Dietary Patterns of University Students in Jordan: A Cross-Sectional Study

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Research

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Abstract

BACKGROUND/OBJECTIVE: University students might have poor diet quality**.** The aim of this study is to identify the dietary patterns of university students and assess their association with different socio-demographic, anthropometric and lifestyle factors.

DESIGN: A cross-sectional study was conducted on students attending the University of Jordan, in a time period between September and November 2019.

METHODS: A total of 664 students (469 females and 195 males aged between 17-30 years with a mean age (SD) of 19.7± 1.8), were included in this study. Data was collected using a survey consistent of two parts; socio-demographic, lifestyle, eating habits questions and a semi-quantitative food frequency questionnaire (FFQ). The FFQ consisted of 55 food items/subgroups, and was specifically designed for this study. Body weight and height were measured by a trained dietitian. Principle component analysis was used to generate the dietary patterns. Associations between dietary patterns with different variables were measured through general linear modelling.

RESULTS: Three main dietary patterns were identified: 'snacking', 'healthy' and 'accessible'. Mean factor scores of the snacking pattern increased with less healthy aspects such as obesity or being underweight, smoking and being physically inactive. While factor scores for the healthy pattern increased with healthier aspects such as physically activity, having three or more meals per day and considering breakfast as the main meal of the day, and this pattern was largely followed by male students. Finally, the accessible pattern had higher scores for students living with their family and having three or more meals per day.

CONCLUSION: The results of this study provide an understanding to the dietary patterns of university students along with related factors (socio-demographic, lifestyle, eating habits). It has identified a number of precursors of both healthy and unhealthy dietary practices. These finding are important for the conceptualization of multi behavioral programs and public health interventions.

Introduction

Dietary patterns or habits can be defined as the combination, quantities, proportions or varieties of food and drinks in a diet, and the frequency that they are usually consumed [1]. Dietary patterns change across the life span, whereas its formed at early stages of life and is an important factor affecting the health of individuals over a long period [2].

Diet is highly linked to health and disease. For years many nutrients and their effects on health have been studied [3, 4]. Foods are a combination of nutrients that interact together and exert diverse health effects [1, 5–7]. Studying the dietary patterns gives an insight on the overall diet and is very helpful in investigating their associations with health outcomes and other lifestyle factors [2, 8]. There are two methods to elicit dietary patterns; the first one is through numerical indices (priori method) such as the

Mediterranean diet score or the healthy eating index and the second method is to empirically obtain the dietary patterns (posteriori method) using factor analysis, principle component analysis or reduced rank regression [9, 10]. Both methods share the same idea of studying the diet as a whole, and studying them gives the same picture in reference to constituents of the dietary patterns.

Dietary patterns were evaluated in young adults, children, university students, and people with comorbidities [2, 7, 8]. Studying dietary patterns of university students has gained considerable investigation [11, 12]. The university stage represents a huge opportunity to adopt new habits and skills that can improve students' lifestyle practices for health outcomes [13]. It is important to connect between the lifestyle factors and the dietary choices of this population such as the globalization and the shift in eating habits that are portrayed upon this population through media, peer pressure, body image and many other contributors [14, 15].

The transition to university life may be associated with changes in food habits, consequently affecting their dietary patterns. In UK, four dietary patterns of university students were identified including: convenience, vegetarian, snacking and health-conscious [16]. In Brazil, four dietary patterns made up of traditional, exam days, end of semester and anxiety patterns [17]. Two studies among university students were conducted in Lebanon, the first one identified five dietary patterns "Lebanese fast-food, Western fast-food, fruits, dairy and traditional Lebanese" [18] and the second study identified three dietary patterns " a vegetarian/low calorie; mixed dietary pattern; and Westernized [19].

Other studies highlighted the food habits of the university students. In Italy, university students living at home got more physical exercise and consumed higher quantities of cooked vegetables, fish, and meat products. In contrast, students living away from home were characterized by higher consumption of raw vegetables, beer and alcoholic drinks, raw/cold meals, frozen meals and ready meals [20]. A Turkish study explored the frequency of food consumption and eating habits of students in two different universities, and they found that their consumption of milk and its products, as well as fruits and vegetables was low [21]. Also, in Malaysia, students of the University Brunei Darussalam had poor eating habits despite their good knowledge in nutrition [22].

In Jordan, there are 282,403 university students (54% Females) distributed across 10 public universities and 19 private universities [23]. The oldest university hosted about 49,000 students in 2019 [24]. Notwithstanding, there are three studies pinpointed the food habits of the university students not their dietary patterns. The first study reported that a significant difference between food consumption patterns for both genders and an overall low consumption of the recommended servings of food groups, despite showing a high prevalence of obesity [25]. The second study showed that male university students living away from home didn't meet the recommended amount of servings of the food groups: dairy, meat, grains, fruits and vegetables [26]. The last study showed a significant caloric contribution from the sugar sweetened beverages (SSBs) to the daily dietary intake of the students as well as a positive association with the body mass index [27].

To the best of our knowledge, there were no studies in Jordan on dietary patterns (posteriori method) among university students. Jordan is part of Middle East and North Africa (MENA) region, which is classified as a region in a nutritional transition stage that may affect the eating patterns or habits of our populations of all ages [28]. However, data on dietary patterns in this population is limited. This study aimed to identify the dietary patterns of university students and assess their association with different socio-demographic, anthropometric and lifestyle factors.

Methods

Study design and recruitment

A cross-sectional study was conducted among 664 students attending the University of Jordan between September and November 2019. A random sample was selected in a way that guaranteed the inclusion of students of different ages and different majors. To achieve this, a list of students that were registered in elective courses was obtained from the office of admission of university of Jordan. Then, the professors teaching these courses were contacted to grant the permission to visit the students in their classrooms and give 20–30 minutes of the lectures time in order to give the students the time to fill the survey. All Jordanian students at the University of Jordan represented eligible participants for this study. Students who were older than 30 years old and the international students and students who have chronic diseases were excluded

Data collection

Data were collected using a self-reported questionnaire and measuring the anthropometric parameters. The questionnaire included two sections: One section covered the socio-demographic and lifestyle data. In the second section, the dietary information was collected through a semi-quantitative food frequency questionnaire (FFQ) that was specifically designed for this study. Before starting this process, a trained dietitian accompanied the subjects and explained the questionnaire. The students were given instructions on how to fill out the FFQ completely and accurately.

After filling out the survey, which approximately took 20–25 minutes, weight and height were measured. The subject's weight was measured barefooted and in light clothing, using seca® scale of accuracy of ± 100 gm. Standing height was also measured barefoot to the nearest cm using a stadiometer, with the arms hanging freely and shoulders in a relaxed position. Body mass index (BMI) was calculated and classified into four categories according to World Health Organization (WHO): Obese: BMI $\geq$ 30 kg/m^2, Overweight: BMI between 25–29.9 kg/m^2, Normal weight: BMI between 18.5 – 24.9 kg/m^2, Underweight: BMI < 18.5 kg/m^2. For students younger than 20 years, body Mass Index-for-age Z-score was calculated. For the association of the BMI-for-age with overweight and obesity, values > + 1SD represent overweight (equivalent to BMI 25 kg/m^2 at 19 years) and > + 2SD represent obesity (equivalent to BMI 30 kg/m^2 at 19 years) according to the WHO reference curves (2007). Whereas, values between + 1 SD and − 2 SD was considered normal [29].

The FFQ was specifically designed for this study to include the ethnic foods consumed by Jordanians. Face and content validity were done for the FFQ and it was pilot tested on 100 subjects that were not included in the final sample. Some food items were added based on the food consumption of the participants. It included eight main groups (milk & dairy products, bread & cereals, fruits, vegetables, meats, fats & oils, desserts and drinks) with 55 subgroups/food items that share the same basic components. Details are provided in Table 1 (presented at the end of the manuscript).

Table 1
Food grouping used in principle component analysis

Food group	Food item(s)
Arabic desserts	Knafeh, hareeseh, baklava…. Etc
Breakfast cereals	Regular corn flakes
Brown-bread	All types of whole wheat bread products
Bulgur, Freekeh & oats	All cooked
Butter	
Cake, cookies biscuits	Sponge cakes, cookies, biscuits and wafers
Canned fish	Canned tuna or sardines
Canned fruits	
Chicken	Cooked
Chocolate	All types of chocolate and chocolate bars
Coffee	Turkish, American, Nescafé (without sugar)
Dried fruits	Dates, raisins, prunes, apricots and figs
Eggs	
Falafel	
Fish	All types of cooked fish
Fresh fruit juices	
Fresh fruits	
Ghee	A type of clarified butter
Green-leafy vegetables	Spinach, Rocca, molokhyeh, lettuce
Herbal drinks	Anise, ginger, thyme …. Etc
Honey	All types
Ice-cream	All types of ice-cream and popsicles
Jam	All types of fruit jam
Juice	All types of processed fruit drinks
Junk food	Shawarma, burger, pizza, sandwiches ….
Ka’ak	Dried breadsticks
Labneh	Drained yogurt

Food group	Food item(s)
Legumes	Lentils, chickpeas, fava beans, kidney beans…etc
Maftool	Steamed wheat balls
Mayonnaise	All types
Milk	All types of milk
Nuts & seeds	Penuts, almonds, walnuts, sunflower seeds…
Olive oil	All types
Olives	Pickled black or green olives
Organ meat	Liver, kidney, brains
Other vegetables	Cucumber, tomato, zucchini, eggplant, broccoli…etc
Pasta	All types of cooked pasta
Pastries	All types of stuffed pastries (spinach, cheese…)
Pickles	Pickled cucumber, carrots, beets and others
Processed meats	Mortadella, hotdogs, smoked turkey…
Qeshtah	Clotted fresh cream
Red meat	All types of cooked meat (Lamb, beef, veal,..)
Rice	All types of cooked rice
Shaneena	Yogurt drink
Soft drinks	All types of soft drinks (regular + diet)
Starchy vegetables	Potatoes, corn, beets, green peas…. Etc
Sugar	White sugar
Tahini	Sesame seed paste
Tea	Brewed tea without sugar
Vegetable oil	Sunflower oil, corn oil
Western desserts	Cheesecake, waffles, crepes, donuts …
White cheeses	Nabulsi cheese, akkawi cheese, feta, halloumi
White-bread	All types of bread products
Yellow cheeses	Cooked cheese, cheddar cheese & spread cheeses
Yogurt	All types

Statistical analysis

Data were entered and analyzed using the IBM SPSS Statistics for Windows, Version 22.0 (Armonk, NY: IBM Corp). Data were examined initially for data entry errors and outliers. Any detected errors were corrected as appropriate. Bartlett's and Kaiser Meyer Olkin (KMO) tests were also used to assess the suitably of principle component analysis (PCA) for this study. The sampling adequacy and the inter-correlation of factors were reinforced by KMO value of 0.81, and Bartlett's test < 0.001. To generate dietary patterns, the 55-food item/ group intake variables were entered into a PCA with a Varimax (orthogonal) rotation. The number of components retained was determined by the scree plot that showed a breakpoint of the curve at the third component, which also met the Kaiser criterion (eigenvalues > 1) and component interpretability [30]. Food/food groups with factor loadings > 0.30 were used to interpret each dietary pattern [10, 31]. A general linear model (GLM) was fitted with each dietary pattern with the different variables (socio-demographic, lifestyle and eating habits). Multivariate logistic regression was used to assess the independent effects of a given variable after adjusting for other potential confounders. A P-value of < 0.05 was considered statically significant.

Results

General characteristics

The socio-demographic, anthropometric, lifestyle and eating data are shown in Table 2. The study included 664 students (469 females (70.6%) and 195 males (29.4%)) aged between 17 and 30 years with a mean age (SD) of 19.7 (1.8) year. The majority of the students were singles (96.5%). Fifty percent of the sample were enrolled in humanitarian schools (50.5%), 36.4% were enrolled in scientific schools and 13.1% were enrolled in health schools. The majority of students lived with their parents (90.1%), only 5.1% lived alone and 4.8% lived with friends or roommates. Almost two thirds of students (65.3%) were of normal weight, 19.2% were overweight, 8.9% were underweight, only 6.6% were obese. Almost 72.0% were non-smokers or ex-smokers, and 28.2% were smokers. More than half students (53.5%) were physically active, and 46.5% were sedentary. Most of students (52.4%) reported that they eat three or more meals per day. 41.2% reported two meals and only 6.4% reported eating one meal a day.

Table 2
Socio-demographic, anthropometric, and relevant characteristics of 664 university students

Variable	Total	Females	Males	P- value
	No (%)	No. (%)	No (%)	
Age (years)	377 (56.8)	267 (56.9)	110 (56.4)	0.902
< 20	287 (43.2)	202 (43.1)	85 (43.6)	
≥ 20				
Body mass index (kg/m^2)	59 (8.9)	50 (10.7)	9 (4.6)	< 0.001
Under weight	432 (65.3)	317 (67.9)	115 (59)	
Normal weight	127 (19.2)	76 (16.3)	51 (26.2)	
Over weight	44 (6.6)	24 (5.1)	20 (10.3)	
Obese				
Marital status	641 (96.5)	450 (95.9)	191 (97.9)	0.020
Single	19 (2.9)	18 (3.8)	1 (0.5)	
Married	3 (0.5)	1 (0.2)	2 (1)	
Divorced	1 (0.2)	0 (0)	1 (0.5)	
Widowed				
Living with	34 (5.1)	16 (3.4)	18 (9.2)	0.004
Alone	32 (4.8)	20 (4.3)	12 (6.2)	
Friends/ roommates Parents	598 (90.1)	433 (92.3)	165 (84.6)	
Family monthly income (JOD)	73 (11.4)	50 (11)	23 (12.4)	0.005
< 366	90 (14.1)	75 (16.6)	15 (8.1)	
366–499	136 (21.3)	95 (21)	41 (22.2)	
500–699	120 (18.8)	93 (20.5)	27 (14.6)	
700–899	219 (34.3)	140 (30.9)	79 (42.7)	
≥ 900				

BMI = body mass index. [a]Physical activity was classified according to the International Physical Activity Questionnaire (sedentary: physical activity ≤ 10 continuous minutes per week and up to 150 minutes per week. active: moderate to high activity like walking for ≥ 5 days/week and ≥ 30 minutes per session).

Variable	Total	Females	Males	P- value
	No (%)	No. (%)	No (%)	
School of faculty	335 (50.5)	264 (56.3)	71 (36.4)	< 0.001
Humanities	242 (36.4)	139 (29.6)	103 (52.8)	
Scientific	87 (13.1)	66 (14.1)	21 (10.8)	
Health				
Smoking	187 (28.2)	110 (23.5)	77 (39.5)	< 0.001
Smoker	477 (71.8)	359 (76.5)	118 (60.5)	
Non-smoker				
Physical activity[a]	355 (53.5)	219 (46.7)	136 (69.7)	< 0.001
Active	309 (46.5)	250 (53.3)	59 (30.3)	
Sedentary				
Dieting	537 (80.9)	388 (82.7)	149 (76.4)	0.059
No dieting	127 (19.1)	81 (17.3)	46 (23.6)	
Following a diet				
Number of meals eaten per day	42 (6.4)	31 (6.7)	11 (5.8)	0.035
One meal	270 (41.2)	205 (44.2)	65 (34)	
Two meals	343 (52.4)	228 (49.1)	115 (60.2)	
≥ three meals				
Main meal	110 (16.6)	77 (16.4)	33 (16.9)	0.499
Breakfast	510 (76.8)	363 (77.4)	147 (75.4)	
Lunch	3 (0.5)	3 (0.6)	0 (0)	
Breakfast + lunch	41 (6.2)	26 (5.5)	15 (7.7)	
Dinner				

BMI = body mass index. [a]Physical activity was classified according to the International Physical Activity Questionnaire (sedentary: physical activity ≤ 10 continuous minutes per week and up to 150 minutes per week. active: moderate to high activity like walking for ≥ 5 days/week and ≥ 30 minutes per session).

Dietary patterns

Table 3 shows the three components that explained 23.3% of the variance in the variables. The three components were retained based on the visual examination of the Scree plot (figure.1) that shows a breakpoint of the curve at the third component and based Kaiser criterion (eigenvalues > 1).

The first component which was labelled “Snacking pattern” had high positive factor loadings (≥ 0.30) for western desserts, Arabic desserts, ice-cream, juice, mayonnaise, soft-drinks, junk food, pastries, ka’ak, canned fruit, fresh juice, cakes, cookies, biscuits, yellow cheeses, processed meats, chocolate, falafel and white bread. The second component was labelled “Healthy” and had high positive loadings (≥ 0.3) for (bulgur, freekeh & oats), dried fruits, fish, canned fish, milk, honey, nuts, fresh fruits, eggs, breakfast cereals, herbal drinks, red meat, maftool, brown bread, green-leafy vegetables, starchy vegetables and other vegetables. The third component was labelled “Accessible” and had high positive factor loadings (≥ 0.3) for olives, olive & vegetable oil, green-leafy vegetables, starchy vegetables and other vegetables, tea, legumes, falafel, pickles, sugar, white bread, yogurt, tahini, coffee, labaneh and junk food.

Table 3
Factor loadings of 55 food groups in the three components extracted from the PCA of the food frequency intake data of 664 university students.

Food group (% variance)	Snacking (13.2%)	Healthy (5.9%)	Accessible (4.2%)
Western desserts	**0.634**		
Arabic desserts	**0.627**		
Ice-cream	**0.574**		
Juice	**0.561**		
Mayonnaise	**0.496**		
Soft drinks	**0.462**		
Junk food	**0.455**		0.313
Pastries	**0.418**		
Ka'ak	**0.396**		
Canned fruits	0.339		
Fresh juice	0.335		
Cake, cookies and biscuits	0.325		
Yellow cheeses	0.319		
Processed meats	0.312		
Chocolate	0.303		
Bulgur, freekeh and oats		**0.582**	
Dried fruits		**0.532**	
Fish		**0.514**	
Canned fish		**0.504**	
Milk		**0.470**	
Honey		**0.461**	
Nuts		**0.424**	

Total variance explained by all patterns is 23.3%.

Absolute values < 0.3 were excluded from the table for simplicity.

Factor loadings ≥ 0.35 are given in bold.

Food group (% variance)	Snacking (13.2%)	Healthy (5.9%)	Accessible (4.2%)
Fresh fruits		**0.405**	
Eggs		**0.394**	
Breakfast cereals		**0.361**	
Herbs		0.344	
Red meat		0.331	
Maftool		0.322	
Brown bread		0.317	
Olive oil			**0.589**
Olives			**0.547**
Vegetable oil			**0.519**
Other vegetables		0.309	**0.506**
Tea			**0.492**
Legumes			**0.461**
Falafel	**0.379**		**0.412**
Pickles			**0.411**
Sugar			**0.411**
Green- leafy vegetables		0.327	**0.392**
White bread	**0.383**	-0.317	**0.391**
Starchy vegetables		0.338	0.344
Yogurt			0.341
Taheeneh			0.340
Coffee			0.322
Labneh			0.313
Total variance explained by all patterns is 23.3%.			
Absolute values < 0.3 were excluded from the table for simplicity.			
Factor loadings ≥ 0.35 are given in bold.			

Dietary patterns and sample characteristics

Mean pattern scores according to socio-demographic and anthropometric measures and lifestyle factors and eating habits are shown in Tables 4 and 5.

Higher snacking pattern scores were independently associated with male gender (p = 0.035), being obese or underweight (p = 0.033), being not physically active (p = 0.016), smokers (p = 0.001), and not following a diet plan (p = < 0.001).

Male gender (p = < 0.001), age ≥ 20 years (p = 0.018), being physically active (p = < 0.001), following a diet plan (p = < 0.001), eating three or more meals per day (p = < 0.001) and considering breakfast to be their main meal (p = 0.004) were associated with higher scores on the healthy pattern.

Family income between 366–899 JDs (p = 0.048), eating three meals per day (p = 0.001) and living with their families (p = < 0.001) were associated with higher scores on the accessible pattern.

Table 4

Dietary patterns mean scores according to socio-demographic and anthropometric factors.

Variable	Snacking Mean (SD)	Healthy Mean (SD	Accessible Mean (SD)
Gender	-0.052 ± 0.9	-0.094 ± 0.9	0.003 ± 0.9
Female	0.126 ± 1.1	0.228 ± 1	-0.007 ± 1.1
Male	0.035	< 0.001	0.903
p-value			
Age	-0.008 ± 0.9	-0.079 ± 0.9	-0.031 ± 0.9
< 20	0.010 ± 1	0.104 ± 1	0.041 ± 1
≥ 20	0.812	0.018	0.352
p-value			
BMI	0.192 ± 0.9	-0.072 ± 0.8	0.163 ± 1
Under weight	0.004 ± 1	-0.002 ± 1	-0.015 ± 0.9
Normal weight	-0.189 ± 0.9	-0.012 ± 0.9	-0.043 ± 0.9
Over weight	0.212 ± 1	0.205 ± 1	-0.002 ± 1.2
Obese	0.033	0.536	0.591
p-value			
Marital status	0.016 ± 1	-0.017 ± 0.9	-0.001 ± 1
Single	-0.410 ± 0.9	0.475 ± 1	0.063 ± 0.9
Married	-0.833 ± 1	0.686 ± 0.4	0.402 ± 0.2
Divorced	-0.470 ± 0	0.131 ± 0	-1.390 ± 0
Widowed	0.128	0.115	0.476
p-value			
Living with	-0.175 ± 1	-0.185 ± 0.9	-0.546 ± 0.9
Alone	-0.068 ± 0.9	0.195 ± 1	-0.853 ± 0.9
Friends/ roommates	0.013 ± 1	0.000 ± 0.9	0.767 ± 0.9
Parents	0.520	0.303	< 0.001
p-value			
Family monthly income (JOD)	0.081	0.072	-0.190
< 366	-0.030	-0.206	0.227
366–499	-0.087	-0.061	0.066
500–699	0.092	0.041	0.036
700–899	-0.011	0.067	-0.082
≥ 900	0.625	0.202	0.048
p-value			
School of faculty	0.018 ± 1	-0.017 ± 1	-0.064 ± 1
Humanities	-0.009 ± 0.9	-0.006 ± 0.9	0.100 ± 0.9
Science	-0.044 ± 1.1	0.084 ± 0.9	-0.034 ± 0.8
Health –related	0.858	0.697	0.139
p-value			

Table 5
Dietary patterns mean scores according to lifestyle and eating factors.

Variable	Snacking Mean (SD)	Healthy Mean (SD)	Accessible Mean (SD)
Smoking	0.212 ± 1	-0.008 ± 1	-0.020 ± 1.1
Smoker	-0.083 ± 0.9	0.003 ± 0.9	0.007 ± 0.9
Non-smoker	0.001	0.891	0.743
p-value			
Physical activity	-0.087 ± 1	0.223 ± 1	0.039 ± 1
Active	0.100 ± 0.8	-0.257 ± 0.8	-0.045 ± 0.9
Sedentary	0.016	< 0.001	0.271
p-value			
Diet	0.080 ± 0.9	-0.134 ± 0.9	0.011 ± 0.9
No diet	-0.341 ± 1.1	0.569 ± 1	-0.049 ± 1
Following a diet	< 0.001	< 0.001	0.533
p-value			
Main meal	-0.177 ± 1	0.285 ± 1.1	0.171 ± 1
Breakfast	0.037 ± 0.9	-0.037 ± 0.9	-0.032 ± 0.9
Lunch	0.019 ± 0.9	-0.281 ± 0.8	-0.059 ± 1.2
Dinner	-0.119 ± 0.5	-0.239 ± 0.9	-0.020 ± 1.1
Breakfast + lunch	0.235	0.004	0.270
p-value			
Number of meals	0.072 ± 0.8	-0.123 ± 0.9	-0.249 ± 0.9
One meal	-0.080 ± 0.9	-0.213 ± 0.8	-0.128 ± 0.9
Two meals	0.034 ± 1	0.180 ± 1	0.146 ± 0.9
≥ three meals	0.312	< 0.001	0.001
P-value			

Discussion

The aim of this study is to identify dietary patterns within Jordan University students. Three dietary patterns were identified named: snacking, healthy and the accessible. Dietary habits at this life stage are influential for quality of life and future health. The number of studies that identified the dietary patterns of the university students is limited; the approach of identifying dietary intake patterns instead of food or food group intakes is still little investigated. Most of the studies identified 3–5 dietary patterns in this group of population [16–19, 32, 33]; moreover, these patterns received different names including: snacking, Westernized, processed, unhealthy traditional, convenience, the dairy products pattern, and traditional Westernized. The differences in identified patterns between different studies and settings may be due to many factors including cultural food variations; the availability and affordability of certain foods; and nutrition transition status of the countries. In addition to, age gender, nutrition and health awareness of the studied groups.

In this study, “Snacking” dietary pattern comprised the highest percentage of variance (13.2%), while, the total dietary intake variance percentage of the three patterns was (23.3%), this pattern is commonly defined by high intakes of sugar, fat and processed products. These findings were consistent with the results of Sprake, et al [16] in five UK universities, where the total variance explained by four components was (21.7%). It should be pointed out that the variance explained by the components is set by the number of components that are selected to be retained by the investigator [5, 31, 34].

The second dietary pattern identified in the current study was “healthy”. A dietary pattern was similar to this one has already been observed in a cross sectional study on healthcare professionals and students from the University of Guadalajara (Mexico) accounted for 8.78% of the variance [33]. Whereas, this pattern accounted for 5.9% of variance in the current study.

The differences between the food items in the patterns that have been identified in our study and patterns from the literature come from the fact that factor analysis is a data driven analysis method; which means that the amount of food groups/items that you enter will affect the item in the patterns that will be retained [31, 34, 35].

The third patterns which named as “Accessible” pattern, it enclosed some food items that were on the snacking pattern as well as some items from the healthy pattern.

We have found some associations between the dietary patterns and some lifestyle and socio-demographic factors. Among the three dietary patterns identified for the university students, the snacking pattern was significantly associated with BMI (obese or underweight) as well as smoking and not being physically active. Other studies have also found that a high fat and sugar pattern is also linked with unhealthy lifestyle choices [18, 36, 37]. On the other hand, the healthy pattern was associated with physical activity and considering breakfast as the main meal of the day, as well as having more than three meals per day. This finding supports that the dietary pattern and lifestyle choices go hand in hand [33]. As for the traditional pattern it had a significant association with consuming three or more meals per day.

In our study, males had higher factor scores for the healthy pattern, which could be because of the higher number of males that are physically active compared to females. Contrary to other studies [16, 18, 37], Females were always linked to healthier lifestyle and eating habits as they were more concerned about dieting and physical activity in order to achieve certain a body image desired [38]. Some factors may have played a role in the BMI distribution in our study sample as the highest percentage was normal weight individuals (65.3%). The participation in the study was voluntary among the students, so obese/overweight students might have refrained from participating because of the fear of stigma or not wanting to be weighed [39].

As most of our students sample lived with their families (90.1%), their dietary choices may be influenced by that, as the living situation has shown direct effect on the dietary choices to university students in our study as well as another study in our country [26]. In the Middle Eastern region, young adults still depend in their families financially. So, the foods they eat are usually the most convenient to them, whether it was the food available at home or it was fast /junk food. So the eating pattern may also reflect the eating habits of the household to some extent [15]. Other than that, the food options available at the university campus do not offer that much variety for the students to choose from. A lot of factors play a role in the choices of university students as they are in a provisional phase of their life and they are easily influenced by others and what the media reflects on them [12, 14].

Strength and Limitations

The present study has a number of limitations and strengths that should be addressed. Studying dietary patterns gives an insight about the whole diet instead of focusing on single nutrient which made it easier to interpret with different factors. It's also important to mention that the dietary data collection method through the food frequency questionnaire (FFQ) was optimal for this study, as it allowed covering a longer period of time which gave us a broader idea of food intake of the study sample. For the anthropometric measurements (weight &height) we relied on the measured data instead of the reported one which adds to the accuracy of the data.

The cross-sectional design of the study allows the examination of associations rather than causations, which makes it unclear if obesity is a result of following unhealthy pattern or they follow an unhealthy pattern because of their obesity. Also, the food frequency questionnaire (FFQ) relies on memory hence the dietary intake information might not be accurate.

The analysis method is data driven so the patterns we identified are specific to the study populations; so different data generates different patterns. The results of this study may not be representative of all university students in Jordan because we included only one university for the study.

Conclusion

The results of this study provide an understanding to the dietary patterns of university students along with related factors (socio-demographic, lifestyle, eating habits). It has recognized a number of predecessors of healthy and unhealthy dietary practices. Three patterns were identified snacking pattern was associated with obesity and poorer life style habits such as smoking and physical inactivity. While the healthy pattern was associated with healthier lifestyle and eating habits such as considering breakfast as the main meal of the days and having three or more meals per day, as well as not smoking and being physically active and have normal weight. The accessible pattern had mixed features of healthy and unhealthy practices. These outcomes are important for the conceptualization of multi behavioral programs for this population as well as the public.

Declarations

Ethics approval and consent to participate: This study was reviewed and approved by the research ethics committee at the National Center for Diabetes, Endocrinology and Genetics (NCDEG), as per ethical standards set in the 1964 Declaration of Helsinki and its later amendments. A signed consent form was obtained from the participants.

Consent for publication: Not applicable.

Availability of supporting data: The dataset used for the current study are available on reasonable request.

Competing interests: The authors state that they have no conflict of interest.

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Authors' contributions: study conception and design were performed by N. KA, D. H, R A and H. AL.; material preparation and data collection were performed by R A., data analysis was conducted by R. A and Y. K; the manuscript was written by R. A; revision and approval of the final manuscript K. A. All authors reviewed and approved the final manuscript.

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References

1. Schulze MB, Martinez-Gonzalez MA, Fung TT, Lichtenstein AH, Forouhi NG. Food based dietary patterns and chronic disease prevention. BMJ.2018; 361:k2396.10.1136/bmj.k2396
2. McNaughton SA. Understanding the eating behaviors of adolescents: application of dietary patterns methodology to behavioral nutrition research. J Am Diet Assoc.2011; 111(2):226-9.10.1016/j.jada.2010.10.041
3. Tapsell LC, Neale EP, Satija A, Hu FB. Foods, Nutrients, and Dietary Patterns: Interconnections and Implications for Dietary Guidelines. Adv Nutr.2016; 7(3):445-54.10.3945/an.115.011718
4. Nitzke S, Freeland-Graves J, American Dietetic A. Position of the American Dietetic Association: total diet approach to communicating food and nutrition information. J Am Diet Assoc.2007; 107(7):1224-32.10.1016/j.jada.2007.05.025
5. Wirfalt E, Drake I, Wallstrom P. What do review papers conclude about food and dietary patterns? Food Nutr Res.2013; 57.10.3402/fnr.v57i0.20523
6. Drake I, Sonestedt E, Ericson U, Wallstrom P, Orho-Melander M. A Western dietary pattern is prospectively associated with cardio-metabolic traits and incidence of the metabolic syndrome. Br J Nutr.2018; 119(10):1168-76.10.1017/S000711451800079X
7. Jacobs S, Kroeger J, Schulze MB, Frank LK, Franke AA, Cheng I, et al. Dietary Patterns Derived by Reduced Rank Regression Are Inversely Associated with Type 2 Diabetes Risk across 5 Ethnic Groups in the Multiethnic Cohort. Curr Dev Nutr.2017; 1(5):e000620.10.3945/cdn.117.000620

8. Karageorgou D, Magriplis E, Mitsopoulou AV, Dimakopoulos I, Bakogianni I, Micha R, et al. Dietary patterns and lifestyle characteristics in adults: results from the Hellenic National Nutrition and Health Survey (HNNHS). Public Health.2019; 171:76-88.10.1016/j.puhe.2019.03.013
9. Cespedes EM, Hu FB. Dietary patterns: from nutritional epidemiologic analysis to national guidelines. Am J Clin Nutr.2015; 101(5):899-900.10.3945/ajcn.115.110213
10. Gleason PM, Boushey CJ, Harris JE, Zoellner J. Publishing nutrition research: a review of multivariate techniques--part 3: data reduction methods. J Acad Nutr Diet.2015; 115(7):1072-82.10.1016/j.jand.2015.03.011
11. Yahia N, Wang D, Rapley M, Dey R. Assessment of weight status, dietary habits and beliefs, physical activity, and nutritional knowledge among university students. Perspect Public Health.2016; 136(4):231-44.10.1177/1757913915609945
12. Dawborn-Gundlach M, Margetts K. Social Adjustment and Transition to University for Mature-Age, Undergraduate Journal of Education & Social Policy Students.2018; 5(1):88-96
13. Godinho CA, Alvarez MJ, Lima ML, Schwarzer R. Health messages to promote fruit and vegetable consumption at different stages: A match-mismatch design. Psychol Health.2015; 30(12):1410-32.10.1080/08870446.2015.1054827
14. Chen Z, Faride S, Ong H, Koshy S, Low B. Influences of genetics, lifestyle and environment on obese and non-obese university students in Malaysia. Journal of Public Health, From Theory to Practice.2019;
15. Delormier T, Frohlich KL, Potvin L. Food and eating as social practice--understanding eating patterns as social phenomena and implications for public health. Sociol Health Illn.2009; 31(2):215-28.10.1111/j.1467-9566.2008.01128.x
16. Sprake EF, Russell JM, Cecil JE, Cooper RJ, Grabowski P, Pourshahidi LK, et al. Dietary patterns of university students in the UK: a cross-sectional study. Nutr J.2018; 17(1):90.10.1186/s12937-018-0398-y
17. Pereira-Santos M, da Mota Santana J, de Carvalho A, Fernanda Freitas F. Dietary patterns among nutrition students at a public university in Brazil. Rev Chil Nutr.2016; 43(1):39-44
18. Jaalouk D, Matar Boumosleh J, Helou L, Abou Jaoude M. Dietary patterns, their covariates, and associations with severity of depressive symptoms among university students in Lebanon: a cross-sectional study. Eur J Nutr.2019; 58(3):997-1008.10.1007/s00394-018-1614-4
19. Salameh P, Jomaa L, Issa C, Farhat G, Salame J, Zeidan N, et al. Assessment of Dietary Intake Patterns and Their Correlates among University Students in Lebanon. Front Public Health.2014; 2:185.10.3389/fpubh.2014.00185
20. BAGORDO F, GRASSI T, SERIO F, IDOLO A, DE DONNO A. Dietary habits and health among university students living at or away from home in southern Italy. Journal of Food and Nutrition Research.2013; 52(3):164-71
21. MEŞE C, KOCA ÖZER B, SAĞIR M, SAĞIR S, ÖZDEMİR A, ÖNAL S, et al. Evaluation of Dietary Patterns and Health Status of Young Adults from Turkey: University Students from Urban and Rural Provinces.

Adv Nutr Food Sci, .2017; 2(1):1-8

22. Yun TC, Ahmad SR, Quee DKS. Dietary Habits and Lifestyle Practices among University Students in Universiti Brunei Darussalam. Malays J Med Sci.2018; 25(3):56-66.10.21315/mjms2018.25.3.6
23. Higher Education in Jordan 2020 [cited 2020 June]. Available from: https://supporthere.org/page/higher-education-jordan.
24. The University of Jordan. UJ is home to 2019 [cited 2020 June]. Available from: http://www.ju.edu.jo/Pages/AboutUJ.aspx.
25. El-Qudah J. Food consumption patterns and prevalence of obesity in an adult population in Amman, Jordan. Australian Journal of Basic and Applied Sciences.2008; 2(4):1165-71
26. Hamad H. Meeting Dietary Food Groups Serving's Requirements of Food Guide Pyramid among Jordanian University Students. Journal of Medicine, Physiology and Biophysics 2017; 29:1-4
27. Bawadi H, Abu-Jamous D, Tayyem R. Evaluation of the dietary pattern of patients with type 2 diabetes in Northern Jordan: An inconvenient truth. International Journal of Diabetes in Developing Countries volume.2014; 34:134-8
28. Garduno S. Dietary Patterns and Food Culture in the Middle East. EC Nutrition 2015; 2(2):318-27
29. de Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. Bull World Health Organ.2007; 85(9):660-7.10.2471/blt.07.043497
30. Tabachnick B, Fidell L. Using Multivariate Statistics 6ed. NewYork: Pearson; 2012.
31. Child D. The Essentials of Factor Analysis 3ed: Bloomsbury Academic; 2006.
32. Diaz-Torrente X, Quintiliano-Scarpelli D. Dietary Patterns of Breakfast Consumption Among Chilean University Students. Nutrients.2020; 12(2).10.3390/nu12020552
33. Betancourt-Nunez A, Marquez-Sandoval F, Gonzalez-Zapata LI, Babio N, Vizmanos B. Unhealthy dietary patterns among healthcare professionals and students in Mexico. BMC Public Health.2018; 18(1):1246.10.1186/s12889-018-6153-7
34. Jacques PF, Tucker KL. Are dietary patterns useful for understanding the role of diet in chronic disease? Am J Clin Nutr.2001; 73(1):1-2.10.1093/ajcn/73.1.1
35. Newby PK, Tucker KL. Empirically derived eating patterns using factor or cluster analysis: a review. Nutr Rev.2004; 62(5):177-203.10.1301/nr.2004.may.177-203
36. Moreno-Gomez C, Romaguera-Bosch D, Tauler-Riera P, Bennasar-Veny M, Pericas-Beltran J, Martinez-Andreu S, et al. Clustering of lifestyle factors in Spanish university students: the relationship between smoking, alcohol consumption, physical activity and diet quality. Public Health Nutr.2012; 15(11):2131-9.10.1017/S1368980012000080
37. Bertin M, Touvier M, Dubuisson C, Dufour A, Havard S, Lafay L, et al. Dietary patterns of French adults: associations with demographic, socio-economic and behavioural factors. J Hum Nutr Diet.2016; 29(2):241-54.10.1111/jhn.12315

38. Olfert MD, Barr ML, Charlier CC, Greene GW, Zhou W, Colby SE. Sex Differences in Lifestyle Behaviors among U.S. College Freshmen. Int J Environ Res Public Health.2019; 16(3).10.3390/ijerph16030482
39. Puhl RM, Heuer CA. Obesity stigma: important considerations for public health. Am J Public Health.2010; 100(6):1019-28.10.2105/AJPH.2009.159491

Figures

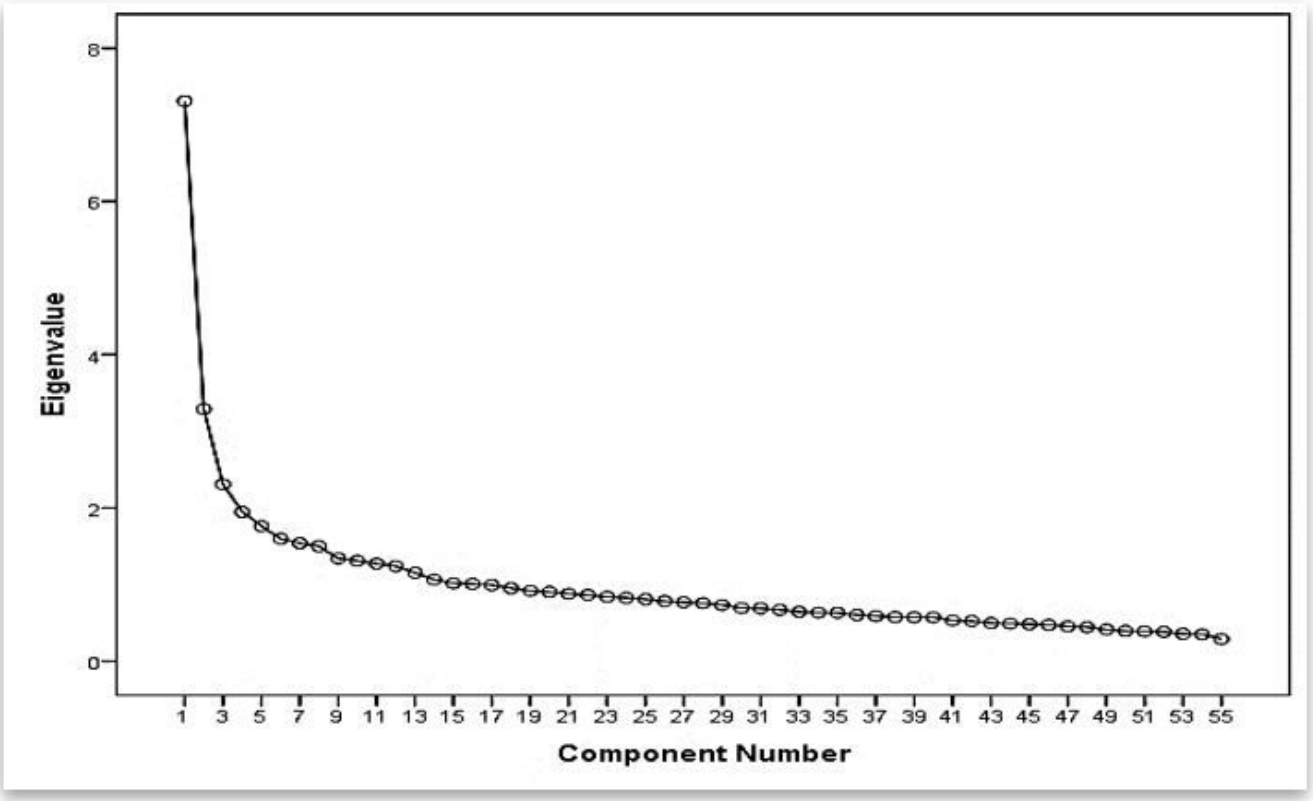

Figure 1

Scree plot of the eigenvalues of the components generated by principle component analysis.