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 ≥ 30 kg/m², Overweight: BMI between 25–29.9 kg/m², Normal weight: BMI between 18.5 – 24.9 kg/m², Underweight: BMI < 18.5 kg/m². 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/m² at 19 years) and > + 2SD represent obesity (equivalent to BMI 30 kg/m² 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).
| 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    | Peanuts, 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 suitability of principle component analysis (PCA) for this study. The sampling adequacy and the intercorrelation 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 statistically 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)                       |       |         |       |         |
| < 20                              | 377 (56.8) | 267 (56.9) | 110 (56.4) | 0.902 |
| ≥ 20                              | 287 (43.2) | 202 (43.1) | 85 (43.6) |         |
| Body mass index (kg/m\(^2\))     |       |         |       |         |
| Under weight                      | 59 (8.9) | 50 (10.7) | 9 (4.6) | < 0.001 |
| Normal weight                     | 432 (65.3) | 317 (67.9) | 115 (59) |         |
| Over weight                       | 127 (19.2) | 76 (16.3) | 51 (26.2) |         |
| Obese                             | 44 (6.6) | 24 (5.1) | 20 (10.3) |         |
| Marital status                    |       |         |       |         |
| Single                            | 641 (96.5) | 450 (95.9) | 191 (97.9) | 0.020 |
| Married                           | 19 (2.9) | 18 (3.8) | 1 (0.5) |         |
| Divorced                          | 3 (0.5) | 1 (0.2) | 2 (1) |         |
| Widowed                           | 1 (0.2) | 0 (0) | 1 (0.5) |         |
| Living with                       |       |         |       |         |
| Alone                             | 34 (5.1) | 16 (3.4) | 18 (9.2) | 0.004 |
| Friends/ roommates/ Parents       | 32 (4.8) | 20 (4.3) | 12 (6.2) |         |
| Family monthly income (JOD)       |       |         |       |         |
| < 366                             | 73 (11.4) | 50 (11) | 23 (12.4) | 0.005 |
| 366–499                           | 90 (14.1) | 75 (16.6) | 15 (8.1) |         |
| 500–699                           | 136 (21.3) | 95 (21) | 41 (22.2) |         |
| 700–899                           | 120 (18.8) | 93 (20.5) | 27 (14.6) |         |
| ≥ 900                             | 219 (34.3) | 140 (30.9) | 79 (42.7) |         |

BMI = body mass index. 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                |         |         |        |         |
| Humanities                       | 335 (50.5) | 264 (56.3) | 71 (36.4) | < 0.001 |
| Scientific                       | 242 (36.4) | 139 (29.6) | 103 (52.8) |         |
| Health                           | 87 (13.1) | 66 (14.1) | 21 (10.8) |         |
| 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<sup>a</sup>    | 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. <sup>a</sup>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 on the Kaiser criterion (eigenvalues > 1).

The first component which was labelled “Snacking pattern” had high positive factor loadings ($\geq 0.30$) 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 ($\geq 0.3$) 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 ($\geq 0.3$) 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            |                |                   |
| Labne/                  | 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 = < 0.001) 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.

| Variable                  | Snacking Mean (SD) | Healthy Mean (SD) | Accessible Mean (SD) |
|---------------------------|--------------------|-------------------|----------------------|
| **Gender**                |                    |                   |                      |
| Female                    | -0.052 ± 0.9       | 0.094 ± 0.9       | 0.003 ± 0.9          |
| Male                      | 0.126 ± 1.1        | 0.228 ± 1         | <-0.001              |
| p-value                   | 0.035              |                   | 0.903                |
| **Age**                   |                    |                   |                      |
| < 20                      | -0.008 ± 0.9       | 0.079 ± 0.9       | -0.031 ± 0.9         |
| ≥ 20                      | 0.010 ± 1          | 0.104 ± 1         | 0.041 ± 1            |
| p-value                   | 0.812              | 0.018             | 0.352                |
| **BMI**                   |                    |                   |                      |
| Under weight              | 0.192 ± 0.9        | -0.072 ± 0.8      | 0.163 ± 1            |
| Normal weight             | 0.004 ± 1          | -0.002 ± 1        | -0.015 ± 0.9         |
| Over weight               | -0.189 ± 0.9       | 0.012 ± 0.9       | -0.043 ± 0.9         |
| Obese                     | 0.212 ± 1          | 0.205 ± 1         | -0.002 ± 1.2         |
| p-value                   | 0.033              | 0.536             | 0.591                |
| **Marital status**        |                    |                   |                      |
| Single                    | 0.016 ± 1          | -0.017 ± 0.9      | -0.001 ± 1           |
| Married                   | -0.410 ± 0.9       | 0.475 ± 1         | 0.063 ± 0.9          |
| Divorced                  | -0.833 ± 1         | 0.686 ± 0.4       | 0.402 ± 0.2          |
| Widowed                   | -0.470 ± 0         | 0.131 ± 0         | -1.390 ± 0           |
| p-value                   | 0.128              | 0.115             | 0.476                |
| **Living with**           |                    |                   |                      |
| Alone                     | -0.175 ± 1         | -0.185 ± 0.9      | -0.546 ± 0.9         |
| Friends/ roommates        | -0.068 ± 0.9       | 0.195 ± 1         | -0.853 ± 0.9         |
| Parents                   | 0.013 ± 1          | 0.000 ± 0.9       | 0.767 ± 0.9          |
| p-value                   | 0.520              | 0.303             | < 0.001              |
| **Family monthly income (JOD)** | |                   |                      |
| < 366                     | 0.081              | 0.072             | -0.190               |
| 366–499                   | -0.030             | -0.206            | 0.227                |
| 500–699                   | -0.087             | -0.061            | 0.066                |
| 700–899                   | 0.092              | 0.041             | 0.036                |
| ≥ 900                     | -0.011             | 0.067             | -0.082               |
| p-value                   | 0.625              | 0.202             | 0.048                |
| **School of faculty**     |                    |                   |                      |
| Humanities                | 0.018 ± 1          | -0.017 ± 1        | -0.064 ± 1           |
| Science                   | -0.009 ± 0.9       | 0.006 ± 0.9       | 0.100 ± 0.9          |
| Health –related           | -0.044 ± 1.1       | 0.084 ± 0.9       | -0.034 ± 0.8         |
| p-value                   | 0.858              | 0.697             | 0.139                |
Table 5
Dietary patterns mean scores according to lifestyle and eating factors.

| Variable                  | Snacking Mean (SD) | Healthy Mean (SD) | Accessible Mean (SD) |
|---------------------------|--------------------|-------------------|----------------------|
| **Smoking**               |                    |                   |                      |
| Smoker                    | 0.212 ± 1          | -0.008 ± 1        | -0.020 ± 1           |
| Non-smoker                | -0.083 ± 0.9       | 0.003 ± 0.9       | 0.007 ± 0.9          |
| p-value                   | 0.001              | 0.891             | 0.743                |
| **Physical activity**     |                    |                   |                      |
| Active                    | -0.087 ± 1         | 0.223 ± 1         | 0.039 ± 1            |
| Sedentary                 | 0.100 ± 0.8        | -0.257 ± 0.8      | < 0.001              |
| p-value                   | 0.016              | < 0.001           | 0.271                |
| **Diet**                  |                    |                   |                      |
| No diet                   | 0.080 ± 0.9        | -0.341 ± 1.1      | < 0.001              |
| Following a diet          | -0.314 ± 1.1       | 0.569 ± 1         | < 0.001              |
| p-value                   | < 0.001            | 0.001             | 0.533                |
| **Main meal**             |                    |                   |                      |
| Breakfast                 | -0.177 ± 1         | 0.285 ± 1.1       | 0.171 ± 1            |
| Lunch                     | 0.037 ± 0.9        | -0.037 ± 0.9      | -0.032 ± 0.9         |
| Dinner                    | 0.019 ± 0.9        | -0.281 ± 0.8      | -0.059 ± 1.2         |
| Breakfast + lunch         | -0.119 ± 0.5       | -0.239 ± 0.9      | -0.020 ± 1.1         |
| p-value                   | 0.235              | 0.004             | 0.270                |
| **Number of meals**       |                    |                   |                      |
| One meal                  | 0.072 ± 0.8        | -0.123 ± 0.9      | -0.249 ± 0.9         |
| Two meals                 | -0.080 ± 0.9       | -0.213 ± 0.8      | -0.128 ± 0.9         |
| ≥ three meals             | 0.034 ± 1          | 0.180 ± 1         | 0.146 ± 0.9          |
| P-value                   | 0.312              | < 0.001           | 0.001                |

**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 lifestyle 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 having 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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Figures

![Scree plot of the eigenvalues of the components generated by principle component analysis.](image)

**Figure 1**

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