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Clustering of lifestyle factors in Spanish university students: the relationship between smoking, alcohol consumption, physical activity and diet quality

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Abstract

Objective: To ascertain the prevalence of and association between main lifestyle factors (diet, physical activity, alcohol consumption and smoking) in students from the Balearic Islands University.

Design: A cross-sectional, descriptive study. A questionnaire including questions on lifestyle, dietary habits and physical activity habits was administered to the students. Four different diet quality scores were calculated (Diet Diversity Score, Mediterranean Diet Score, Dietary Guidelines Score and Global Dietary Guidelines Score).

Setting: A sample of students from the Balearic Islands University.

Subjects: Nine hundred and eighty-seven students (45·5% males; mean age 21·5 (SD 3·3) years).

Results: The dietary pattern of the student population was characterized by a low consumption of cereals and tubers, fruits, vegetables, olive oil, legumes and nuts, and a high consumption of processed meat, sweets, snacks, soft drinks and pastries. Linear, positive and statistically significant correlations were found between the number of meals consumed daily and all of the diet quality scores determined. Determinants of diet quality, both in the univariate and multivariate analyses, were physical activity practice, sex, age and number of meals consumed daily.

Conclusions: Risk factors such as smoking, diet and physical inactivity had a tendency of clustering among Spanish university students. Overall diet quality was low, due to important departures from dietary recommendations and loss of the traditional Mediterranean dietary pattern. Nutritional education campaigns that include promotion of physical activity practice are needed to improve the overall health status of this population.

Keywords
Diet
Physical activity
Smoking
Alcohol drinking
University students

Currently, there is extensive evidence that lifestyle factors, such as unhealthy diet, excessive alcohol consumption, smoking and sedentary lifestyle, contribute to an increase in morbidity and mortality due to the development of chronic diseases such as CVD, type 2 diabetes and cancer, among others[1,2].

Despite the fact that most studies have focused on the independent effect of each lifestyle factor on disease risk, recent publications have studied the synergistic effect of several combined lifestyle factors on health risk[3–7]. This is particularly important given that lifestyle factors tend to cluster in individuals[8–11]. Hence, the study of the clustering of risk factors has important implications on both disease risk and the development of preventive interventions targeting the combination of risk factors rather than individual risk factors.

As recent studies suggest, physical activity and diet are key factors for health maintenance, sharing – even synergistically – physiological mechanisms affecting the global metabolism[12,13].

It is well known that the prevalence of smoking, alcohol consumption and physical inactivity is increasing in Spanish adolescents and young adults, but information on the clustering of these behaviours is scarce[14]. Moreover, because behaviours tend to cluster in adolescence and are maintained through adulthood, and socio-economic status is a determinant of lifestyle factors, it is important to assess lifestyle characteristics in this segment of the

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population. Thus, the aim of the present study was to ascertain the prevalence of and association between main lifestyle factors (diet, physical activity, alcohol consumption and smoking) in students from the Balearic Islands University.

Methods

Study design and sample selection

The present cross-sectional, descriptive study was carried out in a sample of university students. From May to November 2010, a sample of 987 students (age range 17–48 years), from a total of about 13 000 students from the University of Balearic Islands, was recruited. Students were randomly selected from the different faculties in the university. Twenty-five lecture rooms proportionally distributed among the different degrees were randomly selected, and all students present in the room were invited to complete the questionnaire. A total of 1100 questionnaires were distributed within the same semester and 113 students declined to participate in the study. Written informed consent was obtained from all participants. The gender, age and degree distribution of participants in our sample was similar to that of the overall university; hence this sample can be considered representative of the students of the university. The sample size allows a difference in proportions of 5 % ($\alpha = 0{\cdot}05$) to be detected with 99 % statistical power.

The questionnaire

The questionnaire was a short version of the Spanish National Health Survey 2006, completed with information about motivation for physical activity practice based on a previous questionnaire specifically developed for Spanish university students[15]. It was self-completed by the students with the supervision of trained interviewers.

The questionnaire included questions on the following.

1. Demographic and anthropometric characteristics of participants: age, gender, type of study, self-reported weight and self-reported height. BMI (kg/m^2) was calculated. Individuals were classified as underweight (BMI $< 18{\cdot}5$ kg/m^2), normal weight (BMI = 18·5–24·9 kg/m^2), overweight (BMI = 25·0–29·9 kg/m^2) or obese (BMI $\geq 30{\cdot}0$ kg/m^2).
2. Lifestyle: smoking habit (yes or no, age at start and number of cigarettes per day; smokers were also asked about trying to quit smoking), alcohol consumption (yes/no, age at start, frequency of consumption and frequency of drunkenness, type of alcohol consumed) and cannabis consumption (frequency).
3. Physical activity practice: students' PA practice was ascertained with the question 'Do you practise any type of sport or leisure physical activity during your free time?' (possible answers: yes or no). The physically active students were also asked about the type of physical activity performed and weekly time spent on physical activity practice.
4. Dietary habits: a semi-quantitative FFQ, with additional questions on total number of meals per day and food preferences[16].

Diet quality scores

Three different scoring systems covering different diet quality aspects were applied to this sample.

1. A Diet Diversity Score (DDS) evaluating the daily consumption of foods from different food groups: (i) protein-rich foods (meat, fish, eggs); (ii) Ca-rich foods (dairy products and legumes); (iii) complex carbohydrate-rich foods (cereals and tubers); (iv) fruits; and (v) vegetables. Two points were given to each individual consuming at least one serving size of each food group (i to v); 0 points were given when the consumption was below one serving size. The DDS range was 0–10 points[17].
2. A modified version of the Mediterranean Diet Score (MDS) evaluating the consumption of eight typical and two atypical Mediterranean diet food groups. When the individual's consumption of cereal products, whole grains, legumes, fruits, nuts, vegetables, fish and olive oil was above the sex-specific median, 1 point was given; 0 points were given otherwise (consumption below sex-specific medians). On the other hand, when the intake of dairy products and meat products was above the sex-specific median, the participant received 0 points and 1 point otherwise. The score range was 0–10 points. This score is a variation of the original MDS adapted to the dietary patterns and nutritional needs of this population group[18–21].
3. A Dietary Guidelines Score (DGS) assessing the degree of concordance with the Spanish dietary guidelines was created[22,23]. Individuals with consumption (in serving sizes) of the food groups included in the Spanish food pyramid (cereals, fruits/vegetables, olive oil, dairy products, lean meat, legumes/nuts, fish, eggs, red/processed meat, fats and oils different from olive oil, and snacks/soft drinks/sweets) similar to recommendations obtained 1 point. When the intake was lower or higher (depending on the food group) participants received 0 points. The DGS score range was 0–10 points.

Moreover, an average Global Diet Quality Score (GDQS) was created by averaging the points obtained on each of the three scores (DDS, MDS and DGS). These three scoring systems were selected given their associations with chronic disease risk. Hence, the GDQS score range was also 0–10 points.

Statistical analysis

Descriptive statistics were based on the calculation of percentages for categorical variables, and means, medians and standard deviations for continuous variables. The level

of significance of differences between percentages was assessed using the χ^2 test; the level of significance of the differences among means was assessed using one-way ANOVA.

Multivariate analyses were used to study the associations among main lifestyle factors and to study the socio-demographic and lifestyle determinants of being physically active (yes or no) and having a high (GDQS ≥ 5) or low (GDQS < 5) diet quality. First, univariate logistic regression was used to study the individual effect of all plausible determinants of diet quality and physical activity (sex, age, BMI, number of meals consumed daily, consumption of alcohol, tobacco and drugs, physical activity, diet quality). Variables that were significantly associated in the univariate analyses were included in the multivariate model. Hence, multivariate logistic regression, with the calculation of corresponding odds ratios, was used to assess which determinant factors were associated with diet quality and physical activity practice.

The existence of significant bivariate correlations among determinants and diet quality scores was ascertained by means of determining Pearson correlation coefficients.

The data analysis procedures were carried out using the SPSS statistical software package version 19·0 (SPSS Inc., Chicago, IL, USA).

Ethical approval

The study was performed in accordance with the Declaration of Helsinki and was approved by the Research Ethics Committee of the University of the Balearic Islands. All participants were assigned fictitious names to prevent data from being traceable to any individual.

Results

Of participants in the study, 45·5% were men and the mean age was 21·5 (SD 3·3) years. Mean BMI was 23·2 (SD 2·9) kg/m^2 and 20·1 (SD 2·3) kg/m^2 in men and women, respectively. Some 54% of the students (43% of women and 67% of men) reported physical activity practice. The difference between genders was statistically significant ($P < 0·01$). Fitness, football and swimming were the most prevalent types of physical activity. Men were more likely to play football and women to swim or go to the gym (fitness). Among those who practised physical activity, 85·7% did so for ≥3 h/week. Eighty per cent of participants in the study reported to consume alcohol, either sporadically or regularly. On average, students reported to consume alcohol 5·5 (SD 5·0) times/month, of which alcohol consumption led to drunkenness 1·6 (SD 2·3) times/month. Consumption of alcohol and times of drunkenness per month were higher in men than in women ($P < 0·05$). The mean age at which students started to consume alcohol was 15·2 (SD 2·0) years. The most consumed alcoholic beverages were wine, spirits and beer. Regarding smoking habits, 35·9% of participants were smokers (with 8·8% of students reported to smoke sporadically and 27·1% smoking on a regular basis). No statistically significant difference in the proportion of smokers between genders was found. Some 57·5% of smokers reported to have tried quitting smoking without success, with no difference among genders. The mean age at which students reported to start smoking was 16·4 (SD 2·3) years, with no differences between genders. Regarding the use of cannabis, 44·1% of participants in the study consumed cannabis, with no differences between genders in the age they started the consumption but with a higher consumption in men (Table 1).

The mean score for the MDS was 5·1 (SD 1·8), for the DDS 7·6 (SD 1·9) and for the DGS 2·1 (SD 1·3). Women showed significantly higher DDS scores (mean 7·8, SD 1·9) than men (mean 7·4, SD 1·8). However, both sexes showed similar scores in the MDS and DGS. The mean score for the GDQS was 5·0 (SD 1·3), being significantly higher in women (5·0, SD 1·3) than in men (4·9, SD 1·3; Table 1).

Table 2 shows the consumption of food groups in men and women in relation to the Spanish dietary recommendations. The students' dietary pattern was characterized by a low consumption of cereals and tubers, fruits, vegetables, olive oil, legumes and nuts, and a high consumption of processed meat, sweets, snacks, soft drinks and pastries. Women consumed significantly more fruits, vegetables and nuts than men. However, men were more likely to consume foods rich in fat and protein.

Table 3 shows the determinants of physical activity practice. Univariate analyses showed that men, older individuals, those with higher BMI, participants with a higher diet quality (GDQS) and non-smokers were more likely to be physically active. When all of these variables were included in the multivariate model we observed that only male gender, non-smoking and diet quality remained significantly associated with physical activity practice.

A similar analysis was performed to assess the socio-demographic and lifestyle determinants of diet quality. For that, the GDQS was divided into two categories (<5 and ≥5 points). Determinants of diet quality, both in the univariate and multivariate analyses, were physical activity practice, sex, age and number of meals consumed daily (Table 4).

Table 5 shows the relationships between several determinants and the scores of the diet quality indices. Positive and statistically significant correlations were found between number of meals consumed daily and all of the diet quality scores determined. Higher number of meals consumed daily was correlated with higher scores for DDS, MDS, DGS and GDQS. However, no significant associations were found between the diet quality scores and determinants such as BMI, weekly hours of physical activity, tobacco consumption and frequency of alcohol consumption.

Table 1 Lifestyle characteristics of the sample population: students (*n* 987) from the Balearic Islands University, Spain, 2010

	All (*n* 987)		Men (*n* 449)		Women (*n* 538)		
	Mean	SD	Mean	SD	Mean	SD	*P* value
Age (years)	21·46	3·33	21·70	3·39	21·26	3·26	*
Weight (kg)	64·28	11·89	72·69	10·97	57·15	6·97	***
Height (m)	170·44	9·37	176·90	8·19	165·06	6·43	***
BMI (kg/m^2)	21·99	2·77	23·17	2·86	20·99	2·25	***
BMI classification (%)							
Underweight (<18·5 kg/m^2)	8·20		2·70		12·80		***
Normal weight (18·5–24·9 kg/m^2)	72·70		76·00		82·80		
Overweight (25·0–29·9 kg/m^2)	11·10		19·20		4·20		
Obese (≥30·0 kg/m^2)	1·00		2·00		0·20		
Physical activity practice							
Yes (%)	54·00		67·00		43·10		***
Hours/week	5·14	3·07	5·54	3·11	4·62	2·93	**
Alcohol consumption							
Yes (%)	80·00		83·30		77·30		*
Age at start (years)	15·22	1·97	15·16	2·20	15·28	1·75	NS
Frequency of consumption (times/month)	5·49	5·01	6·70	6·08	4·40	3·47	***
Frequency of drunkenness (times/month)	1·60	2·32	1·85	2·47	1·35	2·15	**
Tobacco use							
Yes (%)	35·90		33·90		37·50		NS
Age at start (years)	16·38	2·27	16·72	2·52	16·13	2·03	**
Cigarettes/d	10·53	7·16	10·86	7·50	10·29	6·91	NS
Cannabis consumption							
Yes (%)	44·10		33·90		37·50		NS
Age at start (years)	15·40	5·75	15·96	5·80	14·80	5·65	NS
Cigarettes/month	7·97	24·16	10·46	28·68	5·58	18·60	*
Diet quality							
Number of meals/d	3·76	0·87	3·76	0·87	3·75	0·87	NS
DDS	7·60	1·85	7·41	1·83	7·75	1·85	**
MDS	5·13	1·79	5·04	1·80	5·20	1·79	NS
DGS	2·13	1·32	2·11	1·30	2·15	1·33	NS
GDQS	4·95	1·30	4·86	1·32	5·04	1·28	*

DDS, Diet Diversity Score; MDS, Mediterranean Diet Score; DGS, Dietary Guidelines Score; GDQS, Global Diet Quality Score.
Data are presented as mean and standard deviation, unless otherwise specified.
Level of significance of the observed differences between means or percentages as assessed by one-way ANOVA or the χ^2 test, respectively: *$P<0·05$, **$P<0·01$, ***$P<0·001$.

Table 2 Average intake of food groups in relation to the Spanish Food Guidelines in the sample population: students (*n* 987) from the Balearic Islands University, Spain, 2010

	Food guidelines SENC, 2004†	All (*n* 917)	Men (*n* 412)	Women (*n* 505)	*P* value
Daily consumption (servings/d)					
Bread, grains, pasta, rice, potatoes	4–6 servings/d (mostly wholegrain)	2·9 (0·6)	3·3 (0·5)	2·6 (0·6)	*** (NS)
Milk and dairy products	2–4 servings/d	2·6	2·7	2·5	*
Vegetables	≥2 servings/d	0·9	0·7	1·0	***
Fruit	≥3 servings/d	1·6	1·5	1·7	***
Olive oil	3–6 servings/d	1·4	1·4	1·4	NS
Weekly consumption (servings/week)					
Legumes	2–4 servings/week	1·3	1·4	1·2	NS
Nuts	3–7 servings/week	1·8	1·5	1·6	*
Fish and shellfish	3–4 servings/week	2·1	2·0	2·2	NS
Poultry	3–4 servings/week	1·9	2·0	1·9	NS
Eggs	3–4 servings/week	2·1	2·4	1·9	***
Processed and red meat	<1 serving/week	6·6	7·7	6·0	***
Sweets, snacks, soft drinks	<1 serving/week	6·8	8·4	6·0	***
Butter and margarine	<1 serving/week	3·4	3·9	3·1	**

Level of significance of the observed differences between means as assessed by one-way ANOVA: *$P<0·05$, **$P<0·01$, ***$P<0·001$.
†Food Guidelines for the Spanish population of the Spanish Society of Community Nutrition (SENC)[62].

Discussion

In the present study we analysed food patterns, diet quality and physical activity practice and determinants among university students from the Balearic Islands. We were able to observe the clustering of lifestyle factors in the present sample, mainly physical activity and diet. Taking all these results together, we can determine which

Table 3 Determinants of physical activity practice in the sample population: students (*n* 987) from the Balearic Islands University, Spain, 2010

	Yes		No					
Physical activity practice	Mean	SD	Mean	SD	Crude OR	95 % CI	Adjusted OR	95 % CI
Sex (%)								
Men	56·5		43·5		2·68***	2·07, 3·48	2·53***	1·88, 3·40
Women	32·6		67·4		1·00	Ref.	1·00	Ref.
Age (years)	21·6	3·5	21·2	3·1	1·05*	1·01, 1·09	1·03	0·99, 1·08
BMI (kg/m^2)	22·3	2·7	21·6	2·8	1·11***	1·06, 1·17	1·03	0·98, 1·09
GDQS	5·1	1·3	4·8	1·3	1·23***	1·12, 1·36	1·28***	1·15, 1·43
Number of meals/d	3·8	0·8	3·7	0·9	1·09	0·94, 1·26		
Alcohol consumption (%)								
No	19·7		20·3		0·96	0·70, 1·32		
Yes	80·3		79·7		1·00	Ref.		
Tobacco consumption (%)								
No	69·4		58·1		1·64***	1·26, 2·13	1·60**	1·21, 2·12
Yes	30·6		41·9		1·00	Ref.	1·00	Ref.
Drugs consumption (%)								
No	46·5		46·1		1·02	0·77, 1·34		
Yes	53·9		53·5		1·00	Ref.		

GDQS, Global Diet Quality Score; Ref., referent category.
Level of significance of the crude odds ratio or adjusted odds ratio as assessed by univariate logistic regression or multivariate logistic regression, respectively: *$P < 0·05$, **$P < 0·01$, ***$P < 0·001$.

Table 4 Determinants of diet quality in the sample population: students (*n* 987) from the Balearic Islands University, Spain, 2010

GDQS	High (GDQS ⩾ 5)	Low (GDQS < 5)	Crude OR	95 % CI	Adjusted OR	95 % CI
Sex (%)						
Men	42·5	48·7	0·78	0·60, 1·00	0·65**	0·50, 0·85
Women	57·5	51·3	1·00	Ref.	1·00	Ref.
Physical activity practice (%)						
Yes	59·5	48·1	1·58***	1·23, 2·04	1·70***	1·30, 2·22
No	40·5	51·9	1·00	Ref.	1·00	Ref.
Age (years)						
Mean	21·8	21·1	1·06***	1·02, 1·11	1·07**	1·02, 1·11
SD	3·8	2·7				
BMI (kg/m^2)						
Mean	22·1	21·9	1·02	0·98, 1·07		
SD	2·9	2·6				
Number of meals/d						
Mean	3·9	3·6	1·32***	1·14, 1·52	1·32**	1·14, 1·53
SD	0·9	0·8				
Alcohol consumption (%)						
No	21·3	18·5	1·20	0·87, 1·64		
Yes	78·7	81·5	1·00	Ref.		
Tobacco consumption (%)						
No	65·0	63·2	1·08	0·83, 1·41		
Yes	35·0	36·8	1·00	Ref.		
Drugs consumption (%)						
No	60·2	61·2	0·96	0·73, 1·26		
Yes	39·8	38·8	1·00	Ref.		

GDQS, Global Diet Quality Score; Ref. referent category.
Level of significance of the crude odds ratio or the adjusted odds ratio as assessed by univariate logistic regression or multivariate logistic regression, respectively: **$P < 0·01$, ***$P < 0·001$.

health promotion strategies could be more effective among university students.

Despite the great variation between different populations in the onset age of alcohol consumption, our study shows a similar age[24] or slightly higher age than reported in other studies[25], which found a range between 12 and 15 years. Results from the present study show that alcohol consumption was not related to diet quality and physical activity levels. This may be because this alcohol consumption is so ingrained in our society to the point of being independent of other factors[26].

The smoking prevalence among participants in the present study is higher than the Spanish average and also higher than the prevalence in other neighbouring countries such as France and Italy[27]. Furthermore, and in accordance with most studies that have focused on participants aged 18–24 years, this smoking prevalence tends to be higher in women than in men[27,28]. It seems that

Table 5 Association between determinants and diet scores in the sample population: students (*n* 987) from the Balearic Islands University, Spain, 2010

	DDS	MDS	DGS	GDQS	Daily meals	BMI	Physical activity	Alcohol	Tobacco
DDS	1·000								
MDS	0·467*	1·000							
DGS	0·335*	0·451*	1·000						
GDQS	0·801*	0·833*	0·704*	1·000					
Daily meals	0·113*	0·115*	0·137*	0·152*	1·000				
BMI	−0·128	−0·008	0·139	−0·004	−0·070	1·000			
Physical activity	0·086	0·044	0·058	0·080	0·120	0·024	1·000		
Alcohol	−0·030	0·068	0·051	0·034	−0·091	0·108	−0·010	1·000	
Tobacco	−0·021	−0·081	−0·048	−0·063	−0·143	0·065	−0·002	0·032	1·000

DDS, Diet Diversity Score; MDS, Mediterranean Diet Score; DGS, Dietary Guidelines Score; GDQS, Global Diet Quality Score.
Daily meals (number of meals/d), Physical activity (h/week), Alcohol (alcohol consumption, times/month) and Tobacco (cigarettes/d) were used as determinants.
*Significance of the correlation (Pearson bivariate correlation): $P < 0·01$.

this upward trend is supported by data from the school population (2008) because it was reported that 48·3 % of 18-year-old students smoked at least once in the 30 d preceding the date of the interview[29]. The onset age of smoking found in the present study, about 16·4 years, is likely to have remained stable during past years. The high proportion of smokers who wanted to quit smoking and could not (57·5 %) is similar to that reported in other studies in similar environments and even in the same university in previous years, confirming the addictive power of tobacco[24,30].

Results from the present study show an association between physical activity practice and lower smoking prevalence. This is in agreement with data reported by the Ministry of Health in 2005 and other authors who, in addition, have also associated physical activity practice with lower consumption of alcohol and other drugs[29]. In this sense, more recent and complete studies have reported that belonging to groups of high risk (unhealthy) or low risk (healthy) is correlated with smoking prevalence, practice of exercise, alcohol intake and diet quality, with a tendency for specific health lifestyle factors to aggregate in clusters[31].

No relationship between quality of diet and smoking prevalence has been found in the current study. Literature reflects a great controversy regarding this issue[32]. Other studies found similar results to ours with not only a similar physical activity practice among smokers and non-smokers, as in the present study, but also a similar energy intake[33–35]. On the other hand, some researchers have shown a relationship between smoking and a less healthy diet (and also increased alcohol consumption)[36–38].

The percentage of students reporting being physically active in the present study is similar to that observed in a previous meta-analysis (about 50 %)[39]. As reported previously, men were more likely to be physically active than women[40–44]. Also, engagement in other healthy habits, such as a healthy diet and being a non-smoker, was associated with the practice of physical activity. Similar associations between healthy habits and physical activity have been observed in previous studies[45–48]. However, no associations were found between the weekly hours of physical activity and quality diet scores, indicating that among the students who were physically active, the diet quality was not higher in those performing more hours of physical activity.

The dietary pattern of these university students is quite similar to that of Western societies. It is outstanding in the high consumption of food items from the top of the nutritional food pyramid which should be avoided, such as red and processed meat, snacks, soft drinks, sweets and pastries, butter and margarine. On the other hand, the consumption of fruits, vegetables, legumes, nuts and whole grains is much lower than recommended. Hence the high consumption of foods with high contents of saturated fat and simple sugars, and the low consumption of vegetables, reflect a change in dietary patterns as a consequence of the nutrition transition, and therefore the diet of young generations from the Balearic Islands has become quite different from the healthy Mediterranean diet[49–53]. This has also been observed in previous studies conducted within the same population[54–56]. The change of dietary patterns towards a less healthy diet may lead to an increased risk of developing chronic diseases, such as CVD and cancer, in the future[57,58].

In order to study diet quality in the present sample, several diet quality scores were applied. The evaluation of the overall diet from a global perspective is widely used in nutritional epidemiology studies as a way of taking into account simultaneously several nutritional aspects associated with diet quality and better health status[59–64]. In the present study, diet diversity, concordance with dietary guidelines and adherence to the Mediterranean diet were considered important aspects of diet quality for the present population. In this population, despite showing overall high scores for diet diversity, the concordance with the Spanish Food Recommendations was very low. High diet diversity has been reported in developed populations where access to plenty of food items is common. Mean DDS was higher in women than in men, which led to an overall higher global diet quality in women compared with men. Better nutritional

profiles in young women than men has been reported previously[50,52]. Another independent determinant of diet quality is the number of meals consumed each day. Probably more frequent food consumption led to higher diet diversity and, hence, to higher diet quality.

A limitation of the present study and the methods used to assess diet quality is the fact that we could not adjust dietary intakes for total energy. This was due to the method of dietary assessment that did not allow us to derive energy intake properly, as has been indicated previously[16]. Adjusting for energy intake would have permitted us to reduce part of the measurement error associated with dietary assessment tools and probably may have deattenuated part of the observed associations. Nevertheless, previous authors have questioned whether using energy-adjusted food intakes for the derivation of dietary patterns is necessary or appropriate[65], even with the use of dietary scores such as the MDS, given that energy intake may be in the causal pathway linking a Mediterranean diet with several health outcomes[66].

It is difficult to estimate whether physical activity leads to higher diet quality or vice versa in the present cross-sectional study. However, both factors tend to cluster in this population. Although subtle gender differences may exist, promoting physical activity practice may lead to a better diet quality and the other way round. According to these results, perhaps among women more emphasis should be made on the promotion of physical activity and among men on improving diet quality. Nevertheless, in both genders the association between the two factors was linear and significant (data not shown).

In addition to the lack of adjustment for total energy intake indicated above, our study presents some more limitations. The first one is that, as indicated in the Methods section, some information has been obtained based on self-reports and therefore is subject to measurement errors. Furthermore, it is possible that categorization of variables may have affected our findings, and probably more categories should have been introduced in order to improve results regarding the associations tested. On the other hand, the fact that the study supposes an update of a topic with only a few previous studies focused on the Spanish university population could be considered the most important strength. The relatively high number of participants in the study as well as the number of variables collected from the participants could be also taken into account when considering the strength of results from the study.

Conclusions

Results of the present study demonstrate a tendency for clustering of risk factors (smoking, diet and physical inactivity) among Spanish university students. Overall diet quality was low, due to important differences from dietary recommendations and loss of the traditional Mediterranean dietary pattern. Nutritional education campaigns that include promotion of physical activity practice are needed to improve the overall health status of this population.

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