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Females are more adherent to Lebanese Mediterranean Diet than males among university students

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ABSTRACT

Introduction: Although the Mediterranean Diet has been shown to be protective against several diseases, nutritional transition continues to take place in several countries, particularly among youth. The aim of this study was to evaluate Lebanese Mediterranean Diet Score adherence among university students of Lebanon, along with its correlates, obesity in particular. **Methods:** A cross-sectional study was carried out in 17 universities of Lebanon; standardized questions were asked about food frequency and adherence to a Lebanese Mediterranean Diet using a Lebanese Mediterranean Diet Score (LMDS). Physical activity, anthropometric data, smoking and other socio-demographic factors were also taken into account. **Results:** The study involved 3384 students, with a mean LMDS of 25 (SD=5). We found that adherence to Lebanese Mediterranean diet was moderate among university students in Lebanon; it was however higher for females in comparison to males ($p<0.001$) As for the relationship with obesity, lower adherence to Lebanese Mediterranean diet was found to be related to obesity status among female students and in the total sample; among men, all BMI categories had the same Lebanese Mediterranean diet scoring. **Discussion:** Young adults, mainly men, have a low to moderate adherence to the Lebanese Mediterranean diet; they represent the appropriate age bracket in which health-promotion activities should be carried out, aiming at facilitating the adoption of health-promoting behaviors and eventually reducing premature mortality at a later stage.

Keywords: Mediterranean diet, gender, adherence, transition, Lebanon

Introduction

During the last several decades, the food habits in Mediterranean countries have largely evolved from a plant-based diet to an animal-based one [1], indicating a westernization of food habits and a move away from the traditionally known healthy Mediterranean diet [2,3]; this diet, first studied in Crete, is characterized by "abundant plant foods (fruit, vegetables, breads, other forms of cereals, potatoes, beans, nuts, and seeds), fresh fruit as the typical daily dessert, olive oil as the principal source of fat, dairy products (principally cheese and yogurt), and fish and poultry consumed in low to moderate amounts, zero to four eggs consumed weekly, red meat consumed in low amounts, and wine consumed in low to moderate amounts, normally with meals" [3]. This diet has a protective effect on health outcomes [4,5], leading to a significant reduction in overall mortality (9%), mortality from cardiovascular diseases (9%), incidence of or mortality from cancer (6%), and incidence of Parkinson's disease and Alzheimer's disease (13%) [5]. Thus, the decreased adherence to a Mediterranean diet is expected to have detrimental health effects for Mediterranean populations. Diet westernization in most developing

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countries is affecting youth, leading to increased rates of cardiovascular disease and cancer risk factors, such as obesity, hyper-lipidemic profiles, hypertension, and diabetes [6-9]. University students seem to be most affected by this transition [10]; their health-promoting lifestyle behaviors have been shown to be relatively low [11-14].In Lebanon, a middle-income developing country of the Eastern Mediterranean basin, the prevalence of overweight and obesity has attained alarming rates in children [15,16], adolescents [17, 18], and adults [15, 19], showing higher obesity and overweight rates among males versus females at all ages except after 40 years. These high rates may be the consequence of important changes associated with both reduced physical activity of modern lifestyles [20], and eating habits characterized by energy dense diets that are low in fiber, fruit and vegetables, and high in fats and sugars [21]. The Lebanese population is considered at risk of chronic diseases, such as cardiovascular diseases [22,23] and cancer [24].In Lebanon, a couple of studies have used dietary patterns [25, 26], only one study has used the Mediterranean dietary pattern [27], and they were all performed on adult populations. Moreover, a few studies were conducted on the dietary habits of university students and they were limited to one or two universities [18,28]. Only one study was conducted on a large sample of university students (n=3307) involving a number of public and private universities to define dietary patterns and their correlates among males and females; its descriptive results were presented elsewhere [12]; his study also showed higher rates of obesity and overweight among male students versus females [12]. Thus, the aim of this study was to evaluate adherence among university students of Lebanon to Mediterranean Diet, along with its correlates, stressing on differences between males and females.

Materials and Methods

A cross-sectional study was carried out using a proportionate cluster sample of Lebanese students in the public and private universities, between October 2010 and July 2011 [12]. A list of universities in Lebanon, provided by the Lebanese Center for Educational Researches and Development, was used to adjust the sample size [29]. A sample size of at least 3000 individuals was targeted to allow for adequate power for bivariate and multivariate analysis to be carried out.

Population and sampling

Most universities' administrative offices in Lebanon that we approached did not allow drawing a random sample of their enrolled students to participate in the study: they did not provide us with the lists of students and permission was not granted to enter classrooms and search for students nominatively. Thus our research group work with a nonrandom sample of students outside their classes.Students were approached on campus during break times between courses by one trained field worker. The latter explained the study objectives to the student; and after obtaining oral consent, the student was handed the anonymous and self-administered questionnaire. On average, the questionnaire was completed by participants within approximately 20 min. At the end of the process, the completed questionnaires were placed in closed boxes and sent for data entry. During the data collection process, the anonymity of the students was guaranteed. Out of 4900 distributed questionnaires, 3384 (69.1%) were returned to the field worker. Further methodological details are presented in more details elsewhere [12].

Data collection and data entry

The anonymous questionnaire was administered in Arabic; it was composed of different sections, translated from several internationally validated questionnaires for youngsters: socio-demographic characteristics, a screening section for all risky behaviors [12], a thorough cigarette and waterpipe smoking history, in addition to nutritional [30], physical activity [31], and sedentary behaviors [30]. Data entry was performed by independent lay persons that were unaware of the objectives of the study.

Socio-demographic variables

Socio-demographic variables included: age, the type of university to which the study participant was enrolled to (public vs. private), whether the student was majoring in a health-related field or not, income per person and region of residence. Income per person was calculated by dividing the declared household monthly income by the number of persons in the household.Behavioral variables include: the number of cigarette packs smoked per year and the number of waterpipes smoked per year.

Physical activity

We used a standard questionnaire to calculate leisure time physical activity on the basis of mean metabolic equivalents (MET) for reported activities and their

frequency and duration in MET- min per week; a higher score indicated greater activity [31]. Information was obtained about habitual leisure time physical activity. Questions included frequency of sports or recreational activities [such as bicycling (MET = 8), basketball (MET = 8), and walking for exercise (MET = 4)] and lessons [such as swimming (MET = 6), dance (MET = 6.5), and stretching (MET = 2.5)]. That is, leisure time activities were considered as those requiring energy expenditure above that required for daily living activities. The physical activity score was computed by multiplying an estimate of the metabolic equivalents (MET) for each recorded activity by the weekly frequency with which it was performed and an overall average weekly score was calculated as MET*times per week. Time spent on each activity was multiplied by the MET value of the activity. The resulting MET-min products were summed to produce an index of daily physical activity, expressing the amount of energy per kg body weight expended during the week.

Anthropometric data

Students involved in this study self-reported their weights and heights; measurement conducted on a subsample of individuals (n=618) gave statistically similar results to those reported. Correlation and equations of the relationship between measured and declared height and weight were reported: for weight, r=0.986 between measured and reported weight ($p<0.001$), and measured weight in kg=(0.983*reported weight) +1.056. For height, r=0.972 ($p<0.001$), and measured height in cm=(0.958*reported height) + 6.94. Thus, given the high correlation and close relation between measured and self-reported height and weight in our sample, self-reported values were adopted for the analysis.The body mass index (BMI) for each individual participant was calculated by the researchers to assess the students' weight status. According to the International Classification of adult weight to height status (i.e. underweight, overweight and obese), BMI values were classified into four categories: underweight (BMI $\leq$ 18.5 kg/m2), normal weight (BMI between 18.5 – 24.9 kg/m2), overweight (BMI between 25 – 29.9 kg/m2) and obese ($\geq$ 30 kg/m2) [32].

Dietary assessment

In addition to the numerous questions related to the study participants' socio-demographic background, the self-administered questionnaire used in this study also included a short food frequency questionnaire to assess the usual dietary intake of university students. The FFQ was composed of 16 questions covering different food categories, including the five basic food groups typically consumed by the Lebanese population. The non-quantitative FFQ used in this study was adapted from the questionnaire earlier administered in the Lebanese population [27] and the CDC Global School Health Survey [30]. The FFQ asked how often each food item, group, or beverage was usually consumed with five possible answers for each of the food categories: 1 - Never , 2- two times or less per week, 3- three to six times per week, 4- at least 1 time per day and 5- at all meals.

The Mediterranean Diet Score Calculation

A Lebanese Mediterranean Diet Score (LMDS) based on a priori positive and negative components was derived from the FFQ. This corresponded with the logic behind previous scoring strategies used for the traditional Mediterranean diet [33]. The LMDS calculation in this study underwent some modifications compared to that of the previously and widely used Mediterranean diet score [34]. First, because the FFQ used in this study was non-quantitative, the LMDS was based on intake frequencies instead of median intake in grams. Second, nuts were not included in the LMDS because they were most often consumed salted and oil roasted in the study sample. Third, for fat intake, olive oil intake frequency was used, because this is the only fatty substance to be specifically used by university students separately from cooking. Finally, ethanol consumption was not accounted for in this study as it is believed that alcohol would be, if consumed, largely underreported because of religious prohibitions against consumption.The choice of negative components to be included in the LMDS also showed some differences compared to the initially developed Mediterranean diet score [34], namely fried potatoes or chips, sweets and fast food were added as detrimental food. The rationale behind including the latter food categories was based on a previous study [35], showing that these items were all included in the "Western type food" dietary pattern which was inversely associated with the "plant food" dietary pattern in both the "vegetarian/low calorie diet" cluster and the "westernized diet" cluster.According to the rationale of the Mediterranean dietary pattern [3], the intake frequency (Never, two times or less per week, three to six times per week, at least 1 time per day and at all meals) of the following 14 food categories were included in the diet score. Then, based on previously described Mediterranean scores [36,37], monotonic functions were used in order to score the consumption frequency of these food categories. For

components presumed to be beneficial (raw vegetables, cooked vegetables, fruits, olive oil, grains, beans, fish, rice and pasta, brown bread or crackers, and white bread or crackers), a score of 0 was assigned for people who did not consume it at all, a score of 1 was assigned for those who consumed it three to six times per week, a score of 2 for those who consumed it at least twice a week, a score of 3 for those who consumed it at least once per day and a score of 4 for those who consumed it at every meal.For components presumed to be detrimental (meat, fried potatoes or chips, sweets and fast food), an inverse score was assigned. People who consumed it at every meal were assigned a score of 0, those who consumed it at least once a day were assigned a score of 1, those who consumed it at least twice a week, a score of 2, those who consumed it three to six times a week, a score of 3 and those who did not consume it at all, a score of 4. As for dairy products, fruit juice and carbonated beverage, they were not included in the scale because we had no information on whether they were consumed full fat or low fat, natural or artificial, with sugar or artificial sweeteners, respectively. Thus, the LMDS score ranged from 0 (minimal adherence to the traditional Lebanese Mediterranean diet) to 52 (maximal adherence).

Statistical analysis

Statistical analysis was performed using SPSS software, version 17.0. Cluster sampling effect was taken into account according to Rumeau-Roquette and collaborators [38]. Data weighting was performed according to the total number of students per university, as described by the Center for Educational Research and Development – Lebanese Ministry of Education [29].The analyses were stratified by gender. In bivariate analysis, correlation coefficients, Student's test for means comparison between two groups and ANOVA for means comparison between more than two groups were used. A p-value less than 0.05 was considered significant.In multivariate linear regression, a forward stepwise method was applied with the LMDS as the dependant variable while taking several independent variables into account (age, region, health related major, private vs. public university, BMI, cigarette smoking, waterpipe smoking, income per person, and physical activity).

Results

Characteristics of the sample and the Lebanese Mediterranean Diet Score

The results in Table 1 show that the Lebanese Mediterranean Diet Score (LMDS) ranged between 4 and 44 for Males and 8 and 47 for Females with a significant higher mean for Females (Mean=25.49) than Males (Mean=24.79) with p<0.001. In the total population, the LMDS ranged between 4 and 47, with a mean of 25.22 and median of 25; the distribution skewness was -0.075 (standard error=0.045), while its kurtosis was 0.499(standard error=0.090). Its 25th percentile was 22 and 75th percentile was 28.

Table 1: Characteristics of the Lebanese Mediterranean Diet Score

LMDS	Males	Females	TOTAL
N	1173	1793	2968
Mean*	24.79	25.49	25.22
Median	25.00	26.00	25.00
Std. Deviation	5.39	4.76	5.03
Minimum	4.00	8.00	4.00
Maximum	44.00	47.00	47.00
***p<0.001 (Student T-test)**			

The mean age of the sample was 20.66 (SD=1.92); it was composed of 41.4% of males and 58.6% of females. Among the 3384 participants, 649(19.2%) were current cigarette smokers while 779(23%) were current waterpipe smokers. Furthermore, 1042(30.8%) did not sports at all; 466(13.8%) had

low physical activity (MET*time value ≤ 624), 464(13.7%) had moderate physical activity (624 < MET*time value ≤ 1200), 454(13.4%) were considered to perform high physical activity (1200 < MET*time ≤ 2160), and 451(13.3%) performed the highest level of physical activity (MET*time > 2160).

Association of the LMDS with independent variables-Associations between independent variables and the LMDS are presented for males and females separately (Table 2).

Table 2: Associations between the Lebanese Mediterranean Diet score and independent variables

MDS		Males		Females		Total	
		Mean (SD)	***p-value***	**Mean (SD)**	***p-value***	**Mean (SD)**	***p-value***
University	Public	25.04 (5.31)	0.171	25.82 (4.43)	**<0.001**	**25.58 (4.74)**	**0.001**[a]
	Private	24.61 (5.44)		24.98 (5.19)		**24.80 (5.31)**	
Health-related major	No	24.75 (5.40)	0.443	25.55 (4.71)	0.406	25.19 (5.05)	0.611[a]
	Yes	25.11 (5.40)		25.34 (4.89)		25.30 (5.01)	
Income per person	Quartile 1	25.51 (4.88)	**0.010**[b]	25.37 (6.08)	0.128[b]	25.56 (4.35)	0.232[b]
	Quartile 2	25.36 (4.84)		24.87 (5.15)		25.65 (4.63)	
	Quartile 3	24.60 (5.17)		24.15 (4.95)		24.96 (5.32)	
	Quartile 4	25.06 (5.39)		24.63 (5.50)		25.51 (5.22)	
Region	Beirut	24.40 (6.05)	**<0.001**[b]	25.02 (4.63)	**0.001**	24.75 (5.30)	**<0.001**[b]
	Mount Lebanon	24.54 (5.50)		25.12 (4.91)		24.84 (5.20)	
	North	24.27 (5.27)		26.37 (4.64)		25.82 (4.90)	
	South	26.88 (3.48)		25.40 (4.71)		25.79 (4.46)	
	Bekaa plain	25.53 (4.79)		25.67 (4.22)		25.64 (4.45)	
BMI classes	Underweight (<18.5 kg/m^2)	24.89 (5.58)	0.430[b]	24.45 (5.18)	**<0.001**[b]	24.50 (5.21)	**<0.001**[b]
	Normal (18.5-24.9 kg/m^2)	24.74 (5.33)		25.67 (4.63)		25.34 (4.91)	
	Overweight (25-29.9 kg/m^2)	25.15 (5.36)		26.42 (4.46)		25.57 (5.12)	
	Obese (≥30 kg/m^2)	24.18 (5.80)		22.60 (6.60)		23.74(6.05)	
		Pearson r	***p-value***	**Pearson r**	***p-value***	**Pearson r**	***p-value***
Age (years)		0.073	**<0.001**	0.033	0.264	0.114	**<0.001**[c]
Cigarette smoking (number of packs*years)		-0.208	**<0.001**	-0.115	**<0.001**	-0.175	**<0.001**[c]
Waterpipe smoking (number of waterpipes*years)		-0.076	**0.011**	-0.033	0.174	-0.063	**0.001**[c]
Physical activity (MET-min/week)		-0.053	0.081	0.085	**<0.001**	-0.028	0.143[c]

The mean LMDS was significantly higher in the public university for females (p<0.001) as well as in the total sample (p=0.001). There was no significant difference in the mean LMDS between students enrolled in health studies and those who were not. There was a significant difference in the mean LMDS among the different income quartiles for the total sample (p=0.010), with the 1st quartile having the

highest mean LMDS (Mean=25.51). There was also a significant difference in the mean LMDS for participants living in different regions of Lebanon for males (p<0.001), females (p=0.001) as well as the total sample (p<0.001) with the highest mean belonging to males residing in the South (Mean=26.88), females residing in the North (Mean=26.37) and both sexes residing in the North (Mean=25.82).

There was a significant difference in the mean LMDS among the different BMI classes for males (p<0.001) and females (p<0.001), but not in the total sample, with the lowest LMDS found in obese males and females.

Age was significantly and positively correlated with the LMDS in both females (p<0.001) and the total sample (p<0.001). Cigarette smoking was significantly and negatively correlated with the LMDS with the strongest correlation seen in males (r=0.208, p<0.001). Waterpipe smoking was significantly correlated with the LMDS in males (p=0.011) and in the total sample (p=0.001). Finally, physical activity was significantly correlated with the LMDS only in females (p<0.001).

The multivariate analysis performed (Table 3) showed that the higher the number of cigarette packs per year, the lower the LMDS for the total sample (Standardized Beta= - 0.222), for males (Standardized Beta= - 0.241), and for females (Standardized Beta= - 0.136). The higher the number of waterpipes smoked per year, the lower the LMDS for both the total sample (Standardized Beta= -0.065) and for males (Standardized Beta= -0.114). Residing in Mount Lebanon was associated with a lower LMDS for the total sample (Standardized Beta= -0.054) but with a higher LMDS for females (Standardized Beta=0.066), whereas residing in the South (Standardized Beta=0.150) or in the Bekaa (Standardized Beta=0.071) was associated with a higher LMDS for males. Being in a private university was associated with a lower LMDS for both the total sample (Standardized Beta= -0.061) and for females (Standardized Beta= -0.062). The level of physical activity (Standardized Beta=0.053 and 0.124), and age (Standardized Beta=0.084 and 0.123) were positively correlated with the LMDS in both the total sample and females, respectively. For other variables, no significant effect was found, due to the lack of association or to its non linearity.

Multivariate analysis

Table 3: Multivariate analysis of Lebanese Mediterranean Diet Score correlates

					95% CI for B	
	MDS correlates	Unstandardized B	Standardized B	p-value	Lower Bound	Upper Bound
ALL	Cigarette smoking (number of packs*years)	-0.5434	-0.222	**<0.001**	-0.6442	-0.4425
	Age in years	0.2238	0.084	**<0.001**	0.1172	0.3303
	Private versus Public university	-0.6356	-0.061	**0.003**	-1.0567	-0.2145
	Waterpipe smoking (number of waterpipes*years)	-0.0308	-0.065	**0.002**	-0.0500	-0.0116
	Mount Lebanon vs. Beirut	-0.5470	-0.054	**0.010**	-0.9608	-0.1331
	Physical activity (MET-min/week)	0.0002	0.053	**0.010**	0.0001	0.0003
Males	Cigarette smoking (number of packs*years)	-0.4349	-0.241	**<0.001**	-0.5487	-0.3211
	South Lebanon versus Beirut	2.5455	0.150	**<0.001**	1.4818	3.6092
	Waterpipe smoking (number of waterpipes*years)	-0.0480	-0.114	**<0.001**	-0.0741	-0.0218
	Bekaa versus Beirut	1.3870	0.071	**0.026**	0.1683	2.6057
Females	Cigarette smoking (number of packs*years)	-0.7042	-0.136	**<0.001**	-0.9720	-0.4363
	Age in years	0.3327	0.123	**<0.001**	0.1932	0.4722
	Physical activity (MET-min/week)	0.0006	0.124	**<0.001**	0.0003	0.0009
	Mount Lebanon vs. Beirut	0.7757	0.066	0.015	0.1520	1.3994
	Private vs. Public university	-0.6399	-0.062	0.023	-1.1902	-0.0897

Note: Adjustments were made for university type (private versus public), major type (health related versus other), income per person, region, BMI, age, cigarette smoking, waterpipe smoking and physical activity. MET=Metabolic equivalent; MDS=Meditarranean Diet Score

Discussion

In this study, we found that adherence to the Lebanese Mediterranean diet was moderate among university students; it was however higher for females in comparison to males. As for the relationship with obesity, lower adherence to the Lebanese Mediterranean diet was found to be related to obesity status among females and in the total sample; among males, all BMI categories had the same Lebanese Mediterranean diet scoring. These results are in line with what we previously found for dietary patterns, where males have higher rates of obesity compared to females; however, they had similar high consumption of unhealthy diets across all BMI categories [35]. The observed difference between males and females deserves to be discussed from a public health perspective: female students might be more aware of their nutritional habits and its association with obesity for esthetic and body shape satisfaction reasons [39], while males may just not worry about their shape for cultural reasons [39] and might not relate current obesity to future health issues [40]. Responsible behaviors were also more common among Lebanese females university students, while males tended to take more risks and enjoy the moment [40].Moreover, lower socioeconomic status measured by studying in the public university was related to better adherence to Lebanese Mediterranean diet. If we consider that the Lebanese Mediterranean diet is an example of healthy diet, these results are in line with those of other studies performed outside Lebanon [41, 42], or within the country at smaller scales [43, 28], where individuals tended to consume healthier diets if they were of lower socioeconomic status.Young adults of higher age tended to adhere more to the Lebanese Mediterranean diet; this may reflect the nutritional transition that is taking place among youngsters in Lebanon [1]; it may also reflect a kind of learning effect, induced by university lifestyle and peer influence that increases with the duration of studies. This remains to be established in other studies.Finally, individuals with higher physical activity and lower smoking rate of both cigarettes and waterpipe had better adherence to the Lebanese Mediterranean diet. This may reflect an overall risk taking behavior profile that makes some individuals adopt healthy lifestyles, while others may take more risks and behave recklessly, whether smoking, performing low rates of physical activity or unhealthy eating. Another explanation would be the time passed away from parents' guidance that could encourage youngsters to adopt unhealthy lifestyles [44]. These potential explanations remain to be proved by additional studies. This study has however several limitations. First of all, the scale we used was newly developed in the study based on previous ones, after a contextual adaptation that did not change the previously established concept of positive and negative foods [34-37]; its applicability and validity have not been previously assessed. Additional studies would be necessary to further assess the scale validity in the Lebanese youth population. Despite this, we were able to show interesting results, using standardized methods on all individuals to reduce differential information bias and multivariate analyses to reduce confounding bias. However, an information bias is still possible since body mass index was based on reported height and weight and food consumption frequencies; additional differential misreporting may be possible across socio-demographic groups. Moreover, we may suggest the use of portion sizes in addition to food consumption frequencies for more precise results, to adjust over energy intake. Our semi-quantitative FFQ did not allow us to estimate caloric intake and consumed food quantities.The exclusion of nuts and alcoholic beverages is also an important limitation of our instrument, because both foods are important components of the Mediterranean diet, including healthy effect on cardiovascular protection. The cross-sectional nature of the study also precludes causality judgment between diet and obesity; this remains to be established by appropriate prospective studies. Despite these limitations, we still think that the nutritional transition being witnessed among university students in Lebanon should be tackled by authorities to avoid its future deleterious consequences on health. Young adults represent the appropriate age bracket in which health-promotion activities should be carried out, aiming at facilitating the adoption of health-promoting behaviors and eventually reducing premature mortality at a later stage.

Conclusion

Young adults, mainly men, have a low to moderate adherence to the Lebanese Mediterranean diet; they represent the appropriate age bracket in which health-promotion activities should be carried out, aiming at

facilitating the adoption of health-promoting behaviors and eventually reducing premature mortality at a later stage.

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