem to play an important role in the health of the older adults. Public health should focus on initiatives to help this group to enhance their longevity and quality of life through disease prevention and the promotion of healthier lifestyles that include physical activity and healthy diets.

Acknowledgements

We are particularly grateful to the men and women from the islands of Lesbos, Samothraki, Lemnos, Icaria, Kassos, Rhodes, Karpathos, and Gökçeada, who participated in this research. The MEDIS study group is: M. Tornaritis, A. Polystiopi, M. Economou, (field investigators from Cyprus), A. Zeimbekis, K. Gelastopoulou, I. Vlachou (field investigator from Lesbos), I. Tsiligianni, M. Antonopoulou, N. Tsakountakis, K. Makri (field investigators from Crete), E. Niforatos, V. Alpentzou, M. Voutsadaki, M. Galiatsatos (field investigators from Cephalonia), K. Voutsas, E. Lioliou, M. Miheli (field investigator from Corfu), S. Tyrovolas, G. Pounis, A. Katsarou, E. Papavenetiou, E. Apostolidou, G. Papavassiliou, P. Stravopodis (field investigators from Zakynthos), E. Tourloukis, V. Bountziouka, A. Aggelopoulou, K. Kaldaridou, E. Qira, (field investigators from Syros and Naxos), D. Tyrovola (field investigator from Kassos), I. Protopappa (field investigator from Icaria), C. Prekas, O. Blaserou, K.D. Balafouti (field investigators from Salamina), S. Ioakeimidi (field investigators from Rhodes and Karpathos), A. Foscolou (field investigator from Tinos), A. Mariolis, E. Petropoulou, A. Kalogerakou, K. Kalogerakou (field investigators from Mani), S. Piscopo (field investigators from Malta), J.A. Tur (field investigators from Mallorca and Menorca), G. Valacchi, B. Nanou (field investigators from Sardinia and Sicily), A. Foscolou, E. Paka, P. Drepanidis (field investigators from Gökçeada) for their substantial assistance in the enrolment of the participants.

Conflict of interest

None of the authors have any conflict of interest related to this project.

Funding

The study has been funded by research grants from the Hellenic Heart Foundation (KE 344/HUA/2016).

Stefano Tyrovola's work was supported by the Foundation for Education and European Culture (IPEP), the Sara

Borrell postdoctoral programme (reference no. CD15/00019) from the Instituto de Salud Carlos III (ISCIII – Spain), and the Fondos Europeo de Desarrollo Regional (FEDER).

References

1. Quaglio G, Karapiperis T, Van Woensel L, Arnold E, McDaid D. Austerity and health in Europe. *Health Policy*. 2013;113(1-2): 113–119.
2. Van Hal G. The true cost of the economic crisis on psychological well-being: a review. *Psychol Res Behav Manag*. 2015;8: 17–25.
3. Karanikolos M, Mladovsky P, Cylus J, et al. Financial crisis, austerity, and health in Europe. *Lancet*. 2013;381(9874): 1323–1331.
4. Karavidas A, Lazaros G, Tsiachris D, Pyrgakis V. Aging and the cardiovascular system. *Hellenic J Cardiol*. 2010;51(5): 421–427.
5. Buettner D. *The Blue Zones*. Washington DC: National Geographic Pub.; 2011.
6. Stefanadis Cl. Aging, genes and environment: lessons from the Ikaria study. *Hellenic J Cardiol*. 2013;54(3):237–238.
7. Chrysohoou C, Pitsavos C, Lazaros G, Skoumas J, Tousoulis D, Stefanadis C. Determinants of all-cause mortality and incidence of cardiovascular disease (2009 to 2013) in older adults: the Ikaria study of The Blue Zones. *Angiology*. 2016;67(6): 541–548.
8. Stefanadis Cl. Unveiling the secrets of longevity: the Ikaria study. *Hellenic J Cardiol*. 2011;52(5):479–480.
9. Poulain M, Herm A, Pes G. The Blue Zones: areas of exceptional longevity around the world. *Vienna Yearb Popul Res*. 2013;11: 87–108.
10. Noah A, Truswell AS. There are many Mediterranean diets. *Asia Pac J Clin Nutr*. 2001;10(1):2–9.
11. Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. Executive summary of the third report of the National Cholesterol Education Program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (Adult Treatment Panel III). *JAMA*. 2001;285(19):2486–2497.
12. Tyrovolas S, Pounis G, Bountziouka V, Polychronopoulos E, Panagiotakos DB. Repeatability and validation of a short, semi-quantitative food frequency questionnaire designed for older adults living in Mediterranean areas: the MEDIS-FFQ. *J Nutr Elder*. 2010;29(3):311–324.
13. Panagiotakos DB, Pitsavos C, Stefanadis C. Dietary patterns: a Mediterranean diet score and its relation to clinical and biological markers of cardiovascular disease risk. *Nutr Metab Cardiovasc Dis*. 2006;16(8):559–568.
14. Papanthanasidou 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(4):283–294.
15. Fountoulakis KN, Tsolaki M, Iacovides A, et al. The validation of the short form of the Geriatric Depression Scale (GDS) in Greece. *Aging (Milano)*. 1999;11(6):367–372.
16. Tyrovolas S, Haro JM, Mariolis A, et al. Successful ageing, dietary habits and health status of elderly individuals: a k-dimensional approach within the multi-national MEDIS study. *Exp Gerontol*. 2014;60:57–63.
17. Tyrovolas S, Zeimbekis A, Bountziouka V, et al. Factors associated with the prevalence of diabetes mellitus among elderly men and women living in Mediterranean Islands: the MEDIS study. *Rev Diabet Stud*. 2009;6(1):54–63.
18. Stefanadis Cl. Management of arterial hypertension: from no treatment to renal denervation. *Hellenic J Cardiol*. 2015; 56(3):277–278.

19. Willcox BJ, He Q, Chen R, et al. Midlife risk factors and healthy survival in men. *JAMA*. 2006;296(19):2343–2350.
20. Yates LB, Djoussé L, Kurth T, Buring JE, Gaziano JM. Exceptional longevity in men: modifiable factors associated with survival and function to age 90 years. *Arch Intern Med*. 2008;168(3):284–290.
21. Young J, Angevaren M, Rusted J, Tabet N. Aerobic exercise to improve cognitive function in older people without known cognitive impairment. *Cochrane Database Syst Rev*. 2015;4:CD005381.
22. Trichopoulou A, Vasilipoulou E. Mediterranean diet and longevity. *Br J Nutr*. 2000;84(Suppl. 2):S205–S209.
23. Trichopoulou A, Costacou T, Bamia C, Trichopoulos D. Adherence to a Mediterranean diet and survival in a Greek population. *N Engl J Med*. 2003;348(26):2599–2608.
24. Trichopoulou A. Traditional Mediterranean diet and longevity in the elderly: a review. *Public Health Nutr*. 2004;7(7):943–947.
25. Kolovou G, Barzilai N, Caruso C, et al. The challenges in moving from ageing to successful longevity. *Curr Vasc Pharmacol*. 2014;12(5):662–673.
26. Tourlouki E, Polychronopoulos E, Zeimbekis A, et al. The ‘secrets’ of the long lives in Mediterranean islands: the MEDIS study. *Eur J Public Health*. 2010;20(6):659–664.
27. Panagiotakos DB, Chrysohoou C, Siasos G, et al. Sociodemographic and lifestyle statistics of oldest old people (>80 years) living in Ikaria island: the Ikaria study. *Cardiol Res Pract*. 2011;2011:679187.
28. Kouris-Blazos A, Wahlqvist ML, Trichopoulou A, Polychronopoulos E, Trichopoulos D. Health and nutritional status of elderly Greek migrants to Melbourne, Australia. *Age Ageing*. 1996;25(3):177–189.
29. Kouris-Blazos A, Itsiopoulos C. Low all-cause mortality despite high cardiovascular risk in elderly Greek-born Australians: attenuating potential of diet? *Asia Pac J Clin Nutr*. 2014;23(4):532–544.
30. Kouris-Blazos A, Gnardellis C, Wahlqvist ML, Trichopoulos D, Lukito W, Trichopoulou A. Are the advantages of the Mediterranean diet transferable to other populations? A cohort study in Melbourne, Australia. *Br J Nutr*. 1999;82(1):57–61.
31. Cardoso MA, Hamada GS, de Souza JM, Tsugane S, Tokudome S. Dietary patterns in Japanese migrants to southeastern Brazil and their descendants. *J Epidemiol*. 1997;7(4):198–204.
32. Tousoulis D. The Need for More Research in Europe. *Hellenic J Cardiol*. 2015;56(5):449–450.
33. Panagiotakos DB, Lionis C, Zeimbekis A, et al. Long-term tea intake is associated with reduced prevalence of (type 2) diabetes mellitus among elderly people from Mediterranean islands: MEDIS epidemiological study. *Yonsei Med J*. 2009;50(1):31–38.
34. Polychronopoulos E, Zeimbekis A, Kastorini C-M, et al. Effects of black and green tea consumption on blood glucose levels in non-obese elderly men and women from Mediterranean Islands (MEDIS epidemiological study). *Eur J Nutr*. 2008;47(1):10–16.
35. Tang J, Zheng J-S, Fang L, Jin Y, Cai W, Li D. Tea consumption and mortality of all cancers, CVD and all causes: a meta-analysis of eighteen prospective cohort studies. *Br J Nutr*. 2015;114(5):673–683.
36. Stefanadis CI. Exposure to second-hand smoke and cardiovascular health: time to act. *Hellenic J Cardiol*. 2008;49(1):63–64.
37. Vaughan L, Leng X, La Monte MJ, Tindle HA, Cochrane BB, Shumaker SA. Functional independence in late-life: maintaining physical functioning in older adulthood predicts daily life function after age 80. *J Gerontol A Biol Sci Med Sci*. 2016;71(Suppl. 1):S79–S86.
38. Brambilla G, Bombelli M, Seravalle G, et al. Prevalence and clinical characteristics of patients with true resistant hypertension in central and Eastern Europe: data from the BP-CARE study. *J Hypertens*. 2013;31(10):2018–2024.
39. Karaca S, Erge S, Cesuroglu T, Polimanti R. Nutritional habits, lifestyle, and genetic predisposition in cardiovascular and metabolic traits in Turkish population. *Nutrition*. 2015.