

# Distribution and association of weight-loss diet programs with body mass index and health status among students at Al-Hussein Bin Talal University, Jordan

Osama Y. Althunibat<sup>1</sup> , Sultan Ayeshe Mohammed Saghir<sup>1\*</sup> , Saleem Hmoud Aladaileh<sup>1</sup> ,  
Atika Alrawadeh<sup>1</sup> , Mahmoud Al-Areefi<sup>2</sup> , Reham D. Alghonmeen<sup>1</sup> , Alayn<sup>1</sup> Al-Marddyah A. Alkhawaldeh<sup>1</sup> ,  
Heba M. Obaidat<sup>1</sup> 

<sup>1</sup> Department of Medical Analysis, Princess Aisha Bint Al-Hussein College of Nursing and Medical Sciences, Al-Hussein Bin Talal University, Ma'an, JORDAN

<sup>2</sup> Faculty of Public Health & Health Informatics, Umm Al Qura University, Makkah, SAUDI ARABIA

\*Corresponding Author: [sultan.s.ayesh@ahu.edu.jo](mailto:sultan.s.ayesh@ahu.edu.jo); [sultan\\_a1976@yahoo.com](mailto:sultan_a1976@yahoo.com)

**Citation:** Althunibat OY, Saghir SAM, Aladaileh SH, Alrawadeh A, Al-Areefi M, Alghonmeen RD, Alkhawaldeh AAA, Obaidat HM. Distribution and association of weight-loss diet programs with body mass index and health status among students at Al-Hussein Bin Talal University, Jordan. *Electron J Gen Med.* 2022;19(6):em414. <https://doi.org/10.29333/ejgm/12424>

## ARTICLE INFO

Received: 29 Jul. 2022

Accepted: 20 Aug. 2022

## ABSTRACT

**Introduction:** Many people today, even those with a healthy body mass index (BMI), misperceive their body image and attempt an unhealthy diet regimen to lose weight. The present study aimed to investigate the distribution of weight-loss diet programs among undergraduate students at Al-Hussein Bin Talal University (AHU), Jordan, and to study the association of these strategies with students' BMI and health status.

**Materials and methods:** 1,200 questionnaires were distributed for undergraduate students at AHU, then the data were collected and analyzed using SPSS version 21.

**Results:** The results show that 43.53% (8.50% males & 91.50% females) of respondents were following weight-loss diet programs. Dieting students had a significantly higher mean BMI value (25.67±2.86), compared to non-dieting students (23.23±3.70). "To look better" was found to be the most common reason for trying a weight-loss diet program. Additionally, a significant correlation ( $p=0.008$ ) was found between skipping breakfast and the occurrence of irregular and painful periods among dieting students.

**Conclusion:** Weight-loss diet programs, which involve several unhealthy practices, are widely practiced among AHU undergraduate students, leading to the development of a variety of dietary side effects. Hence, more caution must be taken when attempting weight-loss diet programs.

**Keywords:** diet, BMI, weight-loss, random diet, AL-Hussein Bin Talal University, health status

## INTRODUCTION

Weight reduction has been a major public health concern in recent years due to the growth of obesity-related disorders such as cardiovascular disease, hypertension, diabetes mellitus, and dyslipidemia [1-4]. Approximately 1.2 billion people worldwide are overweight, and at least 300 million are obese [5-7]. Furthermore, obesity affects the socioeconomic status of the population as well as increases morbidity and mortality [8-10].

Obesity was formerly thought to be caused solely by an imbalance in energy intake and expenditure, but current research has demonstrated that genetic, physiological, psychological, socioeconomic, cultural, and behavioral variables all play a role [5,7,11]. Obese people can lose weight effectively by combining a restricted diet with lower calorie consumption, physical activity, and enough sleep [12]. Numerous studies have indicated that dietary, lifestyle, physical activity, and behavioral modifications can assist weight reduction [3,7]. Indeed, various diet regimens, including decreased calorie consumption, modified macronutrient intake, increased dietary fiber intake, meal replacements with

ready-to-eat meals, and improve nutritional availability of certain nutrients, have been practiced promoting body weight loss into various degrees [13-21].

Nonetheless, many people nowadays use commercial or self-help weight loss programs without the necessary professional guidance. Aside from the lack of evidence for the long-term success of these regimens, eating an imbalanced diet or taking too few calories might have serious health risks [22-24].

Deficiency of essential dietary elements such as protein, calcium, biotin, thiamine, vitamin A and magnesium may arise from poor consumption of foods like meat, fish, dairy, eggs, beans, peas, lentils, nuts and seeds [23,25]. Protein-deficient diets can result in muscle loss, hair thinning, and brittle nails. Also, calcium deficiency could lead to bones weakness and increase the risk of fractures [25]. Insufficient intake of vitamins B and A-rich foods can result in hair loss and scaly skin, as well as immune system weakness, and impaired night vision, respectively. Additionally, numerous disorders such as exhaustion, migraines, muscular cramps, and irregular heartbeats might be caused by a shortage of magnesium [21,25].

Consuming less calories than the body required to sustain basic functions may cause estrogen and testosterone levels to fluctuate, reducing bone formation and increasing the risk of fractures. [26]. Furthermore, weak bone may result from increased stress hormone levels which results from low calories intake during physical exercise [27]. This bone loss is a serious problem in females as it's frequently irreversible [28].

Moreover, significantly calories limiting can disrupt women's reproductive systems and lower fertility. In a woman's diet, less than 22-42% of the calories required for weight maintenance might impede ovulation by reducing LH levels [29]. As mentioned above, inadequate calorie intake may also reduce estrogen levels which result in irregular or lack of menstrual cycle [15].

Despite the widespread usage of various weight-loss diet programs in Jordanian society, particularly among youth, no research has been conducted to assess how these diet programs influence health of the public. In our preliminary survey of using the diet programs among Al-Hussein Bin Talal University (AHU), it was found that around 29% of the students are following weight loss diet. A few of them (>10%) follow professionally controlled diet program and receive consultations from specialized physicians or dietitian, while the majority follow random or self-help weight loss diet. Moreover, the survey revealed that around half of the students who follow weight loss diet have suffered from one or more of specific signs and symptoms related to nutrient deficiency after they started their diet (unpublished data).

Consequently, this study was developed to explore the distribution of weight loss diet programs and the development of nutrient deficiency symptoms among students at AHU and their correlations with the body mass index (BMI) other health factors.

## MATERIALS AND METHODS

### Study Design and Setting/Population

This study is a cross-sectional, descriptive study conducted through using a self-administered survey for a period of three months started from June to September 2021.

### Study Setting and Participants

For conducting this study, 1,200 questionnaires written in Arabic language were distributed at the undergraduate lectures' hall complexes at AHU thru announcement to participate in this study (Figure 1). Weight and height were measured by the research assistances and recorded on the questionnaire of each subject. BMI values were calculated as weight in kilogram divided by height in meters squared. According to statistics of 2020, the estimated number of students at AHU was 7,338 (6,169 undergraduates and 1,169 postgraduates). This study targeted the undergraduate students from all colleges at AHU, Ma`an Jordan. The study was approved by the scientific research ethics board in Al-Hussein Bin Talal University (Ref. 18/2019) and the informed consent was obtained from the participants at enrollment.

### Inclusion Criteria

1. Undergraduate students at AHU.
2. Jordanian citizenship
3. Aged ranged between 18-30 years.

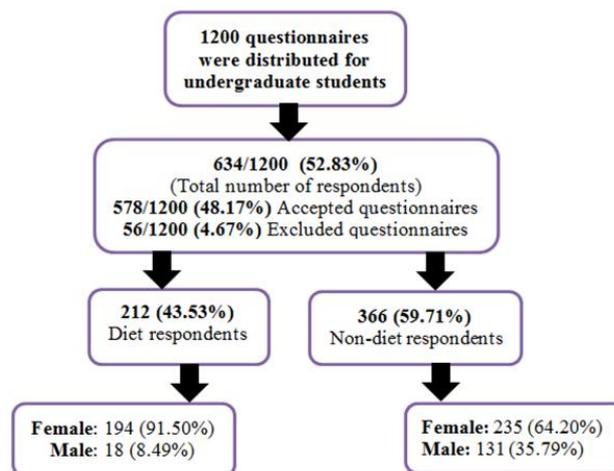


Figure 1. Flow chart of the study

4. Subjecting to weight-loss diet programs for one month at least.

### Exclusion Criteria

1. Aged less than 18 or above 30.
2. Non-undergraduate students.
3. Pregnant women.
4. Non-Jordanian citizenship.
5. Unhealthy students suffering from any diseases.
6. Uncompleted questionnaire or measurement of height and weight.

### Questionnaire Development and Validation

#### Question development

Questions were developed based on a comprehensive review of similar studies in the literature and discussions with subject-matter experts [30].

#### Validation and reliability of questionnaire

Questionnaire validity was confirmed by three experts in public health research from three different universities. The panel was asked to review the relevance of questions for inclusion in the final questionnaire. All their comments and corrections were amended in the final draft of the questionnaire.

#### Format of the questionnaire

The present study's questionnaire was written in the public spoken language (Arabic) and included two parts. The first part concerned certain inquiries about the sociodemographic details of the participants (age, marital status, and university college) and a direct question to determine whether they are currently following a weight loss diet program or not. Only the participants who were on weight-loss diet program were asked to answer the second part of the questionnaire concerned inquiries about the adopted weight-loss program including the source of information about the adopted program, components, and length of the weight-loss diet plan, as well as height and weight before and after beginning the diet, and the pace of weight loss.

Additionally, individual reasons for attempting weight-loss diet plan, daily caloric intake, frequency, and duration of physical activity throughout the day or week, symptoms

related to nutrient deficiency which had been noticed after attempting the program, as well as health and medication information.). The recommended BMI range is 18.5 to 24.9 kg/m<sup>2</sup>. BMI<18.5 was considered underweight, whereas BMI 25-29.9 kg/m<sup>2</sup> were considered overweight, and BMI ≥30 kg/m<sup>2</sup> was considered obese.

### Statistical Analysis

Data was presented as means±standard deviation (SD). Statistical package for the social science program version 21 was used for statistical analysis. One-way analysis of variance (ANOVA) and independent t-test were used to compare between means of different groups. Additionally, a multiple response analysis was performed to assess how diet participants were distributed based on the goals of the adopted diet programs. In addition, Chi-squared test was used to study the association between skipping foods with occurrence of reported diet associated symptoms. A p-value of <0.05 was considered for statistically significant.

## RESULTS

In the present study, the total number of respondents out of 1,200 distributed questionnaires among undergraduate students was 634 (52.83%). Out of 1,200 distributed questionnaires, the number of accepted questionnaires was 578 (48.17%), while the number of excluded questionnaires was 56 (4.67%). Among the 578 accepted questionnaires, 212 (43.53%) of respondents were practicing diet program and 366 (59.71%) were not practicing diets program as illustrated in the flow chart of the study (**Figure 1**).

The percentages of male and female in the diet respondent were 18 (8.49%) and 194 (91.50%), whereas the percentages of male and female in the non-diet respondents were 131 (35.79%) and 235 (64.20%), respectively. Among the diet respondents, percentage of married was higher compared with the non-diet respondents (5.2% diets and 2% non-diets). In addition, the percentage of diet respondents from health college was found to be low (44.8%) compared to (56%) for the non-diet respondents (**Table 1**).

Age average for diet and non-diet respondents was comparable and no significant difference was observed. Also, the average of weight was higher (69.11 kg) in the diet respondents compared with the non-diet respondents (63.55 kg) and no such significant difference was detected in the height between diet and non-diet respondents (163.82 and 164.12, respectively). Moreover, BMI for diet and non-diet respondents was ranged between 23.23-25.67 kg/m<sup>2</sup>.

According to **Table 1**, BMI was found to be higher in diet respondents (25.67 kg/m<sup>2</sup>) compared to non-diet respondents (23.23 kg/m<sup>2</sup>). The BMI of the diet respondents was found to be above the normal limit, and those people were deemed overweight according to the classification limits of BMI.

**Figure 2** depicts the distribution of diet participants based on the goals of utilizing diet plans. For the diet participants, a multiple response analysis revealed that 114 (48.70%) joined diet programs to look better, 74 (31.60%) to prevent diseases, and only 46 (19.70%) to move more easily.

Regarding the duration period of the diet programs followed, majority of participants were following their diet programs for less than one month (33%), followed by those between one-three months (30%), while 22% were following

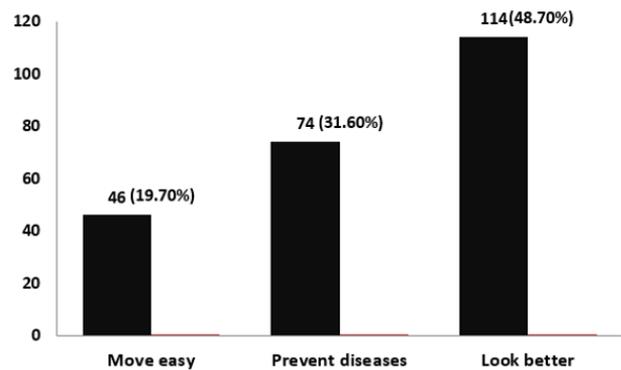
**Table 1.** Basic demographic characteristics of diet and non-diet participants and their distributions among colleges at AHU

Participants	Classification	Frequency (%)
Sex for diet	Male	18 (8.49)
	Female	194 (91.50)
Sex for non-diet	Male	131 (35.79)
	Female	235 (64.20)
Marital status for diet	Single	201 (94.80)
	Married	11 (5.20)
Marital status for non-diet	Single	359 (98.00)
	Married	7 (2.00)
College for diet	Health college	95 (44.80)
	Others	117 (55.20)
College for non-diet	Health college	205 (56.00)
	Others	161 (44.00)

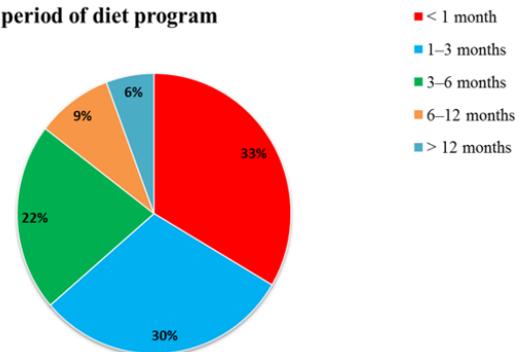
Variable	Diet (Mean±SD)	Non-diet (Mean±SD)	Diet & non-diet (Mean±SD)
Age (year)	21.10±2.52	20.58±1.71	20.70±2.21
Weight (kg)	69.19±11.32	63.55±14.36	65.62±13.59
Height (cm)	163.82±7.87	164.76±9.22	164.41±8.75
BMI (kg/m <sup>2</sup> )	25.67±2.86	23.23±3.70	24.13±3.67

BMI: Body mass index



**Figure 2.** Distribution of diet participants on diet purposes

### Duration period of diet program



**Figure 3.** Distribution of diet participants on duration period of their diet programs

the diet programs for a period three-six months and only 6% and 9% were following the diet regime for periods ranged between six-12 months and more than 12 months, respectively (**Figure 3**).

Differences in the BMI were compared between the different groups using different factors as shown in **Table 2**. Statistically significant increase was observed in the BMI for diet respondents (25.67±2.86) compared with 23.23±3.78 for the non-diet respondents (p=0.01).

Also, statistically significant increase was detected for the BMI between male and females for both diet (26.75±3.31 and 25.36±2.65) and non-diet (24.45±3.91 and 22.80±3.65)

**Table 2.** Differences in BMI among different groups of participants according to diet status, sex, required and consumed calories, duration period, physical activity, drinking water, and degree of satisfaction (variable: BMI)

Factors	Groups	N	Mean±SD	p-value
Diet status*	Diet	212	25.67±2.86	0.001
	Non-diet	366	23.23±3.78	
Sex for diets*	Male	48	26.75±3.31	0.003
	Female	164	25.36±2.65	
Sex for non-diets*	Male	96	24.45±3.91	0.001
	Female	270	22.80±3.65	
Calculated required calories*	Yes	49	25.95±3.01	0.506
	No	163	25.61±2.86	
Calculated consumed calories*	Yes	78	26.29±3.12	0.042
	No	134	25.40±1.69	
Duration period**	<1 month	71	25.60±2.94	0.616
	1-3 months	64	25.93±2.89	
	3-6 months	46	25.16±2.45	
	6-12 months	19	25.94±2.89	
	>12 months	12	26.26±3.74	
Physical activity**	Never	59	25.51±2.41	0.593
	Rarely	82	25.52±2.80	
	Sometimes	42	26.36±3.51	
	Mostly	19	25.60±3.01	
	Always	12	25.40±2.92	
Drinking water (liters/day)**	0.5-1.0	70	25.28±2.45	0.232
	1.1-2	103	25.96±3.24	
	2.1-3	29	26.17±3.12	
	<3	10	25.25±1.87	
Degree of satisfaction**	Never	35	25.13±2.11	0.713
	Weak	54	26.05±3.14	
	Acceptable	47	25.91±3.25	
	Medium	43	25.61±3.01	
	Good	21	25.45±2.29	
	Very good	10	25.69±2.39	
	Excellent	2	23.55±0.97	

BMI: Body mass index; \*Independent t-test; & \*\*One-way ANOVA test were conducted at p-value=0.05

respondents' groups ( $p=0.003$  and  $0.001$ ), respectively. At the same time, statistically significant increase was noted in the BMI when comparing the BMI for those respondents who were calculated consumed calories against the diet respondents ( $26.29\pm 3.12$  and  $25.40\pm 1.69$ ) who do not calculate the consumed calories BMI ( $p=0.042$ ).

On the other hand, there were no statistically significant differences in the BMI across the groups for other variables such as physical activity and water consumption.

In terms of practicing physical exercises, it was observed that 59 (27.8%) of diet respondents were never exercised and 82 (38.7%) were rarely exercised. In contrast, 42 (19.8%) sometimes exercised, 19 people (8.9%) mostly did so, and only 12 (5.7%) frequently exercised.

On comparing the BMI against the degree of satisfaction of using diet program of the diet respondents, no correlation or statistically significant difference were noted ( $p=0.713$ ) using coefficient correlation or one-way ANOVA tests. Individuals who responded to the diet survey's questions on their level of satisfaction with their BMI were found to be weak in 54 cases, acceptable in 47 cases, and medium in 43 cases. Additionally, 21 responded good, 10 answered very good, and only two people expressed excellent levels of satisfaction regarding the degree of weight reduction after starting the diet program (**Table 2**).

**Table 3** presents a summary of the variations in BMI between several participant groups according to dietary sources, type of regimen, and side effects. The BMI of diet respondents who obtained their regimen from traditional

healers showed a statistically significant difference compared with the BMI for diet respondents who do not take their regimen from traditional healers ( $p=0.029$ ), but no statistically significant differences were observed in the BMI among the other groups of respondents who obtained their diet regimens from doctors, pharmacists, internet, or friends (**Table 3**).

Similarly, only those diet participants who skipped breakfast displayed higher statistically significant difference in the mean of BMI compared with the others who did not skip the breakfast meal ( $p=0.031$ ). However, when comparing the BMI of the same group between those who skipped proteins, lipids, proteins and lipids, carbohydrates, lunch, dinner, snakes, or those who only eat vegetables or reduced the amount of food with the other groups who did not skip any foods, no statistically significant differences in the BMI were found ( $p=0.138-0.790$ ).

On the other hand, a statistically significant decrease was detected in the BMI between the diet respondents who had hair loss against the diet respondents without the hair loss issue ( $p=0.041$ ).

Furthermore, when comparing the groups that experienced side effects like lethargy, loss of concentration, irritability, nervousness, discomfort in the extremities, irregular and unpleasant menstrual cycles, and recurrent infections against those groups that did not experience the same side effect, no statistically significant differences were found between the BMI of the various groups ( $p=0.079-0.993$ ).

**Table 4** illustrated the association between skipped foods and different symptoms which could be occurred as a result of

**Table 3.** Differences in BMI among different groups of participants according to diet source, nutritional intake, and side effects (variable: BMI)

Factors	Yes/no	N	Mean±SD	p-value
Source of diet				
Medical doctor	Yes	9	25.94±3.13	0.603
	No	203	25.66±2.86	
Pharmacist	Yes	13	24.92±1.65	0.325
	No	199	25.72±2.94	
Traditional healers	Yes	12	27.42±4.69	0.029
	No	200	25.57±2.70	
Friends /relatives	Yes	16	25.14±2.63	0.493
	No	196	25.71±2.88	
Websites	Yes	18	24.99±1.67	0.290
	No	194	25.74±2.94	
Type of food avoided				
No carbohydrates	Yes	60	25.42±2.90	0.483
	No	152	25.75±2.85	
No lipids	Yes	50	25.93±2.96	0.489
	No	162	25.60±2.83	
No carbohydrates or lipids	Yes	40	26.05±2.84	0.362
	No	172	25.59±2.87	
No proteins	Yes	4	23.79	0.511
	No	208	25.68±2.86	
Eat vegetables only	Yes	28	24.97±1.91	0.163
	No	184	25.75±2.85	
Reduced in quantity	Yes	101	25.62±2.93	0.790
	No	111	25.72±2.81	
Skipped meal				
Skip breakfast	Yes	114	26.06±3.71	0.031
	No	98	25.22±2.40	
Skip lunch	Yes	37	25.42±2.90	0.152
	No	175	25.75±2.85	
Skip dinner	Yes	106	25.32±2.55	0.447
	No	106	26.04±3.11	
Skip snacks	Yes	81	25.39±2.57	0.138
	No	131	25.85±3.02	
Side effect				
Lethargy	Yes	55	26.26±3.44	0.079
	No	157	25.47±2.62	
Loss of concentrations	Yes	74	25.25±2.79	0.108
	No	138	25.90±2.89	
Irritable and nervous	Yes	54	26.0±2.90	0.336
	No	158	25.56±2.86	
Hair loss	Yes	58	25.13±2.18	0.041*
	No	154	26.88±3.06	
Extremities pain	Yes	22	24.94±2.38	0.142
	No	190	25.76±2.91	
Irregular and painful period	Yes	21	25.96±3.05	0.657
	No	191	25.65±2.85	
Recurrent infections	Yes	16	25.67±1.82	0.993
	No	196	25.68±2.94	

\*Independent t-test was conducted at  $P$  value =0.05

**Table 4.** Assessment of the effects of skipped foods on the occurrence of diet associated symptoms

↓ Signs	Type of regime →		
	Skip breakfast	Skip lunch	Skip dinner
Pain in extremities	0.548	0.165	0.352
Hair loss	0.831	0.811	0.794
Irritable and nervous	0.886	0.713	0.779
Loss of concentration	0.215	0.875	0.561
Lethargy	0.371	0.796	0.540
Irregular & painful period	0.008*	0.831	0.364
Recurrent infections	0.952	0.116	0.382

\*Chi-square test was conducted at  $P$  value =0.05

skipping specific food. Statistically significant association was detected between skipping breakfast and occurring of irregular and painful periods ( $p=0.008$ ), while no statistically significant

associations were noticed with the other symptoms. Skipping lunch or dinner did not show any significant associations with the different symptoms (**Table 4**).

## DISCUSSION

Maintaining a healthy weight or losing weight is a concern in today's society, particularly for women, hence several attempts are undertaken to address this problem [1,31]. In an effort to solve this issue, people have begun using various diet plans, adhering to the recommendations of doctors, dietitians, and others (e.g., friends, websites), or creating their own program regardless the risks that could be associated with these plans [4,32,33].

The difficulty of maintaining dietary, exercise, and/or behavioral interventions over time is one of the difficulties in achieving weight reduction and preventing weight gain. However, research has shown that it is difficult to maintain weight loss unless the diet and/or exercise intervention can be incorporated into the individual's lifestyle [3,34,35].

The current study's findings revealed that more women than men reported being on a diet, confirming that women are more worried about diet than men and that this issue is highly important to them. Weight and BMI were higher in the diet respondents than in the non-diet respondents, which served as incentives for those respondents to practice a diet program to lose weight and look better. However, according to the statistical results, the majority (33%) of dieting students started their diets for less than one month, and only a tiny percentage (6%) adhere with the program for a long time (more than six months). This indicates that dieting participants have a low adherence to their selected diet plan after only a short period of attendance. Adherence to a weight reduction diet program is generally recognized to be the key to success, and it is critical to choose a diet program that promotes health by creating a negative energy balance and focusing on high food quality [36].

The current study's results revealed that there were no significant variations in BMI values between the groups practicing varied levels of weekly exercise. However, an earlier study [3] concluded that structured diet and exercise program seems to be more effective at promoting and maintaining weight loss and improving health and fitness markers. Additionally, they found that there were statistically significant variations in the frequency of sessions and the number of hours spent engaging in moderate and strenuous physical exercise per week. The disagreement with our findings might be related to our study's cross-sectional method, which did not allow us to record the BMI of the participants at the beginning of their diet regimen, making it unable to evaluate the effectiveness of weight loss rate.

The findings of our study revealed that a quite number of diet respondents were not following a professional-guided diet programs in which a very few students were attempting doctors- or dietitians-guided diet regimen, which are consistent with the findings reported by [33]. One of the primary reasons for the lack of professional guided weight reduction in rural and impoverished regions, such as ours, is a paucity and high cost of dietitian services. Furthermore, some people are uncomfortable discussing their weight management with a professional [37].

The mean BMI of dieter responders who had estimated their calorie consumption was found to be significantly higher than that of individuals who did not calculate their calorie intake. This may indicate the amount of fear and concern among overweight and obese participants due to their higher

BMI. One of the adverse consequences of this case that it may be developed to anxiety. It was reported that the level of anxiety among medium to high BMI participants is higher than those of low or very high BMI [38].

According to the findings of this study, diet respondents who were taking herbs to lose weight had a significantly higher BMI than diet respondents who were not taking the herbs. Dieters' decision to try traditional herbal treatments to lose weight, regardless of scientific evidence of their efficacy, might also be influenced by their worry about their higher body weight. The alternative rationale for the higher BMI value among herbs users might be a lack of effectiveness of these products in promoting weight reduction and improving BMI. In fact, several studies have demonstrated the misuse of herbs for weight-loss purposes specially among females [39, 40]. Additionally, some reports revealed the adverse toxic effects of these practices [41,42].

In the current study, the majority of dieter respondents followed their selected diet regimens by skipping particular meals or categories of foods, while others just reduced their overall calorie consumption to lose weight. It was shown that dieting individuals who skipped breakfast had a significantly higher mean BMI value than those who used to take their breakfast ( $p=0.031$ ). This might be linked to the fact that missing breakfast has a detrimental impact on diet responses and leads to a rise in BMI. Several dietary studies have concluded that eating breakfast is essential for improving weight reduction among dieters [43]. It was reported that having early breakfast promotes more satiety than eating later in the day, conversely, missing breakfast may result in energy overcompensation later in the day [44]. Also, our findings agree with those of earlier studies that found skipping breakfast may cause weight gain and the development of overweight and obesity [45]. However, the study [46] found that including breakfast in diet plans for people may not be the best strategy to lose weight.

An analysis of the differences in BMI among dieting respondents who reported suffering from a variety of symptoms since beginning the weight-loss program revealed that the mean BMI for those who experienced hair loss was significantly lower than for those who did not. This may indicate that the diet program being followed is unsafe and has deficient in many nutrients required for hair growth. It is a well-known that both hair structure and hair growth are altered by nutritional deficiency. Hair loss can be caused by sudden weight reduction, decreased protein intake, and niacin deficiencies [47,48]. Furthermore, when the association of diet side effects and skipping meals was investigated, the findings indicate that the occurrence of irregular and painful periods is significantly related to the habit of skipping breakfast. Earlier study in Japan reported the influencing effects of dietary habits, including skipping meals, on the female reproductive functions [49]. An improper diet during the reproductive age can cause amenorrhea and may lead to ovarian dysfunction [50]. In line with our findings, studies from various societies show that young women who skip breakfast have a significantly higher prevalence of dysmenorrhea symptoms than those who regularly take their breakfast [51,52].

Some limitations were observed in the current study should be considered in the future work. One of the study's limitations is that a third of the diet respondents just started following their diet plans for a month or less, which is insufficient to demonstrate how the followed diet program

affected BMI or other variables like side effects. Additionally, because the current study was a cross sectional study, we were not able to evaluate the changes in BMI during a specific period of attempting the weight loss diet program. Furthermore, an extensive examination is needed to test and evaluate the nutritional deficiencies of some related elements such as zinc, iron, vitamin B3, fatty acids, selenium, vitamin D, vitamin A, vitamin E, folic acid, biotin, amino acids, and proteins in those who have followed diet programs and experienced various side effects.

In conclusion, the present study concluded that weight-loss diet programs are widely practiced among AHU undergraduate students. BMI and individual's sex are the major factors influencing the decision to attempt weight-loss diet regimen. Additionally, dieter students engage in a variety of unhealthy weight-loss practices, such as ignoring nutritional counseling, skipping meals, and misusing non-prescribed drugs. Subsequently, a wide range of dietary side effects emerge among dieting students. Therefore, people should be aware that when following weight-loss diet programs, they should be under the supervision of doctors or professional dietitians in order to avoid the occurrence of dietary side effects and achieve better results.

**Author contributions:** All authors have sufficiently contributed to the study and agreed with the results and conclusions.

**Funding:** This study was funded by Deanship of Scientific Research, Al-Hussein Bin Talal University, Grant Number 196/2019.

**Acknowledgements:** The authors would like to thank all students who participated in this study as well as all of the administrative support staff members at Al-Hussein Bin Talal University who assisted in conducting this study.

**Declaration of interest:** No conflict of interest is declared by authors.

**Data sharing statement:** Data supporting the findings and conclusions are available upon request from the corresponding author

## REFERENCES

- Williams EP, Mesidor M, Winters K, Dubbert PM, Wyatt SB. Overweight and obesity: Prevalence, consequences, and causes of a growing public health problem. *Curr Obes Rep.* 2015;4(3):363-70. <https://doi.org/10.1007/s13679-015-0169-4> PMID:26627494
- Swallen KC, Reither EN, Haas SA, Meier AM. Overweight, obesity, and health-related quality of life among adolescents: The national longitudinal study of adolescent health. *Pediatrics.* 2005;115(2):340-7. <https://doi.org/10.1542/peds.2004-0678> PMID:15687442
- Kreider RB, Serra M, Beavers KM, et al. A structured diet and exercise program promotes favorable changes in weight loss, body composition, and weight maintenance. *J Am Diet Assoc.* 2011;111(6):828-43. <https://doi.org/10.1016/j.jada.2011.03.013> PMID:21616195
- Wyatt SB, Winters KP, Dubbert PM. Overweight and obesity: Prevalence, consequences, and causes of a growing public health problem. *Am J med Sci.* 2006;331(4):166-74. <https://doi.org/10.1097/00000441-200604000-00002> PMID:16617231
- Cannon CP, Kumar A. Treatment of overweight and obesity: Lifestyle, pharmacologic, and surgical options. *Clin Cornerstone.* 2009;9(4):55-68. [https://doi.org/10.1016/S1098-3597\(09\)80005-7](https://doi.org/10.1016/S1098-3597(09)80005-7)
- Binkiewicz-Glińska A, Bakula S, Kusiak-Kaczmarek M, et al. Obesity prevention in children and adolescents—Current recommendations. *Polish Ann Med.* 2012;19(2):158-62. <https://doi.org/10.1016/j.poamed.2012.07.003>
- Wilborn C, Backham J, Campbell B, et al. Obesity: Prevalence, theories, medical consequences, management, and research directions. *J Int Soc Sports Nutr.* 2005;2(2):4-31. <https://doi.org/10.1186/1550-2783-2-2-4> PMID:18500955 PMCid:PMC2129146
- Bray GA, Frühbeck G, Ryan DH, Wilding JPH. Management of obesity. *Lancet.* 2016;387(10031):1947-56. [https://doi.org/10.1016/S0140-6736\(16\)00271-3](https://doi.org/10.1016/S0140-6736(16)00271-3)
- Jovanović Ž, Crncevic-orlicZ, Stimac D, et al. Effects of obesity reduction on cardiovascular risk factors: Comparison of individual and group treatment—substudy of the Croatian Healthy Weight Loss Programme. *Coll Antropol.* 2009;33(3):751-7.
- Kushner RF. Medical management of obesity. *Semin Gastrointest Dis.* 2002;13:123-32.
- Swinburn BA, Caterson I, Seidell JC, James WPT. Diet, nutrition and the prevention of excess weight gain and obesity. *Public Health Nutr.* 2004;7(1A):123-46. <https://doi.org/10.1079/PHN2003585> PMID:14972057
- Puhkala J, Kukkonen-Harjula K, Mansikkamaki K, et al. Lifestyle counseling to reduce body weight and cardiometabolic risk factors among truck and bus drivers—a randomized controlled trial. *Scand J Work Environ Health.* 2015;41(1):54-64. <https://doi.org/10.5271/sjweh.3463> PMID:25310464
- Miller WM, Franklin BA, Nori Janosz KE, Vial C, kaitner R, McCullough PA. Advantages of group treatment and structured exercise in promoting short-term weight loss and cardiovascular risk reduction in adults with central obesity. *Metab Syndr Relat Disord.* 2009;7(5):441-6. <https://doi.org/10.1089/met.2008.0103> PMID:19450156
- Li Z, Hong K, Wong E, Maxwell M, Heber D. Weight cycling in a very low-calorie diet programme has no effect on weight loss velocity, blood pressure and serum lipid profile. *Diabetes Obes Metab.* 2007;9(3):379-85. <https://doi.org/10.1111/j.1463-1326.2006.00621.x> PMID:17391166
- Sacks FM, Bray GA, Carey VJ, et al. Comparison of weight-loss diets with different compositions of fat, protein, and carbohydrates. *N Engl J Med.* 2009;360(9):859-73. <https://doi.org/10.1056/NEJMoa0804748> PMID:19246357 PMCid:PMC2763382
- Kerksick C, Thomas A, Campbell B, et al. Effects of a popular exercise and weight loss program on weight loss, body composition, energy expenditure and health in obese women. *Nutr Metab (Lond).* 2009;6:23. <https://doi.org/10.1186/1743-7075-6-23> PMID:19442301 PMCid:PMC2693519
- Westman EC, Yancy WS, Edman JS, Tomlin KF, Perkins CE. Effect of 6-month adherence to a very low carbohydrate diet program. *Am J Med.* 2002;113(1):30-6. [https://doi.org/10.1016/S0002-9343\(02\)01129-4](https://doi.org/10.1016/S0002-9343(02)01129-4)
- Olendzki BC, Ma Y, Schneider KL, et al. A simple dietary message to improve dietary quality: Results from a pilot investigation. *Nutrition.* 2009;25(7-8):736-44. <https://doi.org/10.1016/j.nut.2009.01.009> PMID:19359142
- O'Keefe JH, Gheewala NM, O'Keefe JO. Dietary strategies for improving post-prandial glucose, lipids, inflammation, and cardiovascular health. *J Am Coll Cardiol.* 2008;51(3):249-55. <https://doi.org/10.1016/j.jacc.2007.10.016> PMID:18206731

20. Menon VB, Baxmann AC, Froeder L, Martini LA, Heilberg IP. Effects of calcium supplementation on body weight reduction in overweight calcium stone formers. *Urol Res*. 2009;37(3):133-9. <https://doi.org/10.1007/s00240-009-0187-3> PMID:19326108
21. Major GC, Alarie FP, Dore J, Tremblay A. Calcium plus vitamin D supplementation and fat mass loss in female very low-calcium consumers: Potential link with a calcium-specific appetite control. *Br J Nutr*. 2008;101(5):659-63. <https://doi.org/10.1017/S0007114508030808> PMID:19263591
22. Tsai AG, Wadden TA. Systematic review: An evaluation of major commercial weight loss programs in the United States. *Ann Intern Med*. 2005;142(1):56-66. <https://doi.org/10.7326/0003-4819-142-1-200501040-00012> PMID:15630109
23. Tsai AG, Wadden TA. The evolution of very-low-calorie diets: An update and meta-analysis. *Obesity (Silver Spring)*. 2006;14(8):1283-93. <https://doi.org/10.1038/oby.2006.146> PMID:16988070
24. Shapses SA, Riedt CS. Bone, body weight, and weight reduction: What are the concerns? *J Nutr*. 2006;136(6):1453-6. <https://doi.org/10.1093/jn/136.6.1453> PMID:16702302 PMCid:PMC4016235
25. Meyers LD, Hellwig JP, Otten JJ. Dietary reference intakes: The essential guide to nutrient requirements. Washington, DC:National Academies Press;2006.
26. Manolagas SC, O'Brien CA, Almeida M. The role of estrogen and androgen receptors in bone health and disease. *Nat Rev Endocrinol*. 2013;9(12):699-712. <https://doi.org/10.1038/nrendo.2013.179> PMID:24042328 PMCid:PMC3971652
27. Fuqua JS, Rogol AD. Neuroendocrine alterations in the exercising human: Implications for energy homeostasis. *Metabolism*. 2013;62(7):911-21. <https://doi.org/10.1016/j.metabol.2013.01.016> PMID:23415825
28. Chen Y-T, Tenforde AS, Fredericson M. Update on stress fractures in female athletes: Epidemiology, treatment, and prevention. *Curr MRev usculoskelet Med*. 2013;(2):173-81. <https://doi.org/10.1007/s12178-013-9167-x> PMID:23536179 PMCid:PMC3702771
29. Williams NI, Leidy HJ, Hill BR, Lieberman JL, Legro RS, De Souza MJ. Magnitude of daily energy deficit predicts frequency but not severity of menstrual disturbances associated with exercise and caloric restriction. *Am J Physiol Endocrinol Metab*. 2015;308(1):E29-39. <https://doi.org/10.1152/ajpendo.00386.2013> PMID:25352438 PMCid:PMC4281686
30. Zed PJ, Abu\_Laban RB, Balen RM, et al. Incidence, severity and preventability of medication-related visits to the emergency department: A prospective study. *CMAJ*. 2008;178(12):1563-9. <https://doi.org/10.1503/cmaj.071594> PMID:18519904 PMCid:PMC2396352
31. Katan MB. Weight-loss diets for the prevention and treatment of obesity. *N Engl J Med*. 2009;360(9):923-5. <https://doi.org/10.1056/NEJMe0810291> PMID:19246365
32. Kelly AS, Barlow SE, Rao G, et al. Severe obesity in children and adolescents: Identification, associated health risks, and treatment approaches: A scientific statement from the American Heart Association. *Circulation*. 2013;128(15):1689-712. <https://doi.org/10.1161/CIR.0b013e3182a5cfb3> PMID:24016455
33. Almainan A, Al Wutayd O. Assessment of the side effects of random weight-loss diet programs (protein-based) on health in a Saudi Community. *Int J Pharm Phytopharm Res*. 2019;9(6):39-46.
34. Acharya SD, Elci OU, Sereika SM, et al. Adherence to a behavioral weight loss treatment program enhances weight loss and improvements in biomarkers. *Patient Prefer Adherence*. 2009;3:151-60. <https://doi.org/10.2147/PPA.S5802> PMID:19936157 PMCid:PMC2778406
35. Sarwer DB, von Sydow Green A, Vetter ML, Wadden TA. Behavior therapy for obesity: Where are we now? *Curr Opin Endocrinol Diabetes Obes*. 2009;16(5):347-52. <https://doi.org/10.1097/MED.0b013e32832f5a79> PMID:19623061
36. Freire R. Scientific evidence of diets for weight loss: Different macronutrient composition, intermittent fasting, and popular diets. *Nutrition*. 2020;69:110549. <https://doi.org/10.1016/j.nut.2019.07.001> PMID:31525701
37. Butryn ML, Kerrigan SG, Kelly MC. Self-guided weight loss. *Encyclopedia Body Image Human Appearance*. 2012;2:718-23. <https://doi.org/10.1016/B978-0-12-384925-0.00113-9>
38. Haghghi M, Jahangard L, Ahmadpanah M, Bajoghli H, Holsboer-Trachsler E, Brand S. The relation between anxiety and BMI—is it all in our curves? *Psychiatry Res*. 2016;235:49-54. <https://doi.org/10.1016/j.psychres.2015.12.002> PMID:26708439
39. Robinson RF, Griffith JR, Nahata MC, Mahan JD, Casavant MJ. Herbal weight-loss supplement misadventures per a regional poison center. *Ann Pharmacother*. 2004;38(5):787-90. <https://doi.org/10.1345/aph.1D260> PMID:15044657
40. Yen C-C, Tung C-W, Chang C-W, Tsai C-C, Hsu M-C, Wu Y-T. Potential risk of higenamine misuse in sports: Evaluation of lotus plumule extract products and a human study. *Nutrients*. 2020;12(2):285. <https://doi.org/10.3390/nu12020285> PMID:31973198 PMCid:PMC7070534
41. Vanherweghem J-L. Misuse of herbal remedies: the case of an outbreak of terminal renal failure in Belgium (Chinese herbs nephropathy). *J Altern Complement Med*. 1998;4(1):9-13. <https://doi.org/10.1089/acm.1998.4.1-9> PMID:9553830
42. Shaw D. Toxicological risks of Chinese herbs. *Planta Med*. 2010;76(17):2012-8. <https://doi.org/10.1055/s-0030-1250533> PMID:21077025
43. Garaulet M, Gómez-Abellán P. Timing of food intake and obesity: A novel association. *Physiol Behav*. 2014;134:44-50. <https://doi.org/10.1016/j.physbeh.2014.01.001> PMID:24467926
44. de Castro JM. When, how much and what foods are eaten are related to total daily food intake. *Br J Nutr*. 2009;102(8):1228-37. <https://doi.org/10.1017/S0007114509371640> PMID:19650955
45. Wicherski J, Schlesinger S, Fischer F. Association between breakfast skipping and body weight—A systematic review and meta-analysis of observational longitudinal studies. *Nutrients*. 2021;13(1):272. <https://doi.org/10.3390/nu13010272> PMID:33477881 PMCid:PMC7832891
46. Sievert K, Hussain SM, Page MJ, et al. Effect of breakfast on weight and energy intake: Systematic review and meta-analysis of randomised controlled trials. *BMJ*. 2019;364:l42. <https://doi.org/10.1136/bmj.l42> PMID:30700403 PMCid:PMC6352874
47. Mubki T, Rudnicka L, Olszewska M, Shapiro J. Evaluation and diagnosis of the hair loss patient: part I. History and clinical examination. *J Am Acad Dermatol*. 2014;71(3):415.e1-5. <https://doi.org/10.1016/j.jaad.2014.04.070> PMID:25128118

48. Guo EL, Katta R. Diet and hair loss: Effects of nutrient deficiency and supplement use. *Dermatol Pract Concept*. 2017;7(1):1-10. <https://doi.org/10.5826/dpc.0701a01> PMID: 28243487 PMCID:PMC5315033
49. Fujiwara T, Nakata R. Current problems of food intake in young women in Japan: Their influence on female reproductive function. *Reprod Med Biol*. 2004;3(3):107-14. <https://doi.org/10.1111/j.1447-0578.2004.00063.x> PMID: 29699189 PMCID:PMC5906838
50. Fujiwara T. Diet during adolescence is a trigger for subsequent development of dysmenorrhea in young women. *Int J Food Sci Nutr*. 2007;58(6):437-44. <https://doi.org/10.1080/09637480701288348> PMID:17710588
51. Dandotiya D, Priya A, Toppo M, Melwani V, Sethia S. Effect of skipping breakfast on young girls' menstruation. *Ind J Youth Adolesc Health*. 2017;4(3):17-20. <https://doi.org/10.24321/2349.2880.201720>
52. Fujiwara T. Skipping breakfast is associated with dysmenorrhea in young women in Japan. *Int J Food Sci Nutr*. 2003;54(6):505-9. <https://doi.org/10.1080/09637480310001622369> PMID:14522696