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Metabolic profile of the Mediterranean healthy Eating, Lifestyle and Aging (MEAL) study cohort

Antonio Mistretta[a], Stefano Marventano[a], Alessio Platania[b], Justyna Godos[c,d], Fabio Galvano[c,d] and Giuseppe Grosso[c,e,*]

[a]*Department of Medical and Surgical Sciences and Advanced Technologies "G.F. Ingrassia", University of Catania, Catania, Italy*
[b]*Department of Out of Hours Primary Care, ASP3 Catania, Italy*
[c]*Integrated Cancer Registry of Catania-Messina-Siracusa-Enna, Azienda Ospedaliera Universitaria Policlinico "Vittorio Emanuale", Catania, Italy*
[d]*Department of Biomedical and Biotechnological Sciences, University of Catania, Catania, Italy*
[e]*NNEdPro Global Centre for Nutrition and Health (Affiliated with: Cambridge University Health Partners, Wolfson College Cambridge and the British Dietetic Association), St John's Innovation Centre, Cambridge, UK*

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Abstract.
BACKGROUND: Metabolic profiles of individuals living in the Mediterranean area is changing over time, with significant increase of average body weight, blood pressure, blood glucose and lipids.
OBJECTIVE: The main aim was to assess the prevalence of excess weight, hypertension, diabetes and dyslipidemia and their interrelationships between specific background characteristics (age, sex, educational, occupational, physical activity, smoking and marital status, and alcohol drinking habits).
METHODS: The paper is based on the Mediterranean healthy Eating, Lifestyle and Aging (MEAL) study cohort, which is a cross-sectional survey carried out in Sicily between 2014 and 2015. A final sample of 1,814 individuals with complete information on demographic and lifestyle characteristics was examined.
RESULTS: The overall prevalence of overweight and obesity was 35.7% and 17.6%, respectively; 57.6% of men and 45.3% of women were hypertensive, 11.1% of men and 5.1% of women were diabetic, and 14.6% of men and 21.2% of women suffered by dyslipidemia. Besides various expected associations, such as better metabolic status in high physical active and non-smoker individuals, with higher education or occupational status were more likely, to a various extent, to suffer of metabolic disorders.
CONCLUSIONS: Public health prevention campaigns should better target individuals more likely to suffer of metabolic disorders, including those with higher education and occupational level, which were supposed to be at lower risk of cardio-metabolic diseases. Future studies should better investigate the possible positive associations and determining factors of excess body weight and hypertension with higher socio-economic status in Southern Italy.

Keywords: Metabolic profile, BMI, blood pressure, Mediterranean, cohort study

*Corresponding author: Giuseppe Grosso, MD, PhD, Integrated Cancer Registry of Catania-Messina-Siracusa-Enna, Via S. Sofia 85, 95123 Catania, Italy. Tel.: +39 0953782182; Fax: +39 0953782177; E-mail: giuseppe.grosso@studium.unict.it.

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1. Introduction

Individuals living in the Mediterranean regions have been historically characterized by lower rates of cardiovascular disease compared to northern populations [1]. This could be attributed to an overall healthier lifestyle, including high physical activity and high diet quality lately identified with the so-called Mediterranean dietary pattern [2]. Nowadays this condition has changed and metabolic-related diseases have become a major public health threats in the Mediterranean region: Greece, Spain, and Italy have the highest prevalence of both overweight and obesity in Europe [3] accompanied with a rise in diabetic individuals [4] and an increase up to 40% of Italian adult hypertensive population [5]. Overall, elevated blood pressure, high BMI and waist circumference, and fasting blood glucose represent a cluster of conditions that tend to be related each other and representing the major contributor to the global burden of cardiovascular diseases [6].

Social and economic changes observed in Southern European countries may have been responsible for the variation in lifestyle that shaped current prevalence of metabolic disorders [7]. From a public health point of view, it is important to identify groups in which trends in metabolic disorders are less favorable in order to better target more effective interventions program. The association between educational and social disparities with obesity and metabolic-related disorders has been widely reported [8, 9]: higher socioeconomic and educational status has been associated with higher adherence to a Mediterranean dietary pattern in Mediterranean countries, suggesting that food choices are driven by economic allowance and cultural background, which in turn may affect health status [10–13]. However, the social gradient also depends on the country's stage of economic development, cultural factors, and social and health policies, thus further complicating the identification of determinants and its characteristics [14]. The present study aimed to describe the metabolic profile and background characteristics associated with prevalence of overweight, obesity, hypertension, diabetes, and dyslipidemia (Mediterranean healthy Eating, Lifestyle and Aging (MEAL) study cohort).

2. Methods

2.1. Study population

The MEAL study is an observational study aimed to explore the relation between nutritional and lifestyle behaviors characterizing individuals living in the Mediterranean area. The detailed study protocol has been reported in the past [15]. Briefly, a random sample of men and women aged 18 years old and over registered in the records of local general practitioners (GPs) stratified by sex and 10-year age groups, was selected in the urban area of Catania, one of the largest cities in the east coast of Sicily, southern Italy. The theoretical sample size was set at 1500 individuals to provide a specific relative precision of 5% (Type I error, 0.05; Type II error, 0.10), taking into account an anticipated 70% participation rate. The sampling technique included stratification by municipality area, age, and sex of inhabitants, and randomization into subgroups, with randomly selected general practitioners being the sampling units, and individuals registered to them comprising the final sample units. Pregnant women were not considered in this study. Out of 2,405 individuals invited, the final sample size was 2,044 participants (response rate of 85%), out of which 230 were excluded due to missing information, leaving a total number of 1,814 participants used for this analysis.

2.2. Data collection

Data have been collected through measurements and structured interviews performed during the visit at the general practitioners' clinics. After selection through the list of the GP, the patient was invited to attend the visit and participate to the study. The visit was hold in a separate room adequately equipped to perform a physical examination. Interviewers were trained nurses or dieticians under the supervision of a medical doctor. Information

retrieved regarded demographic data, including sex, age, latest educational degree achieved, occupation (specifies the character of the most important employment during the year before the investigation) or last occupation before retirement, and marital status. Educational level was categorized as (i) low (primary/secondary), (ii) medium (high school), and (ii) high (university). Occupational level was categorized as (i) unemployed, (ii) low (unskilled/unemployed workers), (iii) medium (partially skilled workers), and (iv) high (skilled workers). Among lifestyle characteristics, information on smoking habits, alcohol drinking, and physical activity was collected. Smoking status was categorized as (i) non-smoker, (ii) ex smoker, and (iii) current smoker. Alcohol consumption was categorized as (i) none, (ii) moderate drinker (0.1–12 g/d) and (ii) regular drinker (>12 g/d). Physical activity level was evaluated through the International Physical Activity Questionnaires (IPAQ) [11], which comprised a set of questionnaires (5 domains) investigating the time spent being physically active in the last 7 days: based on the IPAQ guidelines, final scores allows to categorized physical activity level as (i) low, (ii) moderate, and (iii) high.

2.3. Anthropometric measurements and metabolic variables ascertainment

Anthropometric examinations were collected using standardized methods. Height was measured to the nearest 0.5 cm without shoes, with the back square against the wall tape, eyes looking straight ahead, with a right-angle triangle resting on the scalp and against the wall. Body mass index (BMI) was calculated, and patients were categorized as under/normal weight (BMI $< 25\ Kg/m^2$), overweight (BMI 25 to $29.9\ Kg/m^2$), and obese (BMI $> 30\ Kg/m^2$) [12]. Waist circumference (centimeters) was measured midway between the 12th rib and the iliac crest and hip circumference (centimeters) around the buttocks, at the level of the maximum extension. Waist-to-hip ratio was then calculated. Arterial blood pressure was measured at the end of the physical examination with subject in sitting position and at least 5 minutes at rest. Blood pressure measurements was taken three times at the right arm relaxed and well supported by a table, with an angle of 45° from the trunk. A mean of the last two measurements was considered for inclusion in the database. Information from measurements was integrated with general practitioners computerized records, as a specialist diagnoses patients with disease in order to obtain drug. Patients have been considered hypertensive when average systolic/diastolic blood pressure levels were greater or equal to 140/90 mm Hg, taking anti-hypertensive medications, or being previously diagnosed of hypertension; patients were considered diabetic or dyslipidemic whether previously diagnosed of diabetes and hypercholesterolemia/hypertriglyceridemia, respectively.

2.4. Statistical analysis

Frequencies are presented as absolute numbers and percentages; continuous variables are presented as means and standard deviations. Differences between groups were compared with Chi-square test for categorical variables, Student's *t*-test or Mann-Whitney U-test were used for variables distributed normally and not normally, respectively. Multivariate logistic regression analyses were used to test association between background characteristics and the outcomes considered. All reported *P* values were based on two-sided tests and compared to a significance level of 5%. SPSS 17 (SPSS Inc., Chicago, IL, USA) software was used for all the statistical calculations.

3. Results

The overall prevalence of overweight and obesity estimated for the adult population of the MEAL cohort was 35.7% and 17.6%, respectively (Table 1). Men had a higher prevalence of overweight than women, but women had a higher prevalence of obesity than men. Men also showed higher BMI and WC than women, while HC and WHR were rather similar (Table 1). The mean systolic and diastolic blood pressure in men was 124.6 and 77.5, respectively, and in women 119.6 and 73.4 respectively. Regarding the overall prevalence of individuals being under medication for specific conditions and having confirmation of diagnosis by a medical specialist, 57.6% of

Table 1
Anthropometric characteristics and prevalence of obesity and overweight of study participants

	Total (n = 1,814)	Men (n = 742)	Women (n = 1,072)
BMI, mean (SD)	25.81 (4.54)	26.40 (3.61)	25.40 (5.05)
WC (cm), mean (SD)	89.26 (15.60)	95.50 (13.38)	84.98 (15.57)
HC (cm), mean (SD)	101.51 (13.89)	101.49 (15.07)	101.49 (15.07)
WHR, mean (SD)	0.99 (0.05)	0.99 (0.02)	0.98 (0.07)
Overweight, n (%)	647 (35.7)	366 (49.3)	281 (26.2)
Obesity, n (%)	320 (17.6)	101 (13.6)	219 (20.4)
Systolic blood pressure, mean (SD)	121.70 (12.85)	124.65 (10.50)	119.66 (13.89)
Diastolic blood pressure, mean (SD)	75.16 (10.44)	77.59 (9.73)	73.49 (10.57)
Hypertension, n (%)	984 (50.4)	468 (57.6)	516 (45.3)
Diabetes, n (%)	148 (7.6)	90 (11.1)	58 (5.1)
Dyslipidemias, n (%)	360 (18.4)	119 (14.6)	241 (21.2)

men and 45.3% of women were hypertensive, 11.1% of men and 5.1% of women were diabetic, and 14.6% of men and 21.2% of women suffered by dyslipidemia.

Excess body weight stratified by background characteristics is shown in Table 2. Individuals in the highest category of occupational class and marital status were more likely to have excess body weight but not obesity. Among lifestyle characteristics, current smoking and high physical activity were directly and inversely associated with both excess body weight and obesity, while individuals consuming alcohol regularly were less likely to be obese (Table 2). Analyses stratified by sex revealed some differences: higher occupational status was positively and inversely associated with obesity but not excess body weight. In contrast, marital status and current smoking were associated with excess body weight. Physically active individuals were less likely to have excess body weight and obesity while alcohol was positively associated. In women, marital status, current smoking, and physical activity were associated with both excess body weight and obesity, while women consuming alcohol frequently was associated with lower odds of being obese. However, ex smokers and medium occupational status category showed inverse trends.

Regarding hypertension (Table 3), there were contrasting results between men and women on educational status: the former were more likely to be hypertensive with increasing level of education while the latter had opposite association trends. There was no association between hypertension and occupational, marital, and smoking status, while men with medium physical activity level and moderate alcohol consumption were less likely to be hypertensive (Table 3). Diabetes was directly associated with high education, being married and current smoking and inversely with higher physical activity level and high alcohol consumption in men (Table 4). Dyslipidemias were directly associated with current smoking in men, and indirectly with moderate and high physical activity in both men and women (Table 5).

In Table 6 are shown lifestyle factors associated with high education and occupational status. Findings were consistent between men and women, showing an inverse association between high education and occupational status and variables such as age, marital status, and current smoking, while a positive association with medium physical activity was found.

4. Discussion

Data from 1.814 individuals living in southern Italy was investigated to assess the relation between their metabolic profile and socio-demographic characteristics. Besides various expected associations, such as better metabolic status in high physical active and non-smoker individuals, an association between metabolic conditions

Table 2

Multivariate logistic regression analysis of sociodemographic and lifestyle characteristics of men and women associated with normal/low weight (BMI < 25 kg/m^2), excess weight (BMI ≥ 25 kg/m^2) and obesity (BMI ≥ 30 kg/m^2)

	BMI<25 (n = 848)	BMI ≥ 25 (n = 966)	Total		Men		Women	
			Excess weight, OR (95% CI)[a]	Obesity, OR (95% CI)[a]	Excess weight, OR (95% CI)[a]	Obesity, OR (95% CI)[a]	Excess weight, OR (95% CI)[a]	Obesity, OR (95% CI)[a]
Educational level, n (%)								
Low	230 (27.1)	407 (42.1)	1	1	1	1	1	1
Medium	346 (40.8)	336 (34.8)	0.88 (0.65, 1.20)	0.71 (0.49, 1.03)	1.33 (0.76, 2.32)	1.80 (0.87, 3.74)	0.77 (0.51, 1.17)	0.54 (0.32, 0.92)
High	272 (32.1)	223 (23.1)	0.82 (0.57, 1.19)	0.69 (0.44, 1.09)	1.12 (0.58, 2.18)	1.43 (0.59, 3.47)	0.68 (0.41, 1.11)	0.62 (0.34, 1.12)
Occupational level, n (%)								
Unemployed	239 (32.2)	199 (24.3)	1	1	1	1	1	1
Low	101 (13.6)	146 (17.8)	1.28 (0.88, 1.87)	1.08 (0.69, 1.67)	2.37 (0.93, 6.00)	0.11 (0.25, 0.50)	1.14 (0.69, 1.89)	3.19 (1.81, 5.61)
Medium	168 (22.6)	248 (30.2)	1.40 (0.99, 1.96)	0.77 (0.50, 1.20)	3.24 (1.39, 7.55)	0.17 (0.04, 0.72)	0.74 (0.46, 1.20)	0.40 (0.19, 0.85)
High	234 (31.5)	227 (27.7)	1.49 (1.04, 2.14)	0.96 (0.61, 1.51)	2.64 (1.10, 6.31)	0.04 (0.01, 0.21)	0.98 (0.61, 1.59)	2.54 (1.42, 4.53)
Marital status, n (%)								
Unmarried/single	424 (50.0)	276 (28.6)	1	1	1	1	1	1
Married/partner	424 (50.0)	690 (71.4)	2.00 (1.51, 2.64)	1.14 (0.80, 1.61)	2.49 (1.58, 3.93)	1.03 (0.54, 1.95)	1.75 (1.16, 2.63)	2.20 (1.30, 3.74)
Smoking status, n (%)								
No smoker	542 (63.9)	589 (61.0)	1	1	1	1	1	1
Ex smoker	250 (29.5)	182 (18.8)	0.74 (0.55, 0.98)	0.77 (0.52, 1.14)	1.23 (0.77, 1.96)	1.39 (0.66, 2.93)	0.45 (0.30, 0.69)	0.84 (0.49, 1.43)
Current smoker	56 (6.6)	195 (20.2)	3.08 (2.03, 4.66)	1.57 (1.05, 2.34)	2.28 (1.24, 4.16)	1.36 (0.65, 2.82)	4.79 (2.42, 9.47)	9.33 (4.68, 18.63)
Physical activity level, n (%)								
Low	100 (13.2)	190 (22.4)	1	1	1	1	1	1
Medium	391 (51.4)	407 (47.9)	0.51 (0.36, 0.73)	0.55 (0.38, 0.81)	0.66 (0.33, 1.31)	1.20 (0.55, 2.59)	0.43 (0.27, 0.67)	0.25 (0.15, 0.42)
High	269 (35.4)	252 (29.7)	0.54 (0.37, 0.78)	0.36 (0.23, 0.56)	0.50 (0.25, 0.99)	0.14 (0.05, 0.38)	0.48 (0.29, 0.79)	0.51 (0.29, 0.90)
Alcohol consumption, n (%)								
No	172 (20.3)	190 (19.7)	1	1	1	1	1	1
Moderate	545 (64.3)	581 (60.1)	1.14 (0.84, 1.56)	0.77 (0.54, 1.11)	1.29 (0.76, 2.19)	1.42 (0.66, 3.03)	1.00 (0.67, 1.50)	0.69 (0.44, 1.10)
Habitual (>12 g/d)	131 (15.4)	195 (20.2)	1.20 (0.81, 1.76)	0.57 (0.36, 0.91)	2.05 (1.25, 4.01)	1.44 (0.59, 3.52)	0.84 (0.51, 1.41)	0.41 (0.22, 0.78)

[a] All odds ratios (ORs) retrieved are age-adjusted.

Table 3
Multivariate logistic regression analysis of sociodemographic and lifestyle characteristics of men and women associated with hypertension

	Hypertension		Hypertension, OR (95% CI)[a]		
	No ($n=968$)	Yes ($n=984$)	Total	Men	Women
Educational level, *n* (%)					
Low	279 (28.8)	424 (43.1)	1	1	1
Medium	406 (41.9)	321 (32.6)	0.95 (0.69, 1.30)	1.92 (1.16, 3.18)	0.60 (0.38, 0.94)
High	283 (29.2)	239 (24.3)	1.52 (1.04, 2.21)	3.25 (1.67, 6.31)	1.18 (0.71, 1.97)
Occupational level, *n* (%)					
Unemployed	262 (32.6)	207 (23.8)	1	1	1
Low	115 (14.3)	156 (18.0)	1.07 (0.73, 1.58)	1.18 (0.49, 2.79)	1.04 (0.60, 1.80)
Medium	204 (25.4)	236 (27.2)	0.94 (0.73, 1.58)	1.20 (0.54, 2.66)	0.90 (0.54, 1.48)
High	223 (27.7)	269 (31.0)	1.46 (0.73, 1.58)	1.83 (0.81, 4.14)	1.00 (0.61, 1.63)
Marital status, *n* (%)					
Unmarried/single	449 (46.4)	343 (34.9)	1	1	1
Married/partner	519 (53.6)	641 (65.1)	0.90 (0.67, 1.21)	1.04 (0.67, 1.63)	0.94 (0.61, 1.45)
Smoking status, *n* (%)					
No smoker	608 (62.8)	598 (60.8)	1	1	1
Ex smoker	268 (27.7)	200 (20.3)	0.99 (0.74, 1.33)	1.10 (0.69, 1.74)	0.878 (0.57, 1.34)
Current smoker	92 (9.5)	186 (18.9)	1.44 (0.99, 2.10)	1.60 (0.93, 2.73)	1.66 (0.87, 3.17)
Physical activity level, *n* (%)					
Low	127 (14.1)	204 (24.1)	1	1	1
Medium	485 (54.0)	382 (45.2)	0.55 (0.39, 0.78)	0.27 (0.13, 0.53)	0.74 (0.46, 1.17)
High	286 (31.8)	259 (30.7)	0.97 (0.67, 1.41)	0.61 (0.31, 1.19)	1.04 (0.61, 1.76)
Alcohol consumption, *n* (%)					
No	167 (17.3)	214 (21.7)	1	1	1
Moderate	640 (66.1)	575 (58.4)	1.32 (0.96, 1.83)	1.86 (0.13, 0.53)	1.04 (0.66, 1.62)
Habitual (>12 g/d)	161 (16.6)	195 (19.8)	1.29 (0.87, 1.91)	1.44 (0.31, 1.19)	1.48 (0.85, 2.57)

[a]All odds ratios (ORs) retrieved are age-adjusted.

and higher education or occupational status was found. In turn, a similar profile of individuals with high education and occupational status, which were younger, unmarried, non-smokers and medially physically active.

Overall obesity, hypertension, diabetes, and dyslipidemia rates confirmed recent regional and national survey representative of the population: the most recent data on Sicily showed that about 35% and 13% of individuals are overweight and obese, respectively, both higher than the national average (31% and 10%, respectively) [16]; average prevalence of diabetes and hypertension in Sicily are about 6% and 21%, while we found higher percentages (especially among men), probably due to the higher number of older individuals [17, 18]; finally, regional data on dyslipidemia assess a prevalence of about 21%, mostly in line with our results [15]. Compared with other Italian regions, Sicily has among the highest rates of overweight, obesity, and diabetes. When compared with other European countries, it can be noted that the prevalence of overweight and obesity in Sicily is slightly higher than the average results observed in the European Union [19].

In the present study, metabolic disorders were associated with age and physical activity. Besides the natural aging processes that increase the risk of chronic non-communicable diseases, it may be hypothesized that increased age is also accompanied by a decrease in engagement in physical activities, which in turn may lead to overweight and obesity. Other lifestyle characteristics, such as smoking and alcohol drinking, were associated with certain metabolic parameters. It is well established that unhealthy lifestyle behaviours tend to cluster

Table 4
Multivariate logistic regression analysis of sociodemographic and lifestyle characteristics of men and women associated with diabetes

	Diabetes		Diabetes, OR (95% CI)[a]		
	No ($n = 1,804$)	Yes ($n = 148$)	Total	Men	Women
Educational level, *n* (%)					
Low	626 (34.7)	77 (52.0)	1	1	1
Medium	678 (37.6)	49 (33.1)	2.19 (1.28, 3.74)	0.76 (0.34, 1.66)	3.02 (1.22, 7.45)
High	500 (27.7)	22 (14.9)	2.09 (1.03, 4.27)	2.02 (0.75, 5.40)	1.26 (0.35, 4.50)
Occupational level, *n* (%)					
Unemployed	435 (28.4)	34 (23.9)	1	NA	1
Low	247 (16.1)	24 (16.9)	0.65 (0.31, 1.38)	NA	0.33 (0.12, 1.10)
Medium	384 (25.1)	56 (39.4)	1.38 (0.75, 2.55)	NA	1.16 (0.39, 3.42)
High	464 (30.3)	28 (19.7)	0.66 (0.32, 1.35)	NA	0.35 (0.11, 1.09)
Marital status, *n* (%)					
Unmarried/single	759 (42.1)	33 (22.3)	1	1	1
Married/partner	1045 (57.9)	115 (77.7)	2.05 (1.21, 3.50)	5.16 (1.98, 13.43)	1.07 (0.46, 2.47)
Smoking status, *n* (%)					
No smoker	1126 (62.4)	80 (54.1)	1	1	1
Ex smoker	448 (24.8)	20 (13.5)	0.59 (0.31, 1.10)	1.06 (0.45, 2.53)	0.21 (0.06, 0.66)
Current smoker	230 (12.7)	48 (32.4)	3.16 (1.82, 5.46)	1.84 (0.84, 4.00)	2.62 (0.90, 7.60)
Physical activity level, *n* (%)					
Low	285 (17.6)	46 (37.1)	1	1	1
Medium	815 (50.3)	52 (41.9)	0.34 (0.19, 0.60)	0.80 (0.34, 1.84)	0.21 (0.08, 0.56)
High	519 (32.1)	26 (21.0)	0.62 (0.33, 1.17)	0.34 (0.13, 0.93)	1.64 (0.63, 4.25)
Alcohol consumption, *n* (%)					
No	353 (19.6)	28 (18.9)	1	1	1
Moderate	1125 (62.4)	90 (60.8)	0.96 (0.56, 1.67)	0.80 (0.37, 1.74)	1.45 (0.58, 3.64)
Habitual (>12 g/d)	326 (18.1)	30 (20.3)	0.54 (0.27, 1.06)	0.36 (0.14, 0.90)	0.74 (0.23, 2.29)

[a]All odds ratios (ORs) retrieved are age-adjusted.

together. There is evidence that smoking habits is associated with higher rates of obesity and diabetes [20, 21]. In contrast, unhealthy metabolic statuses were directly associated with socioeconomic parameters, as individuals having higher level of education and occupational status were more likely of being overweight, hypertensive, and diabetic. There is evidence that higher education may increase the ability to obtain or to understand health-related information as well as to understand and engage healthier lifestyle related with the prevention of metabolic disorders [22, 23]. However, some evidence showed that only education, rather than socio-economic status, might be related to obesity [24]. It is unclear which mechanism may underline this relation, as some evidence on the association between higher educational status and higher prevalence of obesity does exist, but mainly refer to poorer countries [25]. Previous studies conducted on the population living in Sicily, it has been previously reported that higher education was only partially associated with higher adherence to traditional dietary patterns in both adults and adolescents, while occupational status was not associated with Mediterranean diet [11, 26]. On the other hand, economic security may lead to rise in quality but also quantity of food intake, which in turn may affect the overall metabolic status. It may be hypothesized that dietary choices of people living in Mediterranean countries are more likely driven by traditional reasons rather than health-related motivation. Inhabitants of Mediterranean islanders adopted the Mediterranean diet in the past centuries due to their heritage: the poor conditions, the advantage of the geographical localization, and the influence of various cultures historically established in the

Table 5
Multivariate logistic regression analysis of sociodemographic and lifestyle characteristics of men and women associated with dyslipidemias

	Dyslipidemias		Dyslipidemias, OR (95% CI)[a]		
	No (n = 1,592)	Yes (n = 360)	Total	Men	Women
Educational level, n (%)					
Low	505 (31.7)	198 (55.0)	1	1	1
Medium	621 (39.0)	106 (29.4)	0.84 (0.57, 1.23)	0.38 (0.19, 0.74)	1.47 (0.87, 2.49)
High	466 (29.3)	56 (15.6)	0.80 (0.50, 1.29)	0.50 (0.21, 1.16)	1.27 (0.67, 2.40)
Occupational level, n (%)					
Unemployed	384 (28.6)	85 (25.7)	1	NA	1
Low	219 (16.3)	52 (15.7)	0.78 (0.47, 1.29)	NA	0.98 (0.51, 1.89)
Medium	336 (25.1)	104 (31.4)	1.44 (0.92, 2.26)	NA	2.41 (1.30, 4.45)
High	402 (30.0)	90 (27.2)	1.25 (0.77, 2.03)	NA	1.56 (0.85, 2.87)
Marital status, n (%)					
Unmarried/single	662 (41.6)	130 (36.1)	1	1	1
Married/partner	930 (58.4)	230 (63.9)	0.88 (0.61, 1.26)	1.45 (0.72, 2.89)	0.98 (0.60, 1.62)
Smoking status, n (%)					
No smoker	994 (62.4)	212 (58.9)	1	1	1
Ex smoker	408 (25.6)	60 (16.7)	0.77 (0.51, 1.16)	1.90 (0.91, 3.94)	0.51 (0.30, 0.85)
Current smoker	190 (11.9)	88 (24.4)	1.42 (0.94, 2.14)	2.47 (1.23, 4.96)	1.91 (0.96, 3.80)
Physical activity level, n (%)					
Low	217 (15.1)	114 (37.5)	1	1	1
Medium	720 (50.0)	147 (48.4)	0.38 (0.25, 0.57)	0.31 (0.15, 0.61)	0.43 (0.25, 0.73)
High	502 (34.9)	43 (14.1)	0.20 (0.12, 0.32)	0.15 (0.06, 0.34)	0.27 (0.14, 0.52)
Alcohol consumption, n (%)					
No	301 (18.9)	80 (22.2)	1	1	1
Moderate	1019 (64.0)	196 (54.4)	0.70 (0.47, 1.04)	0.72 (0.34, 1.49)	0.64 (0.38, 1.05)
Habitual (>12 g/d)	272 (17.1)	84 (23.3)	0.92 (0.58, 1.46)	0.53 (0.23, 1.20)	1.28 (0.70, 2.31)

[a]All odds ratios (ORs) retrieved are age-adjusted.

Mediterranean area led to the consumption of a mostly entirely plant-based dietary pattern. The globalization processes occurred in the last 50 years provided a higher availability of foods in the market, including unhealthy foods, and improvements of economic disposability may have induced worse diet quality and, consequently, worse metabolic status [27, 28]. For instance, a number of changes in the composition of eating patterns from 1961 to 2011 in Italy have been identified. Considering the rise in metabolic syndrome components during this time, the observed changes in eating habits may be contributing deleterious effects to metabolic health [29]. Notably, this study suggests that major determinants of poorer health related to socioeconomic status were not smoking habits and low physical activity level, as they were inversely associated with both high education and occupational status. Thus, this issue should be further investigated, in order to identify whether higher education and occupational status are associated with unhealthy dietary habits or other unexplored variables leading to worse metabolic health or these social categories are characterized by scarce self-care due to poor health knowledge.

The results of this study should be considered in light of some limitations. The cross-sectional design of this investigation does not allow to define causal relations across variables investigated but only association. Moreover, despite several variables have been taken into account, potential residual confounding by uncontrolled covariates may still exist.

Table 6
Multivariate logistic regression analysis of lifestyle characteristics of men and women associated with high education and occupational status

	High education, OR (95% CI)[a]			High occupational level, OR (95% CI)[a]		
	Total	Men	Women	Total	Men	Women
Age, 1 y increase (continuous)	0.97 (0.96, 0.98)	0.99 (0.98, 1.00)	0.96 (0.95, 0.97)	0.99 (0.98, 1.00)	0.98 (0.97, 1.00)	0.99 (0.98, 1.00)
Marital status						
Unmarried/single	1	1	1	1	1	1
Married/partner	0.74 (0.58, 0.93)	0.82 (0.56, 1.21)	0.63 (0.47, 0.86)	0.99 (0.78, 1.26)	1.71 (1.16, 2.51)	0.65 (0.47, 0.90)
Smoking status						
No smoker	1	1	1	1	1	1
Ex smoker	0.56 (0.43, 0.72)	0.77 (0.52, 1.15)	0.40 (0.27, 0.58)	0.72 (0.55, 0.94)	1.04 (0.69, 1.56)	0.51 (0.34, 0.75)
Current smoker	0.45 (0.30, 0.67)	0.24 (0.13, 0.43)	0.66 (0.37, 1.18)	0.78 (0.55, 1.11)	0.93 (0.59, 1.47)	0.24 (0.11, 0.53)
Physical activity level						
Low	1	1	1	1	1	1
Medium	1.74 (1.28, 2.37)	1.89 (1.12, 3.18)	1.65 (1.11, 2.46)	2.08 (1.49, 2.89)	2.20 (1.28, 3.78)	2.10 (1.36, 3.24)
High	0.87 (0.62, 1.23)	0.60 (0.34, 1.05)	1.16 (0.74, 1.83)	1.39 (0.96, 1.99)	1.04 (0.59, 1.83)	1.45 (0.88, 2.38)
Alcohol consumption						
No	1	1	1	1	1	1
Moderate	1.20 (0.91, 1.60)	1.51 (0.93, 2.45)	0.99 (0.69, 1.43)	1.20 (0.89, 1.62)	1.17 (0.73, 1.88)	1.12 (0.75, 1.67)
Habitual (>12 g/d)	0.93 (0.64, 1.34)	0.98 (0.53, 1.79)	0.88 (0.54, 1.42)	1.34 (0.93, 1.93)	1.34 (0.77, 0.34)	1.24 (0.75, 2.06)

[a] All odds ratios (ORs) retrieved are adjusted for all the variables presented in the table.

In conclusion, the findings of the present study are important to plan public health prevention campaigns and better target individuals more likely to suffer of metabolic disorders, including those with higher education and occupational level, which were supposed to be at lower risk of cardio-metabolic diseases.

Conflict of interest

None to report.

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