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Adherence to the Mediterranean Diet Pattern Has Declined in Spanish Adults[1–3]

Luz M. León-Muñoz,[4,5]* Pilar Guallar-Castillón,[4,5] Auxiliadora Graciani,[4,5] Esther López-García,[4,5] Arthur E. Mesas,[4,5] M. Teresa Aguilera,[6] José R. Banegas,[4,5] and Fernando Rodríguez-Artalejo[4,5]

[4]CIBER of Epidemiology and Public Health, [5]Department of Preventive Medicine and Public Health, School of Medicine, Universidad Autónoma de Madrid/IdiPaz, Madrid, Spain; and [6]Medical Department, Sanofi-Aventis, Barcelona, Spain

Abstract

This work examined the Spanish population's degree of accordance with the Mediterranean diet (MD). This was a cross-sectional study conducted in 2008–2010 among 11,742 individuals representative of the Spanish population aged ≥18 y. Habitual food consumption was assessed with a computerized diet history. Accordance of food consumption with the MD was assessed with the MD Adherence Screener (MEDAS) score using the cutoffs ≥9 to define strict accordance and ≥7 (mid-range value) for modest accordance. Accordance of nutrient intake with the MD was defined as ≥4.5 points (mid-range value) on the high-unsaturated fat OmniHeart diet score. The diet of 12% (95% CI: 11.3–12.7%) of the Spanish population reached MEDAS-based strict accordance with the MD and 46% (95% CI: 44.7–47.7) attained modest accordance. Moreover, 39.0% (95%: 37.8–40.1%) of the population achieved OnmiHeart-based MD accordance. Factor analysis identified 2 main dietary patterns. The first one was called ''Westernized'' and was rich in red and processed meat, French fries, refined cereals, and sweetened beverages and poor in fresh fruit; the second pattern was named ''Mediterranean'' and was rich in olive oil and plant-based foods. Regardless of how it was defined, MD accordance was less frequent and the Westernized pattern was more frequent among the younger, the less educated, current smokers, and those less physically active and more sedentary. In conclusion, the Spanish population is drifting away from the MD to adopt a less healthy diet, typical of Western countries. The departure from the MD mostly affects the socially disadvantaged and clusters with other unhealthy lifestyles, which may have synergistic undesirable effects on health. J. Nutr. 142: 1843–1850, 2012.

Introduction

The Mediterranean diet (MD)[7] is a palatable eating pattern that is culturally rooted in the countries of the Mediterranean basin (1). The MD is characterized by a high consumption of plant-based foods, a low consumption of red meat and other processed foods, the use of olive oil as the main source of fat, and a moderate intake of wine during meals (1). In recent decades, evidence has accumulated showing that the MD confers substantial health benefits, in particular, in the prevention and control of chronic diseases (2). Specifically, adherence to the MD has been associated with a significant reduction in risk of cardiovascular disease, cancer, and degenerative diseases as well as all-cause mortality (2). The mechanisms of the beneficial effects of the MD include a reduction in blood pressure and plasma glucose, improvement in concentrations of blood lipids, diminished LDL-cholesterol oxidation, and reduction of serum inflammatory markers (3,4).

Therefore, nutritional policies in several Mediterranean countries have focused on the preservation and promotion of the MD (5–7). However, effective nutritional interventions require information of the extent to which the population's diet adheres to the MD and of the specific subgroups that mostly deviate from this healthy dietary pattern (5–7).

In Spain as well as other countries in the Mediterranean basin, information on dietary habits comes from 2 sources: studies on national food supply (8,9) and food purchases at the household level (10–12), and local or regional studies that assess individual food consumption or nutrient intake (13–18). However, no nationwide, population-based study has yet assessed individual food consumption or nutrient intake in Spain.

The Study on Nutrition and Cardiovascular Risk in Spain (ENRICA) is the first to assess the current food and nutrient

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[3] Supplemental Table 1 is available from the ''Online Supporting Material'' link in the online posting of the article and from the same link in the online table of contents at http://jn.nutrition.org.
[7] Abbreviations used: ENRICA, Study on Nutrition and Cardiovascular Risk in Spain; MD, Mediterranean diet; MEDAS, Mediterranean Diet Adherence Screener; MP, Mediterranean pattern; WP, Westernized pattern.
* To whom correspondence should be addressed. E-mail: luz.leon@uam.es.

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intake of a large and representative sample of the adult Spanish population. Thus, the objective of this work was to examine the degree to which the Spanish population's diet accorded with the MD by using data from the ENRICA study. To capture the many possible facets of the MD, we used 2 approaches: an a priori approach, where 2 indices of the MD were employed to assess accordance of food and nutrient intake; and an a posteriori approach, which used factor analysis to empirically identify dietary patterns and judge whether they conformed to the MD (19). No attempt, however, was made to cross-validate the different approaches used to assess the MD. Lastly, we examined socio-demographic and lifestyle variables associated with MD adherence.

Participants and Methods

Study design and participants

Data were taken from the ENRICA study, whose methods have been reported elsewhere (20). Briefly, this is a cross-sectional study conducted in 2008–2010 among 12,948 individuals representative of the noninstitutionalized Spanish population aged ≥18 y. Information was obtained in the households of study participants. Data collection included a health interview, samples of blood and urine, physical examination, and a computerized dietary history to obtain habitual diet. The study response rate was 51%, which is within the range of response rates in National Health Interview and Examination Surveys in Europe (21).

Study participants gave written informed consent. The ENRICA study was approved by the Clinical Research Ethics Committees of the University Hospital La Paz in Madrid and the Hospital Clinic in Barcelona.

Study variables

Diet. Habitual food consumption in the previous year was assessed with a computerized diet history that was developed from the one used in the European Prospective Investigation of Cancer-Spain cohort study (22,23). The nutrient intake was estimated using standard composition tables (24–28).

Accordance of food consumption with the MD. Accordance with the MD was evaluated with the MD Adherence Screener (MEDAS) (29), which was developed to assess compliance with the dietary intervention of the Prevención con Dieta Mediterránea study (3). The MEDAS consists of 12 items with targets for food consumption and another 2 items with targets for food intake habits characteristic of the MD in Spain. One point is given for each target achieved. The total MEDAS score ranges from 0 to 14, with a higher score indicating better MD accordance. We considered that a MEDAS score ≥9 represented strict accordance with the MD and a score ≥7 (mid-range value) represented modest accordance (30).

Accordance of nutrient intake with the MD. Given that there is no standard definition of the nutrient composition of the MD, we used the nutrient intake targets of the higher-unsaturated fat variant of the OmniHeart diet (31,32) as an indicator of the accordance of nutrient intake with the traditional MD (33). Assessment was based on a score with 12 nutrient-intake targets. One point is given for achievement of each target and 0.5 points for intermediate targets (32). The score is generated by summing the points for each nutrient target (range 0–12), with higher total scores indicating better MD accordance. We considered that a score ≥4.5 represented accordance of nutrient-intake with the MD (32).

A posteriori dietary patterns derived from food consumption data. To identify a posteriori dietary patterns, the 900 foods were categorized into 36 different groups. The classification of food groups was based on similarities in nutrient profile and culinary preference within the traditional MD in Spain. Factor analysis (principal components analysis) was applied to these food groups to generate various independent dietary patterns (factors) made up of foods with a high degree of inter-correlation (34). The factors were rotated by orthogonal transformation (Varimax rotation) to facilitate their interpretation. Dietary patterns to be retained for future analysis took into account their ease of interpretation and required an Eigenvalue of ≥1.5 on the Scree test (a graphic representation of Eigenvalues, in which the dietary patterns with Eigenvalues >1 explain more variance than each individual food group) (35). Factor loadings were obtained for each food group, making it possible to identify the groups most highly correlated with the dietary pattern. For each pattern, each participant received a score that was calculated as the sum of the intake in each food group weighted by the corresponding factor loading. A higher score indicated a higher adherence to the respective dietary pattern. Finally, we considered that scores equal or greater than the sex-specific median represented accordance with these patterns.

Other variables. Study participants reported their age, sex, level of education, smoking status, and time spent watching TV. Information on physical activity in leisure time was obtained with the questionnaire developed for the European Prospective Investigation of Cancer-Spain cohort and was expressed in metabolic equivalent task-hours per week (36). Weight and height were measured twice in each participant under standardized conditions (37). BMI was calculated as weight in kilograms divided by height in squared meters.

Statistical analysis

Of the 12,948 study participants, we excluded 966 with missing or invalid information on diet and 240 who lacked data for the rest of the study variables. Thus, the analyses were conducted with 11,742 individuals.

The statistical analyses primarily used a descriptive approach by calculating the percentage of people achieving accordance with the MD. To identify variables associated with MD accordance, the analyses were broken down by socio-demographic variables, BMI, and lifestyles. The association between these variables and diet accordance was summarized with OR and their 95% CI obtained from logistic regression. The analyses were initially adjusted for age and sex; given that dietary patterns may be influenced by BMI and total energy intake, we further adjusted the analyses by these 2 latter variables. Because the results adjusted for age and sex were very similar to those additionally adjusted for BMI and energy intake, we report only the fully adjusted data. All variables were modeled as categorical with dummy terms. To test for the dose-response relation between MD accordance and age, level of education, physical activity, time watching TV, and BMI, we estimated P values for linear trend by modeling these variables as continuous.

Significance was set at 2-sided $P < 0.05$. The analyses were performed with the survey procedure in STATA version 11.1 (38).

Results

Table 1 shows the main characteristics of the study participants.

A priori approach

Accordance of food consumption with the MD. **Table 2** shows the percentage of Spanish adults meeting the MEDAS targets and achieving accordance with the MD. More than 80% of individuals met the targets for using olive oil as the main cooking fat and eating foods sautéed in olive oil, as well as for low consumption of red meat, animal fat, and carbonated/sugar-sweetened beverages. In addition, more than one-half of the participants consumed ≥3 servings/wk of fish and ate commercial pastries <2 times/wk. In contrast, consumption of the recommended amounts of vegetables, fruits, and legumes was low, with <20% of individuals meeting the targets. The mean MEDAS score was 6.34 (95% CI: 6.29–6.39) and the food consumption patterns of only 12.0% (95% CI: 11.3–12.7%) of individuals reached accordance with the MD. Although wine consumption may explain a substantial part of the health

TABLE 1 Characteristics of participants in the ENRICA study[1,2]

Men, *n (%)*	5815 (49.5)
Age, *n (%)*	
18–44 y	5906 (50.3)
45–64 y	3475 (29.6)
≥65 y	2361 (20.1)
Level of education, *n (%)*	
No formal or less than primary studies	771 (6.6)
Primary studies	2738 (23.3)
Secondary studies	4926 (42.0)
University studies	3307 (28.2)
Tobacco smoking, *n (%)*	
Never smoker	5603 (47.7)
Ex-smoker	2898 (24.7)
Current smoker	3241 (27.6)
Physical activity in leisure time, *MET-h/wk*	28.5 ± 0.30
Time watching TV, *h/wk*	13.6 ± 0.13
BMI, *n (%)*	
<25 kg/m^2	4461 (38.0)
25–29.9 kg/m^2	4608 (39.2)
≥30 kg/m^2	2674 (22.8)
Dietary intake	
Energy, *kcal/d*	2170 ± 9.04
Total fat, *% of energy*	37.0 ± 0.08)
Saturated fat, *% of energy*	11.7 ± 0.04
Monounsaturated fat, *% of energy*	15.8 ± 0.04
Polyunsaturated fat, *% of energy*	6.2 ± 0.03
Carbohydrate, *% of energy*	42.1 ± 0.09
Protein, *% of energy*	18.1 ± 0.05
Fiber, *g/1000 kcal*	11.0 ± 0.05
Cholesterol, *mg/1000 kcal*	162 ± 0.71
Calcium, *mg/1000 kcal*	418 ± 1.92
Magnesium, *mg/1000 kcal*	150 ± 0.54
Potassium, *mg/1000 kcal*	1540 ± 6.03
Sodium, *mg/1000 kcal*	1390 ± 5.42
Among participants aged ≥65 y, *n (%)*	
Ischemic heart disease	47 (2.0)
Stroke	31 (1.3)
Cancer	63 (2.7)
Antihypertensive treatment	990 (41.9)
Lipid-lowering treatment	634 (26.8)
Use of vitamin or mineral supplements	216 (9.2)

[1] Values are frequencies or mean ± SE, n = 11,742. ENRICA, Study on Nutrition and Cardiovascular Risk in Spain; MET, metabolic equivalent.
[2] Results were obtained through sampling correction procedures.

benefits of the MD (39), there is no consensus on whether the use of alcoholic beverages can be recommended for cardiovascular prevention. Thus, we recalculated the MEDAS score after removing the target for wine consumption; the mean MEDAS score based on 13 targets was 6.20 (95% CI: 6.15–6.25) and MD accordance (≥8 points) increased to 22.7% (95% CI: 21.7–23.7) of Spanish adults. Lastly, the prevalence of modest MD accordance (≥7 points in MEDAS score) was 46% (95%CI: 44.7–47.7).

In analyses adjusted for age, sex, BMI, and total energy intake, the frequency of MD accordance (MEDAS score ≥9 points) increased with age, educational level, and physical activity and decreased with time spent watching TV (P-trend < 0.001) (**Fig. 1***A*); it was higher among ex-smokers [OR = 1.31 (95% CI: 1.11–1.53)] and lower among women [OR = 0.84 (95% CI: 0.72–0.98)]. However, there were no sex differences in MD accordance when we removed the target for wine consumption from the MEDAS score [OR = 0.94 (95% CI: 0.83–1.06)]. Similar results were obtained when the cutoff ≥7 was used for MEDAS-based accordance with the MD (data not shown).

Accordance of nutrient intake with the MD. **Table 3** shows the percentage of Spanish adults meeting the OmniHeart nutrient targets and reaching accordance of nutrient intake with the MD. The targets achieved by the largest proportion of individuals were for carbohydrates and total fat consumption, whereas ~20% of persons met the protein and sodium targets. Only a small percentage of the population met the rest of the targets. The mean OmniHeart score was 3.99 (95% CI: 3.96–4.02) and 39.0% (95% CI: 37.8–40.1) of individuals achieved MD accordance. This relatively high percentage of MD accordance is due to the fact that >40% of individuals met many of the intermediate targets. Figure 1*B* shows that the frequency of MD accordance was somewhat higher among women [OR = 1.37 (95% CI: 1.24–1.53)] and increased with age, educational level, and physical activity in leisure time (P-trend ≤ 0.001). Furthermore, it was lower in current smokers [OR = 0.73 (95% CI: 0.65–0.82)].

A posteriori approach

Two main patterns were identified by applying factor analysis to food consumption data. The first one (Eigenvalue, 2.66; explained variance, 7%) was labeled the Westernized pattern (WP), because it was characterized by a high consumption of red and processed meat, French fries, refined bread products, whole-fat dairy products, pasta, and sweetened beverages and also by a low consumption of fresh fruit and fruit juice, low-fat dairy products, and whole-grain products. The second pattern (Eigenvalue, 2.29; explained variance, 6%) was called the Mediterranean pattern (MP) because of the high consumption of olive oil, vegetables, fish, and legumes. A table showing the factor-loading matrix for the a posteriori dietary patterns is available online (**Supplemental Table 1**).

Figure 2 shows the variables associated with the WP and MP. The WP was more frequent among women [OR = 3.84 (95% CI: 3.38–4.37)] and current smokers [OR = 1.79 (95% CI: 1.57–2.03)] and was also associated with time spent watching TV (P-trend < 0.001). Ex-smokers had less accordance with the WP [OR = 0.76 (95% CI: 0.67–0.87)], as did older people, those with a higher educational level, and more physically active individuals (P-trend < 0.001) (Fig. 2*A*). In contrast, the MP was associated with older age and higher education, BMI, and physical activity. Moreover, compared with never smokers, the MP was more frequent among ex-smokers [OR = 1.29 (95% CI: 1.14–1.45)] and less frequent in current smokers [OR = 0.84 (95% CI: 0.75–0.94)]. Time spent watching TV was inversely associated with the MP (Fig. 2*B*).

Finally, after adjusting for age, sex, BMI and energy intake, individuals with MEDAS-based accordance with the MD were more likely to show OnmiHeart-based MD accordance [OR = 4.81 (95% CI: 4.15–5.57)] and a posteriori MP [OR = 10.16 (95% CI: 8.42–12.25)].

Discussion

Our study found low accordance of the Spanish population's diet with the MD, whether it was defined based on food consumption or nutrient intake. Moreover, our results confirm that Spaniards are drifting away from the MD to progressively adopt a less healthy Westernized diet.

TABLE 2 Spanish adults who achieve each target of the MEDAS score, and accordance of food consumption with the MD[1,2]

	Target	Achievement of MEDAS target
Use of olive oil as the principal source of fat for cooking	Yes	89.4 (88.3–90.4)
Olive oil (including that used in frying, salads, meals eaten away from home, etc.)	≥4 tablespoons/d (1 tablespoon = 13.5 g)	8.0 (7.4–8.6)
Vegetables (including those eaten as a garnish and side serving, which were given 0.5 points)	≥2 servings/d (1 serving = 200 g)	12.3 (11.6–13.0)
Fruits (including fresh-squeezed juice)	≥3 pieces/d	13.4 (12.6–14.2)
Red meat, hamburger, or sausage	<1 serving/d (1 serving = 100–150 g)	81.5 (80.5–82.4)
Butter, margarine, or cream	<1 serving/d (1 serving = 12 g)	86.8 (86.0–87.6)
Carbonated and/or sugar-sweetened beverages	<1 cup/d (1 cup = 100 mL)	80.1 (79.0–81.1)
Wine	≥1 cup/d (1 cup = 100 mL)	14.0 (13.1–14.8)
Legumes	≥3 servings/wk (1 serving = 150 g)	15.7 (14.8–16.5)
Fish/seafood	≥3 servings/wk (1 serving = 100–150 g fish, 4–5 pieces, or 200 g seafood)	52.5 (51.2–53.7)
Commercial (not homemade) pastry such as cookies or cakes	<2 times/wk	53.3 (52.1–54.5)
Nuts	≥3 servings/wk (1 serving = 30 g)	20.5 (19.5–21.5)
Preference for white meat (chicken, turkey, rabbit) over red meat (beef, pork, hamburgers, sausages)	White meat (g)/red meat (g) >1	24.0 (22.9–25.0)
Foods with a sauce of tomato, garlic, onion, or leeks sautéed in olive oil	≥2 times/wk	82.6 (81.4–83.7)
MEDAS score		6.34 ± 0.03
MEDAS score ≥7		46.0 (44.7–47.3)
MEDAS score ≥9		12.0 (11.3–12.7)

[1] Values are percent (95% CI) or mean ± SE, n = 11742. MD, Mediterranean diet; MEDAS, Mediterranean Diet Adherence Screener (score range: 0–14).
[2] Accordance of food consumption with the MD is defined as achieving ≥9 targets of MEDAS.

The low accordance of food consumption with the traditional MD (12%) is partly due to the rigorous goals set in MEDAS, which aimed to strictly reproduce the traditional MD. When a 7-point cutoff (the mid-value of the score range) rather than the 9-point cutoff was used to define accordance, 46% of individuals reached MD accordance. This less strict cutoff in the MEDAS score might correspond to the so-called "evolved MD" (40), which reflects the progressive adaptation of the MD to the socioeconomic changes that have occurred in Spain over the last decades. In fact, the majority of people still adhere to some characteristic features of the MD, such as using olive oil as the principal source of fat and not consuming a lot of red meat or butter. Moreover, the average consumption of vegetables was 201 g/d, fruits was 238 g/d, and that of legumes 45 g/d. These figures are relatively high and represent a substantial intake of fiber [11 g/(1000 kcal · d)].

The diet in Spain is rich in protein and total fat (mostly from unsaturated fat) and somewhat low in carbohydrates, which is relatively in line with the OmniHeart unsaturated diet. In fact, fat and carbohydrate intake are the targets with the highest compliance. These results attest to the progressive replacement of carbohydrates by protein and fat, which has been reported in studies using food supply data and household budget surveys (11,13) and which paralleled socioeconomic development in Spain during the last 60 y. Overall, the diet in Spain is high in saturated fat and cholesterol, which is consistent with the incorporation of larger amounts of red and processed meats and whole-fat dairy products. Despite the relatively low intake of carbohydrates, the diet is rich in sugars, which account for 17.8% of total energy intake. The substitution of simple for complex carbohydrates is another feature of the Westernized diet, which is rich in sweetened beverages, sugars and honey, and pastries and biscuits (Supplemental Table 1). Our results concur with those of several regional studies in Spain (15,41,42).

Women had a lower food consumption accordance with the MD than men. This is mostly due to women's lower consumption of wine; whereas 20% of men achieved the target for wine consumption, <8% of women did. This difference in attainment of the wine target was independent of age and education because, after adjusting for these variables, the OR of wine target achievement for women compared with men was 0.29 (95% CI: 0.25–0.34). Consequently, the sex difference in MD accordance disappeared when it was recalculated by excluding wine from the MEDAS score. As for the a posteriori dietary patterns, women were more likely than men to have both the WP and the MP, which suggests that their diet is more heterogeneous. Other regional studies in Spain have also failed to find consistent differences by sex in quality of the diet (42,43).

With regard to age, MD accordance was higher among older than younger people, whereas the opposite was observed for the WP. To examine whether the association between age and better MD accordance was independent of lifestyles linked to older age, we ran models with adjustments for sex, age, BMI, energy intake, level of education, tobacco smoking, physical activity, and time watching TV. After adjusting for all these variables, older age was still associated with higher MD accordance [OR 45–64 y vs. 18–44 y = 2.87 (95% CI: 2.39–3.45); OR ≥65 y vs. 18–44 y = 4.70 (95% CI: 3.78–5.83); P-trend < 0.001]. Thus, factors other than the above-mentioned lifestyles should account for the better MD accordance in older adults. It is possible that the elderly simply maintain traditional dietary habits acquired in infancy; it is also easier for older people to cook and eat at home, because they do not suffer from work-related time constraints. Other population-based studies have also reported a higher adherence to the MD among older people (44).

MD accordance increased with educational level, whereas the opposite was true for the WP. This is the first study to document a clear inverse socioeconomic gradient in healthy eating in Spain

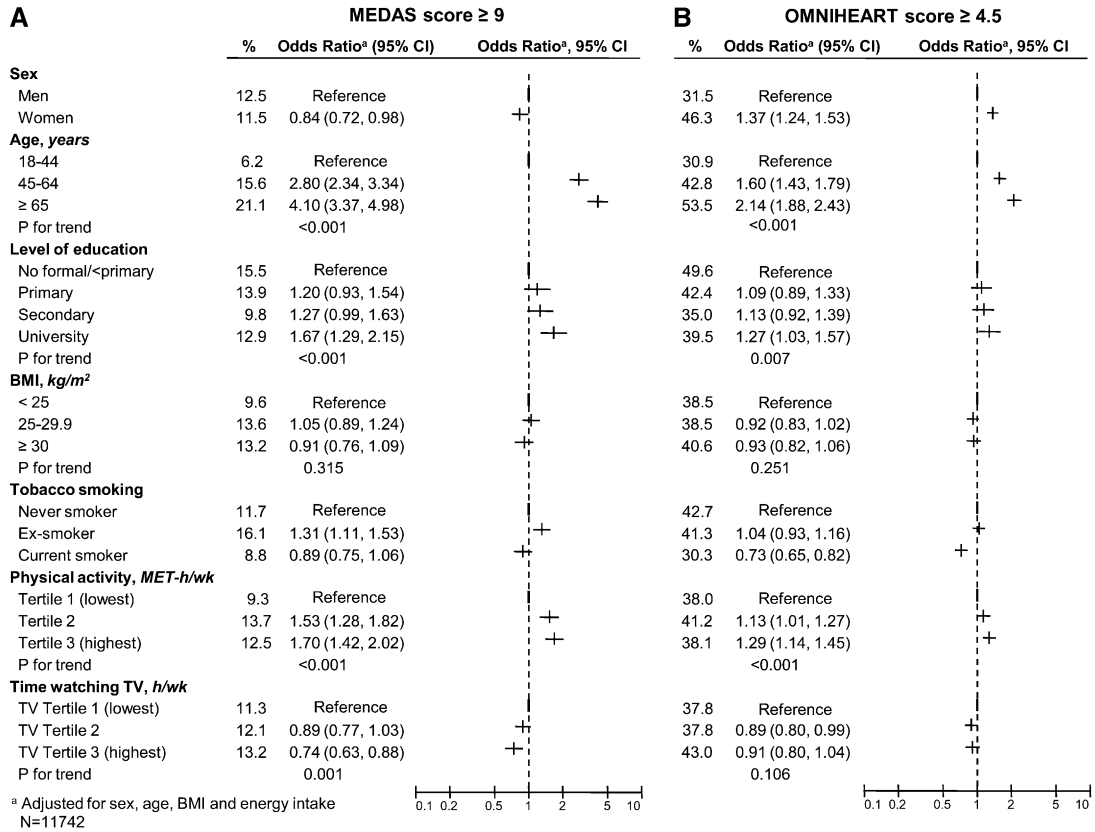

FIGURE 1 Variables associated with accordance with the MD in Spanish adults: accordance of food consumption with MD (MEDAS score ≥9) (*A*) and accordance of nutrient intake with MD (OmniHeart score ≥4.5) (*B*). MD, Mediterranean diet; MEDAS, Mediterranean Diet Adherence Screener.

(44,45), which may contribute to the higher burden of chronic diseases widely observed in those with lower educational status (46).

The frequency of MD accordance and of the a posteriori MP was lower in current smokers and in those who spent more time watching TV and higher in those who were more physically active, whereas these associations were in the opposite direction in the case of the a posteriori WP. Our results are consistent with the abundant literature on the association of tobacco smoking with poorer diet quality (47). Moreover, they may be interpreted as a recurrent manifestation of the well-known clustering of

TABLE 3 Spanish adults who meet OmniHeart nutrient targets, and accordance of nutrient intake with the MD[1,2]

	Intermediate target (0.5 point/target)	Achievement of intermediate target	OmniHeart target (1 point/target)	Achievement of OmniHeart target
Total fat, *% of energy*	≥32	78.5 (77.5–79.5)	≥37	51.9 (50.7–53.1)
Saturated fat, *% of energy*	≤11	43.6 (42.5–44.8)	≤6	2.5 (2.1–2.8)
Monounsaturated fat, *% of energy*	≥13	79.4 (78.4–80.4)	≥21	6.7 (6.2–7.3)
Polyunsaturated fat, *% of energy*	≥8	16.6 (15.7–17.4)	≥10	5.0 (4.5–5.4)
Protein, *% of energy*	≤15	19.1 (17.9–20.2)	≤15	19.1 (17.9–20.2)
Carbohydrate, *% of energy*	≤53	93.6 (93.0–94.1)	≤48	81.0 (80.1–82.0)
Fiber, *g/1000 kcal*	≥9.5	61.7 (60.5–62.9)	≥14.3	13.3 (12.6–14.1)
Cholesterol, *mg/1000 kcal*	≤107.1	13.2 (12.4–14.0)	≤71.4	1.4 (1.2–1.7)
Calcium, *mg/1000 kcal*	≥402	46.3 (45.0–47.5)	≥590	11.7 (10.9–12.4)
Magnesium, *mg/1000 kcal*	≥158	32.7 (31.6–33.9)	≥237	3.7 (3.3–4.2)
Potassium, *mg/1000 kcal*	≥1534	44.2 (42.9–45.6)	≥2225	6.8 (6.2–7.4)
Sodium, *mg/1000 kcal*	≤1286	42.7 (41.5–43.9)	≤1095	22.6 (21.6–23.5)
OmniHeart score				3.99 ± 0.16
Accordance of nutrient intake with the MD				39.0 (37.8–40.1)

[1] Values are numerical references for targets, percent (95% CI), or mean ± SE, *n* = 11,742. MD, Mediterranean diet; OmniHeart, Optimal Macronutrient Intake Trial to Prevent Heart Disease (score range: 0–12).

[2] Accordance of nutrient intake with the MD is defined as OmniHeart score ≥4.5 points, where 1 point was given for achievement of each target and 0.5 points for each intermediate target. The total OmniHeart score was generated by summing the points for each nutrient target.

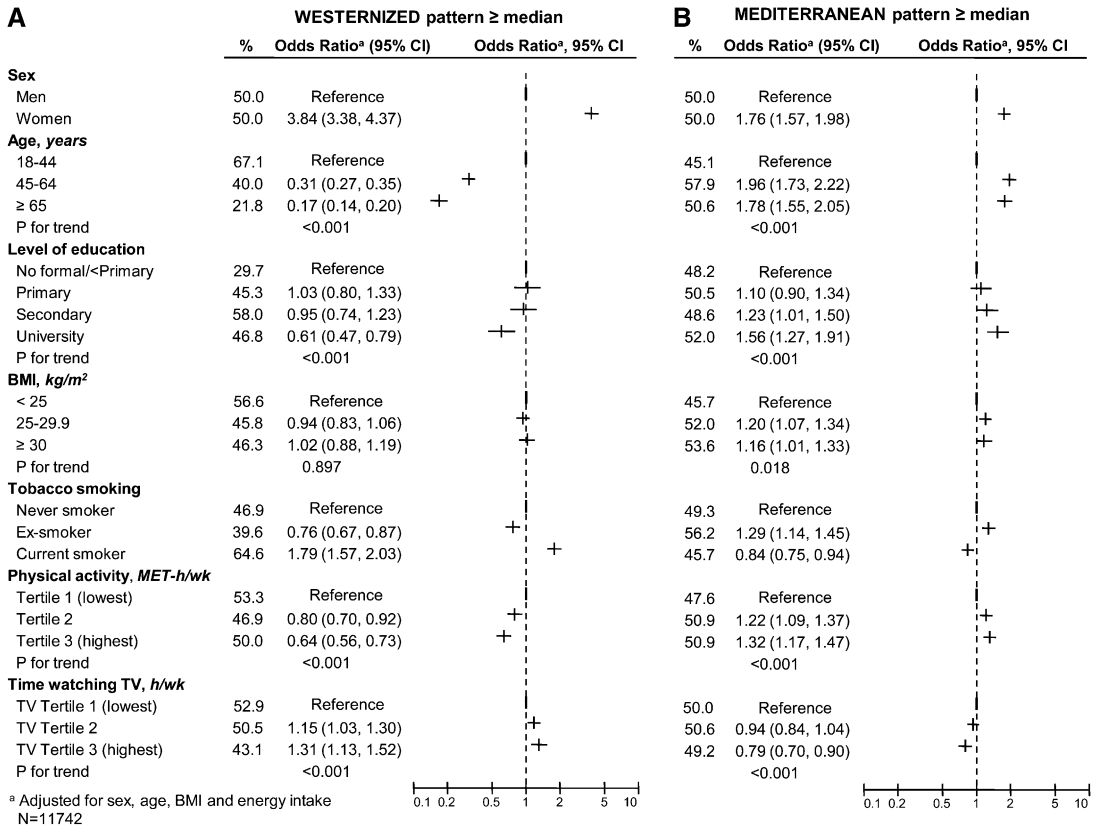

FIGURE 2 Variables associated with a posteriori defined dietary patterns in Spanish adults: WP (*A*) and MP (*B*). MP, Mediterranean pattern; WP, Westernized pattern.

behavioral risk factors, including smoking, excessive alcohol intake, physical inactivity, and unbalanced diet (48,49).

The similar distribution of the different socio-demographic and lifestyle variables across dietary patterns suggests that the different approaches used to define the MD (a priori and a posteriori; food based and nutrient based) identified the same underlying construct of the MD. In fact, individuals with MEDAS-based MD accordance were also more likely to have MD accordance based on the OminiHeart diet score and to have an a posteriori MP. Only a small discrepancy between methods was observed when MD accordance was measured in absolute terms. Specifically, MEDAS-based modest accordance was 46%, whereas OmniHeart-based modest accordance was 39%. This difference may result from the cutoffs used to define accordance, because higher cutoffs lead to lower accordance and vice-versa. We have used cutoffs previously reported in literature, but it should be noted that they result from a reasonable though arbitrary convention to categorize a continuous variable.

Methodological issues. A few methodological issues merit comment. First, this study had a large sample size and used appropriate sampling methods, so the results can be generalized to the noninstitutionalized adult population of Spain. Second, diet was measured under standardized conditions using validated methods. However, food consumption was based on self-reported data and therefore is subject to recall bias, misreporting of foods and portion sizes, and/or inaccurate or incomplete food composition tables. Their effect on target achievement, however, may vary with the specific nutrients or foods considered. Third, there are a number of different indices to assess the MD; thus, the results on MD accordance could vary with the index used. However, recent research has shown that most a priori-defined indices of MD are rather concordant (50), so that the use of indices other than MEDAS and OmniHeart would have likely led to only small changes in the results. Fourth, one important limitation of the study was the cross-sectional design, which did not allow us to examine the prospective influence of socio-demographic factors, lifestyles, and other variables, such as family or early introduction of food habits, on MD accordance. Lastly, factor analysis involves several arbitrary but important decisions, including the consolidation of food items into food groups, the number of factors to extract, the method of rotation, and even the labeling of the factors (51).

In conclusion, our results point to the abandonment of the MD by a substantial proportion of the Spanish population. This is particularly troublesome for several reasons. First, MD accordance was lower in the younger segment of the population, so that their lifetime risk of chronic disease is increased. Second, adherence to the MD was lower in the less educated, which may contribute to increasing health disparities. And third, the MD has been partly replaced by an unhealthy Westernized dietary pattern, which clusters with other unhealthy lifestyles and may lead to synergistic undesirable health effects. The National Strategy for Nutrition, Physical Activity and Prevention of Obesity in Spain (52), which is currently under evaluation, should effectively address these issues in Spain.

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L.M.L-M. and F.R-A. designed the research; L.M.L-M., P.G-C., A.G., E.L-G., A.E.M., M.T.A., J.R.B., and F.R-A. conducted the research; L.M.L-M. and P.G-C. analyzed the data; L.M.L-M. and F.R-A. drafted the manuscript and had primary responsibility for the final content. All authors read and approved the final manuscript.

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