

Changes in Mediterranean dietary pattern of university students: a comparative study between Spain and Algeria

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Recibido: 14/mayo/2019. Aceptado: 27/junio/2019.

ABSTRACT

Aim: Assess and compare the diet quality of university students living in two different Mediterranean countries (Algeria and Spain).

Methods: 303 university students from two different Mediterranean areas (Algeria and Spain) were enrolled in this cross-sectional study. The data collection of students' diet and other personal variables was based on a self-reported method; a nutritional evaluation was carried out using the DIAL[®] nutritional software.

Results: There were found significant differences in the diets, not only because of gender but also nationality, probably due to inherent cultural and socioeconomic characteristics of each country resulting in variants of Mediterranean diet.

Conclusions: Nutrition education programs based on the promotion of Mediterranean lifestyle must be aimed at all ages, but especially in university stage.

KEYWORDS

Dietary pattern, Mediterranean diet, university students.

ABBREVIATIONS

BMI: Body mass index.

MUFAs: Monounsaturated fatty acids.

MD: Mediterranean diet.

PUFAs: Polyunsaturated fatty acids.

RDA: Recommended daily allowance.

SFA: Saturated fatty acids.

WHO: World Health Organization.

INTRODUCTION

At present, many developed countries are experiencing similar diet-related health problems. Epidemiological evidence highlights the importance of consuming a well-balanced diet, among other healthy habits, to prevent some of the most-prevalent chronic diseases in our society (e.g. obesity, diabetes, cardiovascular and neurological diseases)¹. For this reason, governmental organisations regularly publish national dietary guidelines to promote healthier eating patterns²⁻⁵. Many of these nutritional recommendations are based on well-recognised healthy diets, such as Mediterranean diet (MD). In this sense, it has been observed long time ago that replacing processed foods by fruit and vegetables decrease risk of obesity and related chronic disease^{6,7}. Paradoxically, although MD was recognized as UNESCO Intangible Cultural Heritage in 2010, Mediterranean countries are also facing diet-related health problems, ranging from malnutrition to overweight/obesity. This phenomenon, called nutrition transition, is seemed to be mainly caused by shifts from traditional dietary patterns⁸.

Youth is one of the critical life stages related to adoption of a healthy lifestyle, including physical and dietary habits. In this sense, unhealthy dietary patterns at early age could become a general tendency in their adulthood, resistant to future modifications and with a great impact on their health⁹. University stage can suppose a negative influence on the ac-

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quisition of healthy eating behaviours. In general, the profile of food consumption in university students is characterised by a simple and quick meal preparation, very limited budget and no-conventional consumption styles, including a high presence of snacks and alcohol in their diets^{10,11}.

In this sense, nutritional assessment of young population from Mediterranean basin could provide us with critical information about the above-mentioned nutrition transition. For this reason, the present work is aimed to assess and compare the quality of the diet of university students living in two different Mediterranean countries (Algeria and Spain).

METHODS

The present cross-sectional study was carried out on 303 healthy undergraduate university students (both sexes, age=19–24 years) from two different Mediterranean areas: Djelfa (Algeria) [n=120; male (M) =48 and female (F) =72] and Badajoz (Spain) [n=183: M =42 and F =141]. During 2013-2014 / 2014-2015 academic courses, students enrolled in different degree courses in health sciences were invited to participate. Volunteers were excluded if they were under 19 or over 24 years old and if they could not or did not wish to complete the proposed procedures. Each subject was ascertained to be in good health by means of their medical history. They were nonsmokers and were not using any medication. In addition, students were required to be consuming their usual mixed diet. An informed consent was obtained from all participants in accordance with the Declaration of Helsinki, the Council of Europe and the Universal Declaration of UNESCO on Human Rights, Genome and Biomedicine.

Participants were asked to record in detail the daily food and beverage intake (type, quantity and mealtimes) during five consecutive days (from Monday breakfast to Friday afternoon snack). This experimental period was established to eliminate bias provided by a differential food intake on weekend. Other personal data such as age, weekly physical activity, weight and height were also self-reported by volunteers.

Data were computer-processed for nutritional assessment using the specific software DIAL® (Alce Ingeniería S.L., Spain). Among the outcomes provided by the software, the variables of interest selected were: body mass index (BMI), diet content of macronutrients, micronutrients, calories and lipids, and percentage of energy consumed according to food groups. For each subject, BMI was calculated by software DIAL® as weight (kg)/height (m²), in account the self-reported weekly physical activity. The BMI values were categorized according to the World Health Organisation (WHO) criteria as follows: <18.5 kg/m² as underweight, 18.5–24.9 kg/m² as normal weight, 25–29.9 kg/m² as overweight and ≥30 kg/m² as obese⁶.

Results were expressed in terms of mean±standard deviation (SD). Analysis of statistical significance was performed by

using T-Student test. The significance level was set at p<0.05. Statistical analysis was performed using GraphPad Prism® (version 5.0, 2007; GraphPad Software, Inc.; San Diego, CA).

RESULTS

The characteristics of the university students (age, weight, height and BMI) are summarized in Table 1, categorized by country and gender. As it can be observed, Algerian students were older than Spanish ones. Statistical comparison among countries of each gender revealed differences in the height of male students (Spain>Algeria) and height and weight of female students (Spain>Algeria). Moreover, male students were found to have significantly higher mean values than their female colleagues. Accordingly, statistically significant differences between genders were observed in relation to BMI (in terms of total mean value and normal weight category). However, the highest mean value in obesity category was reported by Spanish women. Moreover, it is noteworthy that, compared to Spanish students, Algerian students were not categorized as obese.

Table 2 shows the mean daily intake (MDI) of energy, macronutrients, fiber, water and alcohol in university students. Comparative analysis revealed that, in both countries, the energy and protein values were significantly higher in men, particularly in Spanish students. For their part, intake of carbohydrates and fiber were significantly different because of gender (men>women) and nationality (Algeria>Spain). Regarding fats MDIs, Spanish students obtained significant higher values of total lipids, saturated fatty acids (SFA), monounsaturated fatty acids (MUFAs), (PUFAs+MUFAs)/SFA ratio and omega-3 fatty acids, whereas PUFAs/SFA ratio was higher in Algeria. On the other hand, comparison among genders of each country showed that Algerian male students consumed more fats than their female colleagues; in Spain, total lipids, SFA and polyunsaturated fatty acids (PUFAs) MDIs were significantly higher in men compared to women. Moreover, results about cholesterol intake showed that Algerian female students reported the lowest MDIs. Finally, statistically significant differences were detected in water and alcohol intake among Spanish students (male>female). Algerian students did not drink alcoholic beverages.

Caloric and lipid content in the university students' diet is described in Figure 1. All the groups reported slightly higher percentages of proteins in their diets compared to recommended daily allowance (RDA). Unlike in Spain, fats and carbohydrates were properly consumed in Algeria. Accordingly, statistically significant differences were detected in the caloric content because of nationality and sex (Figure 1A). As mentioned above, alcohol consumption was only observed in Spanish students (men 0.79±0.21; women 0.42±0.03) and mean values were below the RDA (<10% of total calories) (data not shown). With regards to lipid content of student's diet (Figure 1B), SFA proportion was higher than RDA for all

Table 1. General characteristics of the sample of students (N=303): age (years), weight (kg), height (cm) and BMI (kg/m²).

	SPAIN (n=183)		ALGERIA (n=120)	
	M (n=42)	F (n=141)	M (n=48)	F (n=72)
Age (years)	19.33±1.86	19.29±4.08	22.20±2.16 ^b	22.56±1.93 ^c
Weight (kg)	73.11±12.31	56.96±7.32 ^a	69.79±10.19	54.47±6.82 ^{a,c}
Height (cm)	176.86±6.56	164.07±5.33 ^a	173.78±7.32 ^b	162.14±5.02 ^{a,c}
BMI (kg/m ²) ¹	23.33±3.53	21.26±2.90 ^a	23.34±2.60	20.75±2.51 ^a
Underweight	18.05±0.25	18.50±2.34	17.45±0.75	17.73±0.75
Normal	22.10±1.87	20.96±1.75 ^a	22.64±1.61	20.67±1.57 ^a
Overweight	26.33±1.75	25.85±0.73	26.76±1.25	25.83±0.85
Obesity	30.60±0.61	33.27±1.07 ^a	--	--

¹ Categories according to BMI (WHO): Underweight <18.5 kg/m²; Normal weight: 18.5–24.9 kg/m²; Overweight: 25–29.9 kg/m²; Obese: ≥30 kg/m². -- = no values (no alcohol intake).

Results are expressed in terms of mean ± SD. ^a Significantly different (p<0.01) among genders of each country (Spanish M vs. F / Algerian M vs. F); ^{b, c} Significantly different (p<0.01) among countries of each gender (^b Spanish M vs. Algerian M; ^c Spanish F vs. Algerian F).

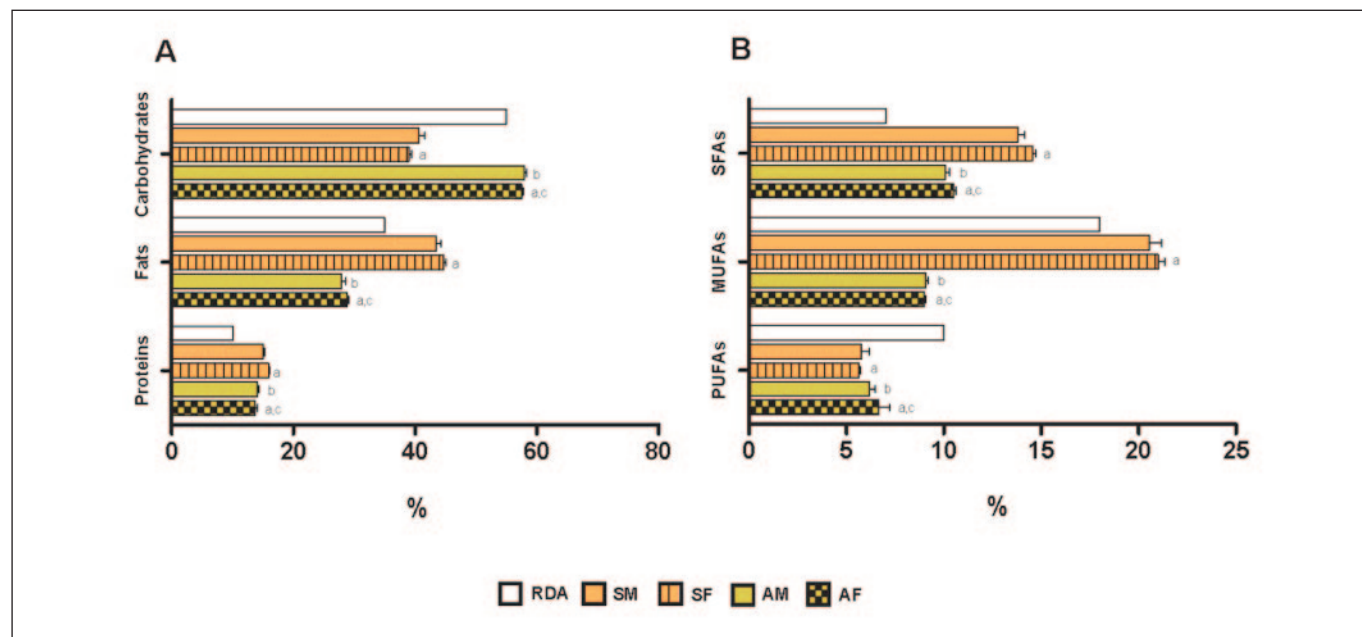
Table 2. Mean daily intake of energy (kcal), macronutrients (g), fiber (g), water (g) and alcohol (g) in university students (N=303).

	SPAIN (n=183)		ALGERIA (n=120)	
	M (n=42)	F (n=141)	M (n=48)	F (n=72)
Energy (kcal)	2287.02±488.22	2006.96±480.17 ^a	2177.0±401.0	1612.0±551.3 ^{a,c}
Proteins (g)	86.38±15.31	78.85±18.52 ^a	76.66±15.11 ^b	55.13±19.52 ^{a,c}
Carbohydrates (g)	225.26±66.43	185.48±52.2 ^a	298.30±48.95 ^b	217.0±65.77 ^{a,c}
Fiber (g)	19.49±5.49	16.74±5.92 ^a	28.13±5.73 ^b	19.65±5.57 ^{a,c}
Total lipids (g)	111.97±26.11	100.93±29.6 ^a	69.03±23.41 ^b	50.97±24.27 ^{a,c}
SFA (g)	35.61±9.36	32.38±9.08 ^a	24.89±10.33 ^b	19.88±10.49 ^{a,c}
MUFAs (g)	52.27±12.51	47.45±18.11	22.37±8.25 ^b	16.85±8.67 ^{a,c}
PUFAs (g)	15.16±8.85	12.59±3.5 ^a	15.10±4.96	11.91±5.02 ^a
PUFAs/SFA	0.43±0.24	0.39±0.07	0.64±0.18 ^b	0.69±0.32 ^c
(PUFAs+MUFAs)/SFA	1.95±0.5	1.86±0.35	1.57±0.26 ^b	1.57±0.45 ^c
Cholesterol (mg)	357.33±96.5	345.47±86.65	323.6±129.5	252.3±137 ^{a,c}
Omega-3 Fatty Acids (g)	0.62±0.19	0.67±0.16	0.04±0.13 ^b	0.07±0.23 ^c
Water (g)	1984.38±550.02	1766.35±521.33 ^a	1858.66±378.20	1789.14±451.43
Alcohol (g)	2.60±0.66	1.26±0.31 ^a	--	--

-- = no values (no alcohol intake).

Results are expressed in terms of mean ± SD. ^a Significantly different (p<0.01) among genders of each country (Spanish M vs. F / Algerian M vs. F); ^{b, c} Significantly different (p<0.01) among countries of each gender (^b Spanish M vs. Algerian M; ^c Spanish F vs. Algerian F).

Figure 1. Caloric and lipid content in university student´s diet (N=303) compared to recommended daily allowance (RDA, % of total).



Results are expressed in terms of mean ± SD. SM= Spain male; SF= Spain female; AM= Algerian male; AF= Algerian female. ^a Significantly different (p<0.01) among genders of each country (SM vs. SF / AM vs. AF); ^{b,c} Significantly different (p<0.01) among countries of each gender (^b SM vs. AM; ^c SF vs. AF). SFAs= saturated fatty acids; MUFAs= monounsaturated fatty acids; PUFAs= polyunsaturated fatty acids.

groups, especially in Spanish female students. On the other hand, MUFAs percentages were slightly higher in Spain and lower in Algeria compared to RDA. All groups showed PUFAs values that met the RDA. Comparative analysis detected statistically significant differences because of sex and nationality; in general, women´s diet (especially Spanish ones) presented higher proportions of fats compared to men.

MDIs of vitamins and trace elements in university students are shown in Table 3. Statistically significant differences in vitamin A, B1, B2 and C intake were observed because of country (Spain>Algeria) and gender (male > female; with the exception of vitamin A and C values of Algerian women). In addition, the presence of folic acid in male students´ diet was observed to be significantly higher than female colleagues;

Table 3. Mean daily intake of micronutrients (vitamins and trace elements) in university students (N=303).

	SPAIN (n=183)		ALGERIA (n=120)	
	M (n=42)	F (n=141)	M (n=48)	F (n=72)
Vitamin A (µg Eq. Retinol)	867.70±327.30	752.10±282.91 ^a	541.70±264.80 ^b	639.01±340.83 ^c
Vitamin B1(mg)	1.54±0.54	1.29±0.37 ^a	1.05±0.24 ^b	0.75±0.24 ^{a,c}
Vitamin B2 (mg)	1.84±0.62	1.62±0.57 ^a	1.14±0.38 ^b	0.98±0.37 ^{a,c}
Folic acid (µg activity)	260.60±93.72	226.90±68.19 ^a	269.10±63.06	203.60±62.80 ^{a,c}
Vitamin C (mg)	125.90±63.85	104.80±48.05 ^a	69.50±38.38 ^b	80.96±32.53 ^c
Calcium (mg)	872.03±254.90	787.01±301.31	588.71±192.52 ^b	483.92±184.71 ^{a,c}
Iron (mg)	14.01±4.34	11.80±2.99 ^a	13.55±2.44	9.82±3.05 ^{a,c}
Sodium (mg)	3057.01±943.62	2607.0±903.31 ^a	4484.0±1519.03 ^b	3167±1026.11 ^{a,c}

Results are expressed in terms of mean ± SD. ^a Significantly different (p<0.01) among genders of each country (Spanish M vs. F / Algerian M vs. F); ^{b, c} Significantly different (p<0.01) among countries of each gender (^b Spanish M vs. Algerian M; ^c Spanish F vs. Algerian F).

statistical comparison among gender of each country showed that Algerian women had the lowest MDI of this vitamin. With regards to trace elements, significant differences were observed in calcium and iron values (Spain>Algeria), as well as sodium (Algeria>Spain) MDI. Comparison among genders of each country demonstrated that MDIs of iron and sodium were significantly higher in men compared to women; additionally, Algerian men consumed more calcium compared to female ones.

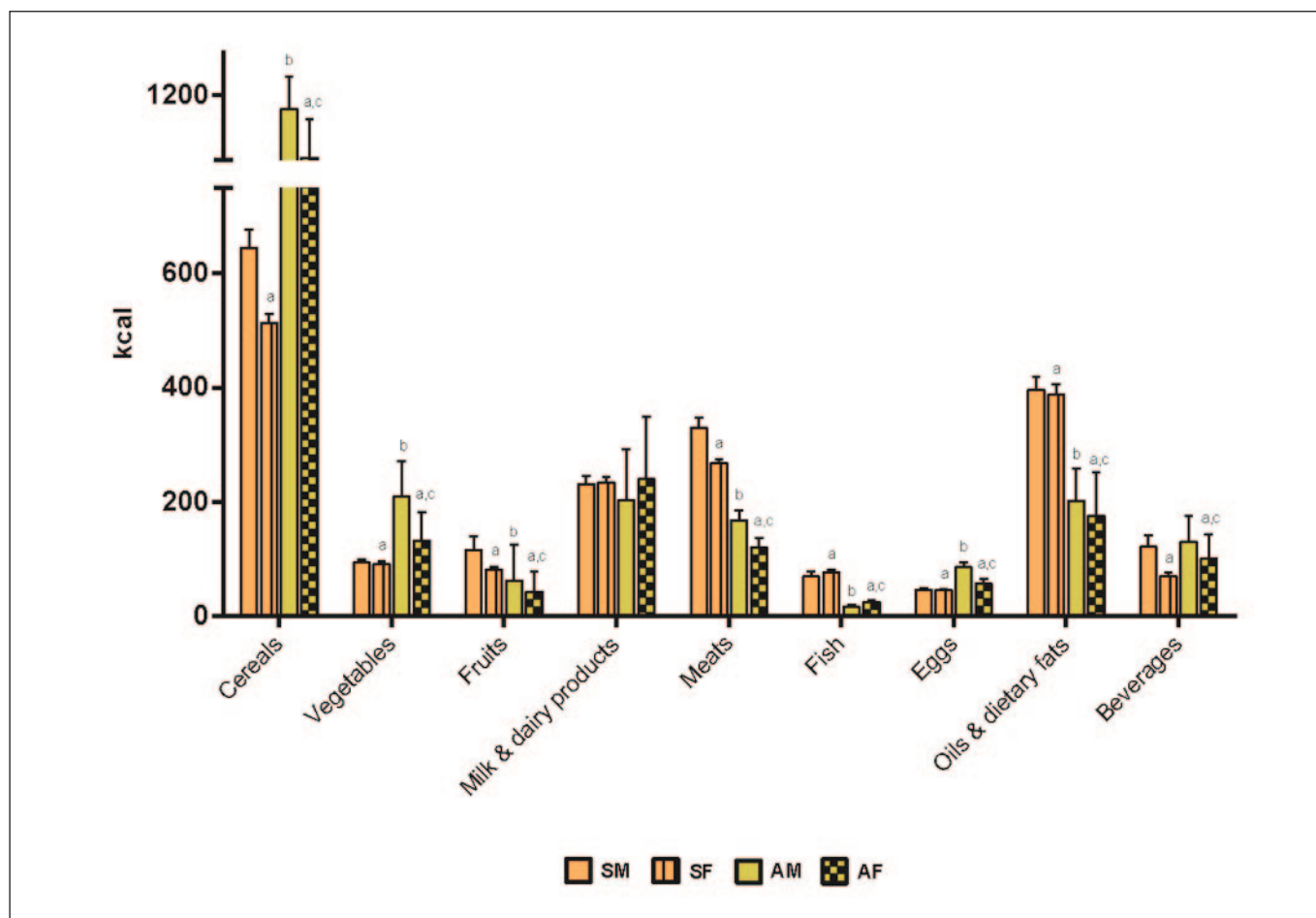
Finally, calorie energy distributed by kind of foods in university students' diet was also analyzed (Figure 2). Cereals, vegetables and eggs were significantly more consumed in Algeria than Spain, in contrast to that observed for other food groups such as fruit, meat, fish and oils and dietary fats. Related to gender, male students of both countries consumed a significantly higher quantity of cereals, vegetables, fruit, oils and dietary fats, beverages, meat and eggs compared to their female colleagues. It is noteworthy the significantly higher consumption of fish in female students compared to their

male colleagues in both countries. In addition, Algerian female students reported the highest intake of milk and dairy products in the study, but this difference did not reach statistical significance compared to the rest of the groups.

DISCUSSION

Countries of Mediterranean basin are quite heterogeneous in terms of economic resources (developed, middle-income and emerging societies), as well as inherited cultural and religious traditions, but share a well-recognized healthy dietary pattern: MD. Last decades, most of these populations have rapidly changed this ancient lifestyle towards more globalized behaviours, particularly young people^{12,13}. This sociological phenomenon leads to different risks for health, including an alarmingly increased prevalence of obesity and non-communicable chronic diseases associated with obesity and diet¹⁴. To the best of our knowledge this is one of the few comparative studies analyzing dietary patterns in university students from two different Mediterranean countries (Spain and Algeria) and

Figure 2. Calorie energy (kcal) distributed by food groups in university students' diet (N=303).



Results are expressed in terms of mean ± SD. SM= Spain male; SF= Spain female; AM= Algerian male; AF= Algerian female. ^a Significantly different (p<0.05) among genders of each country (SM vs. SF / AM vs. AF); ^{b,c} Significantly different (p<0.05) among countries of each gender (^b SM vs. AM; ^c SF vs. AF).

the first study exploring nutritional status in this important population in Algeria.

Our results about anthropometric characteristics demonstrated that most of the students were in the range of normal weight, both in Spain and Algeria. As expected by sexual dimorphism, males were taller and heavier than female and accordingly showed significantly higher BMI values (in terms of total BMI and normal weight category). These findings are similar to those of prior investigations carried out in university students of different Mediterranean countries, such as Spain^{10,15-17}, Croatia¹⁸, Tunisia¹⁹, Lebanon²⁰ and Turkey²¹. However, in this study there were not observed statistically significant differences between genders in underweight and overweight categories. In addition, Spanish women reported the highest mean value in obesity category compared to Spanish men. Other authors have observed contradictory results about the prevalence of obesity in Spanish female students²². On the other hand, Algerian students were not categorized as obese. In 2002, a comparative study between six Mediterranean countries demonstrated that, in general, Algeria population showed the lowest prevalence of obesity²³. Last statistics pointed that this prevalence seems to be increasing in the last years, both in adolescents²⁴ and adult population²⁵.

In agreement with the results obtained in other Spanish university populations^{12,15-17}, the dietary intake of Spanish students was observed to be high in proteins and fats and low in carbohydrates compared with the correspondent RDAs; however, Algerian students showed a proper intake of carbohydrates and fats but high for proteins, particularly in men. It should be mentioned that fibre intake has previously been referred as low both in Algerian population²³ and Spanish university students^{15,17}. In fact, a comparative study between university students of Spain, Tunisia and United State surprisingly showed that Americans students showed the highest intake of fibre²⁶. A more detailed analysis of lipid content revealed that SFA almost duplicated the upper limit of the RDA in Spanish students but MUFAs and PUFAs percentages were similar to the recommended. This lipid content in this population is in accordance with Cervera et al.¹⁵, but differs from results obtained by Baldini et al.¹² and Rizo-Baeza et al.¹⁶, likely due to the existence of variants of MD among the Spanish regions analysed. In respect of Algerian students, similar lipid content has been obtained, except for the low intake of MUFAs in comparison to RDA; furthermore, Algerian female students showed the highest values of PUFAs. With regards to cholesterol, all the groups showed MDIs of cholesterol above the recommended (<300 mg/day) except Algerian female students, in agreement with other studies^{12,15}. However, it should be mentioned that in the last edition of *Dietary Guidelines for Americans*²⁷, scientific committee claimed to remove limitations for cholesterol consumption defending that this should not be considered as a

nutrient of concern for overconsumption. Omega-3 fatty acids were much more consumed by Spanish students than Algerian one. Finally, alcohol consumption in Spain was higher in male students than their female colleagues, which also has been observed by other studies^{11,12}. As commented below, Algerian students did not report the intake of alcohol beverages, similarly to that observed in the general population²³. This might be partially explained by religious reasons¹³. However, other important sociological factors must influence alcohol consumption in North African countries belonging to Mediterranean basin. Thus, in previously studies carried out in others predominantly Muslim countries as Tunisia, alcohol consumption was reported among university students¹⁹; on the contrary, the 96.6% of Libyans university students reported never consuming alcohol²⁸.

In order to make a more exhaustive evaluation of the diet of university students, micronutrient (vitamins and trace elements) intake was also analyzed. In this way, MDIs of vitamin A, B1, B2 and C, calcium and iron (only among women) were higher in Spanish students than in Algerian ones. Moreover, there were observed significant differences because of gender in the intake of all micronutrients, except for calcium in Spain. Literature reported that, in general, micronutrients intake of male students is higher than female ones. As Perez-Gallardo et al.¹⁷ pointed, this should be explained by the fact that men consume diets more rich in calories (and consequently, more rich in nutrients) than women. Some other studies also showed lower iron intake among females^{16,18}.

The comparative analysis of calorie energy distributed by kind of foods in university students' diet reflects the results obtained by nutritional assessment of macro- and micronutrients. There were observed statistically significant differences because of gender and nationality. Thus, Spanish university students consumed more quantity of meat, fish, fruit, oils and dietary fats than Algerian ones. Other authors have reported a deficient consumption of cereals, vegetables and fruit, and higher percentages of energy provided by meat, oil fats¹⁷ and cereals¹⁵ among Spanish university students. Similar to our results, in a comparative study between Spanish and Italian university students, Baldini et al.¹² observed that some classic Mediterranean foods such as cereals, fruit and vegetables were consumed more frequently in the Italian groups compared to Spanish groups. These findings might explain the low content of carbohydrates (and fiber) and high levels of protein and fats registered in their diet; in this sense, although meat and meat products would be probably the food sources of protein and fats (SFA and cholesterol), it should not be forgotten that olive oil is considered the primary source of healthy fats (MUFAs and PUFAs) in Spain¹³. With regards to Algerian university students, cereals, vegetables and eggs were more present in their diet. Previously researches carried out in other Muslim countries as Lebanon²⁰ and Tunisia¹⁹ also reported that the intake of fruit and fish were

low among university students. Additionally, statistical data points that diet in Maghreb countries is based on vegetable and especially cereal intakes, with low intakes of meat, fish and wine¹³. Our results also showed gender differences in dietary patterns. In general, male students consumed more cereals, fruit, oils and dietary fats, beverages, meat and eggs, whereas fish intake was higher in their female colleagues. These results differ from other studies in Mediterranean countries where women have been shown to consume significantly more fruit and vegetables¹¹. Moreover, Algerian women showed the greater consumption of milk and dairy products in the study but, interestingly, these observations were not correlated with high MDIs of calcium. According to Perez-Gallardo et al.¹⁷, it could be due to men obtained this micronutrient from other food sources.

The potential limitations of the present study should be taken into account. First, it was a cross-sectional study with a relatively small sample size that might reduce the power to detect statistically significant differences between groups. Therefore, derived conclusions are only indicators for further prospective and experimental investigations. In addition, subjective errors in self-reporting data along with the use of nutritional databases could be causes of underestimation of the studied variables. Notwithstanding the above-mentioned limitations, which are always present in the field of nutritional studies, the present work contributes to generate knowledge about different dietary habits in young populations of Mediterranean countries.

Last but not least, we would like to highlight other important ideas derived from this study. Nutrition education programs based on the promotion of Mediterranean lifestyle must be aimed at all ages, but are especially important to include them from basic education. It is concerning that research evidence points that students pursuing university careers related Health Sciences (Nutrition, Nursing, Medicine...) are consuming unbalanced diets and presenting nutritional deficits, similarly to students of others careers^{16,20}; therefore, it is essential that these students acquire relevant knowledge, not only for their own health but also for society. Furthermore, different social and environmental barriers have been observed to limit the acquisition and maintenance of healthy lifestyle patterns among adolescents living in Mediterranean countries. Thus, a poor nutritional education (i.e. nutritional knowledge, food shopping and preparation skills) and even the religious traditions may condition healthy habits in adolescents, which is likely to persist into adulthood. In Arab countries, these obstacles lead to significant differences between genders, for example, in terms of physical activity. Finally, several studies have been demonstrated that students who adopt healthy habits (i.e. regular meals and high fruit consumption) have higher academic achievement²⁹, in addition to the well-known healthy effects.

CONCLUSION

To the best of our knowledge this is the first comparative study about dietary patterns in university students from two different Mediterranean countries (Spain and Algeria). As expected, it has been observed significant differences in the diets, not only because of gender but also nationality, probably due to inherent cultural and socioeconomic characteristics of each country resulting in variants of MD. Moreover, results confirm currently available scientific evidence about that, in general, Mediterranean younger populations are replacing their dietary traditions for unhealthy patterns such as Western diet. It is urgent to encourage next generations to preserve and perpetuate Mediterranean diet, and even upgrading its healthy effects through the next recommendations³⁰: increasing the consumption of nuts, extra-virgin olive oil, fatty fish and whole grain cereals 2) reducing sodium intake and 3) maintaining a moderate consumption of wine with meals.

ACKNOWLEDGEMENTS

Authors are grateful to Junta de Extremadura (ERDF Funds – GR 18040). C. Carrasco holds a post-doctoral fellowship from "Ayudas para el fortalecimiento de la I+D+i mediante la movilidad de investigadores posdoctorales para el ejercicio 2017" programme (Junta de Extremadura, PO17027). We also thank all the university students from University of Extremadura (Badajoz, Spain) and University of Djelfa (Algeria) that have collaborated in this study in an unselfish manner.

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