Original article

Preliminary observations on the eating behavior in a selected group of Jordanian adults with CVD and type 2 diabetes

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Abstract. *Background:* Various factors have influenced eating behaviors, including the occurrence of diseases. *Aims:* To evaluate eating behaviors and how disease incidence affects them in Jordan's healthy population. *Methods:* A cross-sectional study was conducted on 1054 males and 1361 females (>18 years) between March and May 2022. Participants were categorized into two groups: those with diseases (diabetes, cardiovascular diseases (CVD), and comorbidities) and those with no diseases. Eating behaviors, including meal timing and frequency, late-night eating, and fast-food consumption, were evaluated. *Results:* Regardless of age group, most participants tended not to skip meals, consumed two to three meals daily, had one to three snacks, ate lunch between 1:00 and 6:00 p.m., and did not consume food late in the day. The most consumed food group is cereals (males: 65.5% for healthy and 60.2% for diseased; females: 64.2% for healthy and 61.0% for diseased). The prevalence of the most frequent food consumption (1-5 times per week) was higher in healthy participants (67.4%) compared to diseased participants (49.6%) ($p < 0.001$). Diseased participants reported significantly higher consumption of vegetables in the group (10.3%) compared to healthy participants (5.0%, $p<0.001$). The most frequently missed or under-consumed food group was dairy products (48.0% for healthy individuals and 41.0% for those with disease). The prevalence of morning and night eating was 42.8% and 26.6% among the diseased participants, compared to healthy participants (35.6% and 32.9%, respectively). *Conclusion:* Even if Jordanians' eating behaviors contradict healthy behaviors, the presence of diseases is a beneficial factor that enhances healthy eating behaviors. (www.actabiomedica.it)

Key words: eating behaviors, diabetes, cardiovascular diseases, meal timing and frequency, late-night consumption, and fast food intake

Introduction

Eating behavior is "normal behavior involving eating habits, food selection, and preparation techniques, as well as the amount of food consumed" (1). Moreover, LaCaille defines it as a broad concept that encompasses motivations for choosing certain foods, food preferences, eating practices, weight loss efforts, and issues related to eating, such as obesity and eating disorders (2). Unfortunately, the way we eat and the type and quantity of food we consume have a significant impact on our health. Obesity and related health complications and diseases were the most significant concerns when considering eating behaviors (3). Therefore, research on eating behavior is focused on the causes, prevention, and treatment of obesity, as well as the promotion of healthy eating habits that aid in managing and preventing obesity-related diseases, including type 2 diabetes (T2D), hypertension, and certain malignancies (2). For decades, researchers have focused on the role of diet and its components in the development, management, and treatment of obesity and related diseases. However, the efforts have recently focused on eating behaviors and dietary patterns. Healthier eating behaviors such as consuming high-quality food and maintaining a balanced diet can help people maintain their physical health and mental stability (4); consumption of fruits, vegetables, and whole grains is inversely related to chronic diseases (5), also controlling and regulating meal timing may be more important than the macronutrient composition of the diet in managing changes in body weight (6, 7). Additionally, these healthy eating habits have been linked to a lower risk of metabolic syndrome (MetS) (8). Uncooperatively, unhealthy eating behaviors, including eating foods deficient in nutrients, skipping meals, and failing to maintain a regular diet, are linked to several health issues and nutritional deficiencies (9, 10). Moreover, numerous studies have demonstrated a connection between meal timing and frequency and various chronic diseases over the past five years (11). In addition, epidemiological studies have shown that eating late at night is associated with an increased risk of obesity (12), cardiovascular disease (CVD), and T2D (13, 14). Furthermore, Madjd et al. documented that weight loss plans should include recommendations about energy intake and the timing of food intake (7). The Jordanian population is experiencing an alarmingly high rate of obesity (15). In 2020, Ajlouni et al. reported that three-quarters of men and women in Jordan were overweight or obese (16). Also, the Jordanian population has been engaged in unhealthy eating behaviors, verified by numerous studies. Alomari et al. observed that age, sex, obesity, education, and income appeared to contribute to changes in dietary behaviors. They also found that a higher percentage of Jordanian adults reported increased consumption of high-calorie food and late-night eating (17). Moreover, among Jordanian university students, researchers have indicated that most have a high prevalence of fast-food consumption (18) and do not meet the recommendations for fruit and vegetable intake (19). Despite the high prevalence of excess weight among the Jordanian population and its related chronic diseases, including T2D and CVD, no study has highlighted the general population's eating behaviors and the shifting of eating behaviors due to disease. Therefore, the current study's objectives were to assess eating behaviors among Jordan's population and to investigate the impact of disease occurrence on the eating behaviors of Jordanians.

Materials and Methodology

Study population and ethical approval

A cross-sectional study was conducted, recruiting outpatients from three government hospitals in the central regions of Jordan. Between March and May 2022, participants were randomly selected for this population-based study. Participants aged 18 years or older, regardless of sex, were invited to participate in the study. Exclusion criteria included subjects less than eighteen years old, female subjects who were pregnant or lactating, subjects with mental disorders, and any terminally ill subjects. People with a medical condition requiring significant dietary changes in type, frequency, or quantity, or a food allergy that significantly affected their intake or changed their eating behaviors were also excluded. Before participation, all willing and eligible subjects gave oral informed consent to be included in the survey. The study was conducted by the Declaration of Helsinki, and the protocol was approved by the Institutional Review Board of The Hashemite University (No. 19/1/2022/2023) and the Jordanian Ministry of Health (MBA/20219).

Data collection and anthropometric assessment

Following the participant's agreement, a face-to-face interview was conducted to extract data using a pre-designed set of questions. The data comprised general demographic information, including age and sex, as well as general health and questions about chronic diseases or other health issues. Questions on food consumption type, amount, and time were also collected. A team of well-trained and highly qualified nutritionists obtained these data. Weight (kg), height (cm), waist circumference (cm), and hip circumference (cm) were recorded during these interviews. The research team verified the accuracy of the collected anthropometric data to ensure its suitability for further analysis. Researchers used the participants' height and weight to calculate their body mass index (BMI), which was then computed using Quetelet's formula: BMI = weight (kg)/height (m^2) (20). BMI values lower than 18.5 kg/m^2 for adults and older persons indicate underweight, between 18.5 and 24.9 kg/m^2 indicates normal weight, between 25 and 29.9 kg/m^2 indicates overweight, and above 30 kg/m^2 indicates obesity (21). Participants were categorized into two groups: those with diseases (diabetes, cardiovascular diseases (CVD), and comorbidities) and those without diseases.

Eating behaviors and meal timing assessment

Eating behaviors, including meal timing and frequency, as well as late-night and fast-food consumption, were evaluated. Meal timing was categorized as eating in the morning time (breakfast and snacks), evening time (lunch and snacks), and nighttime (dinner and snacks) (22). Eating times included: morning eating (eating between 5:00–9:00 a.m.), non-morning eating (eating after 9:00 a.m.), evening eating (eating between 6:00–9:00 p.m.), and night eating (eating after 9:00 p.m.) (22, 23). Regarding meal frequency, participants were asked to describe their regular eating meals, food groups (most and least food groups consumed, type of consumed snacks, and most skipped meals), and eating frequency (number of meals and snacks/day).

Statistical analysis

Data were analysed using IBM SPSS Statistics (IBM Corp., 2012. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: The IBM Corp. utilized the Kolmogorov-Smirnov test and calculated Kurtosis and Skewness values to verify the normality of the variables. Continuous variables were expressed as means with standard deviations. Categorical variables were presented as frequencies and percentages (%). A chi-square ($\chi 2$) test was performed to test participant differences. An independent-sample t-test was performed to analyse the differences between the means of continuous variables. A *p*-value of less than 0.05 was used as the level of significance.

Results

Table 1 presents the general characteristics of the study population by sex. Table 1 presents the general characteristics of the study population by sex. The study population consisted of 1054 males and 1361 females. The male participants had a mean age of 48.0 ± 17.1 years, a weight of 75.5 ± 12.7 kg, a height of 171.7 ± 10.1 cm, a waist circumference of 83.3 ± 14.9 cm, a hip circumference of 96.2 ± 16.9 cm, and a BMI of 25.7 ± 5.9 kg/m². The female participant had a mean age of 46.5 ± 17.8 years, a weight of 70.5 ± 12.8 kg, a height of 162.1 ± 5.8 cm, a waist circumference of 76.7 ± 21.7 cm, a hip circumference of 88.5 ± 23.9 cm, and a BMI of 26.8 ± 4.7 kg/m². More than half of the male and female participants had a high school education level or lower, and female participants had a lower prevalence of university-level or higher education (24.0%) compared to male participants (32.3%). Regarding employment status, although both sexes had a high prevalence of unemployment, male participants had a higher prevalence of being employed (51.8%) compared to females (13.8%) ($p < 0.0001$). Almost two-thirds of the male and female participants were married. Of males, 73.2% were smokers, while 33.3% of females were smokers. Females were more negative smokers (35.3%) and non-smokers (21.2%) compared to males (5.7% and 8.3% respectively). Most males and females were not physically active daily. However, the number of males who engage in daily physical activity was higher (22.9% vs. 13.6% for females). Based on BMI classification (Figure 1), males had a higher prevalence of normal weight (50.94%) and overweight (37.62%) than females (41.78% and 36.53%, respectively), but females had a higher prevalence of obesity (21.69% vs. 11.44% for males).

Studying the meal frequency and eating behavior of the study population (Table 2), based on whether they had the disease (healthy) or not (diseased), revealed that two-thirds of both healthy and diseased individuals tend not to skip their meals. If they skip meals, breakfast is the most skipped (19.3% and

Table 1. General characteristics (n=2415)

Variables	Mean ± SD Males (n=1054)	Mean ± SD Females (n=1361)	*p*-value*
Age (year)	48.0 ± 17.1	46.5 ± 17.8	0.020
Weight (Kg)	75.5 ± 12.7	70.5 ± 12.8	<0.001
Height (cm)	171.7 ± 10.1	162.1 ± 5.8	<0.001
Waist circumference (cm)	83.3 ± 14.9	76.7 ± 21.7	<0.001
Hip circumference (cm)	96.2 ± 16.9	88.5 ± 23.9	<0.001
Body Mass Index (kg/m^2)	25.7 ± 5.9	26.8 ± 4.7	<0.001
n (%)			
Educational level			
High school or less	511 (49.2)	798 (60.0)	<0.001
Diploma	192 (18.5)	213 (16.0)	
University level or higher	335 (32.3)	319 (24.0)	
Work Status			
No work	502 (48.2)	1148 (86.2)	<0.001
Work	539 (51.8)	184 (13.8)	
Marital Status			
Married	793 (75.7)	975 (71.9)	<0.001
Single	185 (17.7)	179 (13.2)	
Widow	51 (4.9)	169 (12.5)	
Divorced	19 (1.8)	33 (2.4)	
Smoking Status			
Smoker	763 (73.2)	433 (33.3)	<0.001
Non-Smoker	87 (8.3)	276 (21.2)	
Negative Smoker	59 (5.7)	459 (35.3)	
Ex-Smoker	134 (12.8)	131 (10.1)	
Daily Physical Activity			
No	793 (75.5)	1163 (85.7)	<0.001
Yes	241 (22.9)	184 (13.6)	
None	17 (1.6)	10 (0.7)	

*p<0.05 is considered significant. BMI: body mass index.

16.5%, respectively), followed by dinner (13.0% and 15.3%, respectively). This was supported by the fact that 62.0% of healthy and 64.7% of diseased participants reported consuming three meals daily. Healthy participants reported a higher prevalence of consuming two meals (31.5%) and a lower consumption of one meal (0.9%) than diseased participants (27.9% and 2.1%, respectively, p = 0.020).

Meal frequency and eating behavior based on sex, as illustrated in Table 3, reported similar results of the total population regarding skipping meals, except for females, where healthy females reported a higher prevalence of skipping breakfast (21.5% vs. 15.5% for diseased) ، and diseased females reported a higher prevalence of skipping dinner (18.5% vs. 12.9% for healthy). Based on sex (Table 3), both males and females,

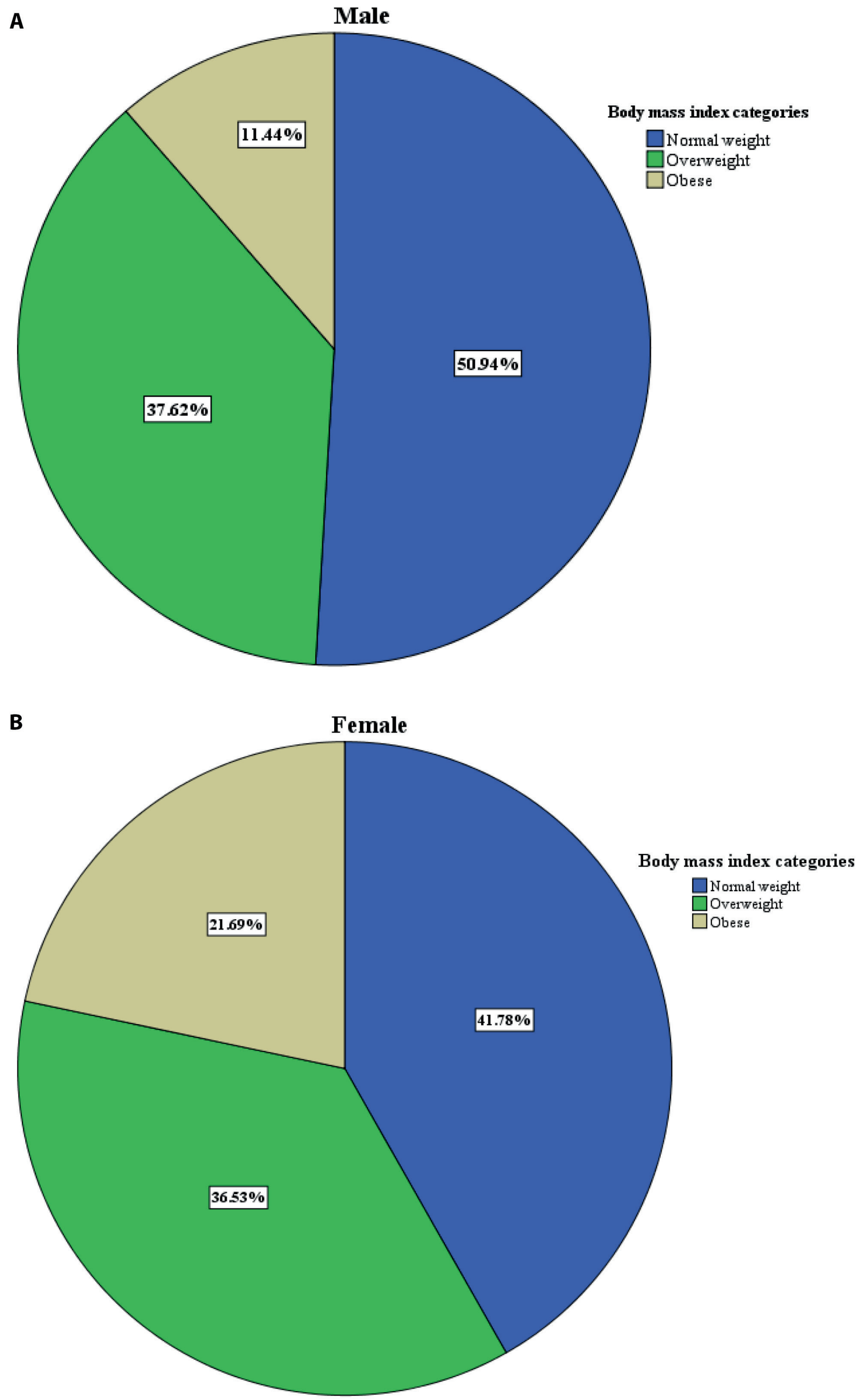

Figure 1. Body Mass Index Categories by Sex.

Table 2. Meal frequency and eating behavior among the study population based on having diseases.

	Having Disease		
	No	**Yes**	***p*-value***
Skipped Meal n (%)			
Dinner	179 (13.0)	152 (15.3)	0.141
Lunch	18 (1.3)	9 (0.9)	
Breakfast	265 (19.3)	164 (16.5)	
I don't skip meals	911 (66.4)	666 (67.2)	
Number of Meals			
one meal	12 (0.9)	21 (2.1)	0.020
two meals	436 (31.5)	277 (27.9)	
three meals	858 (62.0)	642 (64.7)	
> three meals	78 (5.6)	52 (5.2)	
Number of Snacks			
one snack	280 (20.8)	224 (22.5)	0.349
two snacks	565 (40.9)	382 (38.4)	
three snacks	286 (20.7)	218 (21.9)	
four snacks	36 (2.6)	15 (1.5)	
> four snacks	15 (1.1)	13 (1.3)	
No snacks	193 (14.0)	142 (14.3)	
Late Food Intake			
Yes	305 (22.8)	205 (21.3)	0.369
No	1035 (77.2)	759 (78.7)	
Fast Food Consumption			
none	225 (16.4)	302 (30.8)	<0.001
Less than once /week	208 (15.2)	191 (19.5)	
1-5 times/week	924 (67.4)	486 (49.6)	
once daily	13 (0.9)	1 (0.1)	
twice or more daily	2 (0.1)	0 (0.0)	
Most Consumed Food Group			
legumes	39 (2.8)	22 (2.2)	<0.001
Cereals	893 (64.8)	604 (60.8)	
Dairy products	31 (2.2)	17 (1.7)	
Vegetables	69 (5.0)	102 (10.3)	
Fruits	33 (2.4)	26 (2.6)	
Protein	313 (22.7)	223 (22.4)	
Most Missed Food Group			
legumes	323 (23.4)	251 (25.4)	<0.001
Cereals	64 (4.6)	44 (4.5)	
Dairy products	662 (48.0)	405 (41.0)	
Vegetables	111 (8.1)	75 (7.6)	
Fruits	98 (7.1)	47 (4.8)	
Protein	120 (8.7)	165 (16.7)	

*$p<0.05$ is considered significant.

Table 3. Meal frequency and eating behavior among the study population based on having diseases and based on sex.

	Males			Females		
	Having Disease			Having Disease		
Variables	**No**	**Yes**	***p*-value***	**No**	**Yes**	***p*-value***
Skipped Meal n (%)						
Dinner	83 (13.3)	43 (10.8)	0.240	96 (13.9)	109 (18.5)	0.004
Lunch	10 (1.6)	2 (0.5)		8 (1.1)	7 (1.2)	
Breakfast	104 (16.6)	72 (18.0)		160 (21.5)	91 (15.5)	
I don't skip meals	429 (68.5)	283 (70.8)		481 (64.6)	381 (64.8)	
Number of Meals						
one meal	3 (0.5)	5 (1.2)	0.078	9 (1.2)	16 (2.7)	0.149
two meals	179 (28.3)	88 (21.8)		256 (34.1)	189 (32.1)	
three meals	420 (66.5)	287 (71.6)		437 (58.3)	352 (59.9)	
> three meals	30 (4.7)	21 (5.2)		48 (6.4)	31 (5.3)	
Number of Snacks						
one snack	130 (20.6)	75 (18.6)	0.574	157 (21.0)	149 (25.3)	0.246
two snacks	252 (39.9)	153 (38.0)		312 (41.7)	228 (38.8)	
three snacks	156 (24.7)	117 (29.0)		130 (17.4)	100 (17.0)	
four snacks	15 (2.4)	7 (1.7)		21 (2.8)	8 (1.4)	
> four snacks	8 (1.3)	8 (2.0)		7 (0.9)	5 (0.9)	
No snacks	71 (11.2)	43 (10.7)		122 (16.3)	98 (16.7)	
Late Food Intake						
Yes	141 (23.1)	82 (21.2)	0.485	164 (22.6)	121 (21.0)	0.512
No	470 (76.9)	305 (78.8)		563 (77.4)	454 (79.0)	
Fast Food consumption						
none	103 (16.5)	105 (26.4)	0.001	122 (16.4)	197 (34.0)	<0.001
Less than once/week	86 (13.8)	53 (13.4)		122 (16.4)	138 (23.8)	
1-5 times/week	423 (67.8)	238 (60.0)		499 (66.9)	245 (42.2)	
once daily	11 (1.8)	1 (0.3)		2 (0.3)	0 (0.0)	
twice or more daily	1 (0.2)	0 (0.0)		1 (0.1)	0 (0.0)	
Most Consumed Food Group						
legumes	13 (2.1)	8 (2.0)	0.001	26 (3.5)	14 (2.4)	0.137
Cereals	413 (65.5)	242 (60.2)		478 (64.2)	359 (61.0)	
Dairy products	18 (2.9)	8 (2.0)		13 (1.7)	9 (1.5)	
Vegetables	25 (4.0)	45 (11.2)		44 (5.9)	57 (9.7)	
Fruits	6 (1.0)	6 (1.5)		27 (3.6)	20 (3.4)	
Protein	156 (24.7)	93 (23.1)		157 (21.1)	130 (22.1)	
Most Missed Food Group						
legumes	154 (24.5)	91 (22.7)	<0.001	169 (22.6)	160 (27.4)	0.001
Cereals	31 (4.9)	15 (3.7)		33 (4.4)	29 (5.0)	
Dairy products	312 (49.7)	164 (40.9)		349 (46.7)	239 (41.0)	
Vegetables	41 (6.5)	39 (9.7)		69 (9.2)	36 (6.2)	
Fruits	51 (8.1)	24 (6.0)		47 (6.3)	22 (3.8)	
Protein	39 (6.2)	68 (17.0)		81 (10.8)	97 (16.6)	

*$p<0.05$ is considered significant.

regardless of their health status, had a high prevalence of consuming two to three meals per day. Regarding the number of snacks among the total population (Table 2) or by sex (Table 3), most study participants, whether healthy or diseased, reported consuming one to three snacks and not eating late-night food.

Fast food consumption was reported more frequently, 1-5 times per week, among participants, with a higher prevalence among healthy participants (67.4%) compared to those with disease (49.6%) ($p < 0.001$). Additionally, diseased participants reported a higher prevalence of non-consumption of fast food (30.8% vs. 16.4% for healthy participants). Similar results based on sex were reported (Table 3); males and females, regardless of whether they had the disease or not, reported a high prevalence of 1-5 times/week frequent consumption of fast food (males: 67.8% for healthy and 60.0% for diseased, p=0.001; females: 66.9% for healthy and 42.2% for diseased, p<0.001). These results suggest that having diseases altered the population's eating habits, leading to a decrease in fast-food consumption.

From the food group based on MyPlate, the most consumed group by both healthy and diseased participants was cereals (64.8% for healthy and 60.8% for diseased), followed by the protein group (22.7% for healthy and 22.4% for diseased). In addition, participants in the disease group reported a significantly higher consumption of vegetables (10.3%) compared to healthy participants (5.0%, $p < 0.001$) (Table 2). Male and female participants reported similar results for the total study population, with the most consumed group being cereal (Males: 65.5% for healthy and 60.2% for diseased; Females: 64.2% for healthy and 61.0% for diseased) followed by protein (Males: 24.7% for healthy and 23.1% for diseased; Females: 21.1% for healthy and 22.1% for diseased) and higher consumption of vegetables by diseased participants than the healthy participants in both sexes (Table 3). The most missed or under-consumed food group, based on MyPlate, for the total study population (Table 2), was dairy products (48.0% for healthy and 41.0% for diseased), followed by legumes (23.4% for healthy and 25.4% for diseased). Although the protein group was one of the most consumed groups by participants, it was still one of the food groups with a high prevalence of being unconsumed by participants with disease (16.7%). The same trend was observed in both male and female participants, who reported a high prevalence of missing dairy products, followed by the legumes group (Males: 24.5% for healthy and 22.7% for diseased; Females: 22.6% for healthy and 27.4% for diseased). The consumption of dairy products was reported to be higher among healthy males and females (49.7% for males and 46.7% for females) compared to those with diseases (40.9% for males and 41.0% for females).

The distribution of primary meal timing among the study population is presented in Table 4. Regarding the breakfast meal, 51.3% of healthy and 47.1% of diseased participants were non-morning eaters who had breakfast after 9:00 a.m., which may indicate that having the disease affects breakfast meal timing, resulting in an earlier start. Almost all healthy and diseased participants reported having lunch between 1:00 and 6:00 p.m. About dinner, 55.5% of healthy and 60.4% of diseased participants had dinner between 6:00 and 9:00 p.m. Nevertheless, 32.9% of healthy participants reported night eating after 9:00 p.m., which is higher than the prevalence among diseased participants (26.6%, $p = 0.004$). Regarding males, 51.5% of healthy and 46.2% of diseased male participants reported being non-morning eaters. However, at the same time, 44.7% of diseased males and 37.4% of healthy males were also reported to be morning eaters. Nearly all healthy males (91.9%) and those with disease (94.3%) had lunch between 1:00 and 6:00 p.m. However, diseased females had a higher percentage of morning eating (41.8%) compared to healthy females (34.1%, $p = 0.005$). Both healthy and diseased females had a prevalence of having lunch between 1:00 and 6:00 p.m. (93.2% and 94.6%, respectively) and dinner between 6:00 and 9:00 p.m. (57.3% and 63.3%, respectively). However, healthy females still reported a higher percentage of night eating (30.4%) than diseased females (21.7%, $p = 0.001$).

Discussion

Most chronic illnesses, such as T2D and CVD, require significant dietary changes as part of their

Table 4. Distribution of main meal timing among the study population**.**

Meals	Having Disease		*p*-value*
	No	Yes	
Total n(%)			
Time of breakfast intake			
Morning eating	493 (35.6)	426 (42.8)	0.001
Non-morning eating	710 (51.3)	469 (47.1)	
Skipping breakfast	182 (13.1)	100 (10.1)	
What time do you have lunch?			
Between 1:00 and 6:00 p.m.	1283 (92.6)	939 (94.4)	0.004
Evening eating (After 6:00 p.m.)	50 (3.6)	14 (1.4)	
Skipping lunch	52 (3.8)	42 (4.2)	
What time do you have dinner?			
Between 6:00 and 9:00 p.m.	769 (55.5)	601 (60.4)	0.004
Night eating (After 9:00 p.m..)	456 (32.9)	265 (26.6)	
Skipping Dinner	160 (11.6)	129 (13.0)	
Males			
Time of breakfast intake			
Morning eating	237 (37.4)	180 (44.7)	0.065
Non-morning eating	326 (51.5)	186 (46.2)	
Skipping breakfast	70 (11.1)	37 (9.2)	
What time do you have lunch?			
Between 1:00 and 6:00 p.m.	582 (91.9)	380 (94.3)	0.002
Evening eating (After 6:00 p.m.)	26 (4.1)	2 (0.5)	
Skipping lunch	25 (3.9)	21 (5.2)	
What time do you have dinner?			
Between 6:00 and 9:00 p.m.	337 (53.2)	227 (56.3)	0.622
Night eating (After 9:00 p.m..)	228 (36.0)	136 (33.7)	
Skipping Dinner	68 (10.7)	40 (9.9)	
Females			
Time of breakfast intake			
Morning eating	256 (34.1)	246 (41.8)	0.005
Non-morning eating	383 (51.1)	281 (47.7)	
Skipping breakfast	111 (14.8)	62 (10.5)	
What time do you have lunch?			
Between 1:00 and 6:00 p.m.	699 (93.2)	557 (94.6)	0.414
Evening eating (After 6:00 p.m.)	24 (3.2)	12 (2.0)	
Skipping lunch	27 (3.6)	20 (3.4)	
What time do you have dinner?			
Between 6:00 and 9:00 p.m.	430 (57.3)	373 (63.3)	0.001
Night eating (After 9:00 p.m..)	228 (30.4)	128 (21.7)	
Skipping Dinner	92 (12.3)	88 (14.9)	

*$p<0.05$ is considered significant.

treatment. These therapeutic dietary changes typically involve making healthier, more nutrient-dense food choices and, in most cases, additional modifications to the patient's eating behaviors to align their dietary intake with their medications. In the current study, most healthy or diseased participants consumed three meals daily. Additionally, most study participants, whether healthy or suffering from an illness, reported consuming one to three snacks daily. Food frequency, which refers to the frequency of food consumption, is associated with an increased risk of chronic diseases (11). Many studies documented this relationship and suggested modifying behavior to minimize the risk or prevent chronic diseases. At the same time, eating fewer than three meals daily was reported to be associated with being overweight or obese (24). Furthermore, Alkhulaifi and Darkoh suggested that eating frequent meals may protect against MetS (11). In another study, Titan et al. discovered that eating more than six meals per day was associated with lower levels of total and low-density lipoprotein (LDL) cholesterol, with a difference of 0.25 mmol/L (25). Additionally, Tąpolska et al. reported that consuming more than four meals per day effectively increases high-density lipoprotein (HDL) cholesterol and lowers fasting triglycerides (TG); thus, higher levels of HDL and lower TG are associated with a reduced risk of heart disease (26). On the other hand, compared to people who ate three meals a day, individuals who consumed only one meal had higher fasting plasma glucose levels and reduced morning glucose tolerance (27). Most published papers categorize meals and snacks together as meals, whereas the present study divides them into two categories. Regarding the current study results, we do not know if the participants' frequent meal consumption behavior was taught as part of their therapy or if it developed due to their chronic illness diagnosis. Ultimately, people act healthily; thus, either of these explanations is true. Fortunately, whether healthy or not, two-thirds of the participants in the current study did not skip their meals. Nonetheless, among the meal skippers, breakfast is the most skipped meal. Participants with chronic illnesses tend to skip breakfast less than individuals in good health, demonstrating that they engage in healthier behaviors. Meal skipping has generated much discussion in recent years. Although irregular mealtimes have become a common practice recently, their impact on health is of concern, especially when skipping breakfast. In contrast to our results, Khusun et al. (28) reported that only 5.2% of Indonesian adults skipped breakfast. A systematic literature review by Pendergast et al. found that meal skipping (of any meal) was reported in 12 of 35 studies, with a prevalence ranging between 5% and 83%. Breakfast was the most frequently ignored meal, ranging from 14% to 88%, compared to lunch and dinner (29). Additionally, Zeballos and Todd documented that skipping breakfast or lunch has a more significant adverse effect on one's diet than skipping dinner (30). Furthermore, skipping breakfast (hazard ratio (HR): 1.13, 95% confidence interval (CI): 1.03-1.23) was associated with a 3-point increase in major adverse cardiovascular events, leading to the conclusion that dietary behavior is a potential risk factor for incident CVD in Japanese people (31). Earlier, Ofori-Asenso and colleagues had systematically reviewed multiple studies and stated that people who frequently skip breakfast are about 21% more likely than those who regularly eat it to experience an incident of CVD or die from it (HR: 1.1.08- 1.351.08-1.35; I2 = 17.3%, p = 0.34). Additionally, the risk of all-cause death was 32% greater in those who routinely skipped breakfast compared to those who consistently ate it (HR:1.32, 95% 1.17- 1.48; I^2 =7.6%, p = 0.339) (32). According to Ballon et al.'s comprehensive review and meta-analysis, which included 96,175 individuals and 4,935 cases, the summary relative risk (RR) for type 2 diabetes (T2D) comparing skipping breakfast occasionally with never skipping was 1.33 (95% CI: 1.22, 1.46, n = 6 studies). Additionally, the nonlinear dose-response meta-analysis revealed that skipping breakfast increased the risk of T2D with each additional day, reaching a peak risk of 55% at day 5 (summary RR: 1.55; 95% CI: 1.41, 1.71), supporting the findings of Ballon et al. that breakfast skipping increases the risk of T2D (33). Surprisingly, Ogata et al. discovered that when breakfast was skipped, plasma-free fatty acid (FFA) levels were significantly higher after lunch, and this relationship between FFA levels and the postprandial glycaemic response was positive (r = 0.631, p < 0.01). In summary, skipping breakfast just once can lead to postprandial hyperglycaemia and an altered insulin response after lunch (34). Regarding sex-specific MetS and its components, Park et al. documented that men who ate two meals a day had a higher risk of MetS than men who ate three meals a day (odds ratio (OR):1.16, 95% CI:1.01–1.33), while women who ate two meals a day and skipped breakfast had a higher risk of having high fasting blood glucose levels (OR:1.18, 95% CI:1.02–1.35), and elevated triglycerides (OR:1.19, 95% CI:1.02–1.39). They hypothesized that meal frequency and the type of significant meal skipped might be related to MetS and addressed the significance of eating breakfast in preventing MetS (35). Thankfully, they noted that our study's diseased participants' behaviors regarding meal skipping in general and breakfast skipping specifically are promising for the future, hopefully continuing to stop or prevent their illness consequences. Notably, in the current study, most healthy and diseased participants reported that they did not consume late-night food. Diseased participants preferred to eat in the morning and consumed fewer meals at night than healthier participants. These findings supported the hypothesis that individuals with diseases may adjust the timing of their breakfast meals and shift their bedtimes earlier to accommodate the frequency of their medication intake. It has been established that appetite-regulating hormones and energy metabolism in the body are regulated by circadian rhythms, which, when disrupted, can potentially have unfavourable metabolic consequences (36). There has been a connection between this circadian misalignment and obesity (36-38), CVD (7, 39), MetS (11, 14), high blood pressure (39, 40), and T2D (39). Studies have shown that eating later in the day and closer to bedtime is linked to a better weight status and an elevated risk of adverse weight consequences (37, 39), highlighting the timing of food intake as a key focus of research efforts. In line with our results, Mirghani reported that 20% of his study's participants ate late at night (compared to 21.5% of our diseased participants), and also found a direct relationship between eating dinner late, BMI, and HbA1c (Wald, 4.210, 95% CI, 0.743-0.993, P-value, 0.04 for HbA1c, and Wald, 6.777, 95% CI, 1.0221-1.165, p-value, 0.009 for BMI) (41). According to Zhang et al.'s hypothesis, the velocity change rate between the group that ate at night most days and the group that never or rarely ate at night was 14.1 (95% CI, 0.6-27.5) cm/s per year in an adult population free of major chronic diseases. Arterial stiffness is a sign of arteriosclerosis and biological aging (42). Furthermore, as compared to early eaters, late eaters had a lower average weekly rate of weight loss (505 (467) g/wk vs. 585 (667) g/wk; p = 0.008), higher odds of having weight-loss barriers (OR (95% CI): 1.22 (1.03, 1.46; p = 0.025), and lower odds of being motivated to lose weight (0.81 (0.66, 0.99); p=0.044). Eating late is associated with increased cardiometabolic risk factors and reduced effectiveness of weight-loss interventions (39). Indeed, several researchers have demonstrated that individuals who eat their meals earlier in the day experience more significant weight loss than those who eat the same meal later in the day (3, 7, 37). Meal timing studies, while there is universal agreement that a meal consists of a certain amount of food consumed at a particular time (11), many cultures worldwide have different mealtime traditions. The lack of a uniform method for defining meal timing has been a critical obstacle (37). However, clock time has been utilized in numerous studies to describe the timing of food consumption. According to Eom et al., eating breakfast, lunch, and dinner simultaneously every day may boost the success of weight loss. A significant determinant of the amount of weight loss was mealtime regularity at breakfast (model 1: $\beta = -2,576.526$, $p < 0.001$), lunch (model 2: $\beta = -1,511.447$, $p < 0.05$), and dinner (model 3: $\beta = -1,721.428$, $p < 0.05$). They also noted that eating regularly is frequently more successful than substantially reducing calorie intake (43). Surprisingly, most participants in the present study who had a chronic illness ate regular meals at established times and continued to practice healthier behaviors. Although participants in this study consumed fast food more frequently (1–5 times per week), healthy participants consumed it more regularly than those with diseases. Additionally, those with diseases reported a higher prevalence of not eating fast food. These findings suggest that the eating behaviors of participants with the disease, regarding reduced fast-food consumption, have been modified. Considering the aforementioned research on meal timing, it is essential to carefully assess the quantity and type of food consumed at each meal. A growing body of research indicates that fast food consumption is a vital factor for nutrition and may be a significant factor in obesity and its related comorbidities. Furthermore, fast food is often nutritionally poor and high in calories (44). Even in previously metabolically fit individuals, Mirmiran et al. hypothesized that eating fast food could be linked to unhealthy phenotypes that included more than one component of MetS (45). Moreover, during the last decades, numerous studies have assessed the effect of fast food consumption on health and found that individuals who consume it regularly were more likely at risk for developing obesity (46, 47), insulin resistance with or without incidence of T2D (48), CVD (49), elevated blood pressure (49, 50), and MetS (51). Odegaard et al.'s study, which included follow-up data on Singaporean women, found that eating fast food ≥ 2 times per week increased the risk of developing type 2 diabetes (HR= 1.27, 95% CI= 1.03-1.54) and dying from coronary heart disease (HR = 1.56, 95% CI= 1.18-2.06)(48). According to Hosseini et al., eating a "fast-food" diet was associated with a 26% increased risk of having MetS (OR = 1.26; 95% CI: 1.04-1.54; $p = 0.0195$) (52). On the other hand, Mohammadbeigi et al. demonstrated that fast food intake was associated with abdominal obesity, as measured by the waist-to-hip ratio (WHR) (OR: 1.46, 95% CI: 1.11-2.26). Additionally, they found that obesity and overweight are prevalent among Iranian students (46). Undeniably, weight and its associated comorbidities are influenced by both meal composition and timing. Cereals were the food category that healthy and diseased participants consumed the most in the present research sample, followed by protein. The amount of vegetables consumed by participants with the disease was significantly higher than that of healthy individuals. Despite being one of the food groups that participants consumed the most, protein was one of the food groups that participants with diseases were least likely to consume. Regarding cereals, Belobrajdic and Bird documented that diets high in whole grains are associated with a 20-30% reduction in the risk of developing type 2 diabetes (T2D) (53). This finding is somewhat consistent with our observation that participants with disease consumed cereals more frequently than healthy participants, although we did not study the specific types of cereals. According to Amiot-Carlin, consuming up to 800 g of fruit and vegetables per day and up to 600 g daily can lower the risk of developing CVD and cancer, respectively. Interestingly, increasing the amount of fruits and vegetables by one serving daily decreases the risk of CVD (54). A meta-analysis of 11 prospective cohort studies with a total of 64,306 deaths among 350,452 participants confirmed the findings for total and animal protein intake: higher total protein intake was linked to higher all-cause mortality (pooled RR for highest versus lowest quantile: 1.05 (1.01, 1.10); and an association between animal protein and CVD mortality (RR: 1.09 (1.01, 1.18)]. A higher intake of plant protein was also linked to lower all-cause and CVD mortality in the meta-analysis [RR: 0.93 (0.87, 0.99) and for CVD mortality [RR: 0.86 (0.73, 1.00) (55). However, Pfeiffer and colleagues noted that other studies comparing various animal proteins or contrasting animals with plant proteins in diabetic patients found that plant protein resulted in a more significant reduction in blood cholesterol (56). Unfortunately, we did not distinguish between the source of the eaten protein in this investigation. Therefore, we proposed that this would explain why this food group was the most and least consumed among people with diseases. Dietary changes for chronic diseases typically recommend consuming fewer servings of animal protein to reduce the concentration of saturated fat found in them, while emphasizing plant-based proteins that are low in saturated fat. Indeed, the results of this study confirmed that dairy products were the most neglected or underutilized food group. According to scientific evidence, milk and dairy products help people meet nutrient guidelines and may prevent most chronic diseases (57, 58). Additionally, Quann et al. hypothesized that increasing the population's consumption of dairy products to recommended levels is a realistic dietary modification that could significantly enhance the population's sufficiency of certain under-consumed nutrients with beneficial health effects (59). A higher total dairy intake-related metabolite profile score was associated with a lower T2D risk [HR per 1 SD; Spanish: 0.76 (95% CI, 0.63-0.90); US: 0.88 (95% CI, 0.78-0.99)] according to Drouin-Chartier et al. based on 38 identified metabolites (60). Feng et al. found a linear relationship between total dairy, milk, and yogurt consumption and the risk of being overweight or obese. For each 200 g/d increase in total dairy, high-fat dairy, and milk, the risk fell by 25%, 7%, and 12%, respectively. The risk decreased by 13% for yogurt for every 50 g/d increase. Also, a nonlinear relationship between total dairy consumption and hypertension was established, although significant inverse associations were reported for low-fat dairy (RR: 0.94; 95% CI: 0.90, 0.98) and milk (RR: 0.94; 95% CI: 0.92, 0.97) per increase in intake of 200 g/d (61). However, despite the presence of saturated fat, a body of observational and clinical evidence suggests that consuming whole-milk dairy products does not increase the risk of cardiovascular disease (62). Therefore, we assume that consuming dairy products at levels below the recommended amount is a harmful behavior among our participants.

Strengths and limitations

The strength of the present study lies in its application to a free-living population, making it straightforward for individuals with chronic illnesses who wish to improve their health to apply the findings. Our analysis is constrained by the fact that the dietary evaluation in this study only examined the assumed daily nutritional intake in the previous twelve months using FFQ, not the dietary composition at each meal. Knowing the type, quantity, and timing of food intake is necessary. Additionally, in this study, using clock time was crucial for characterizing the timing of food intake. However, this method falls short of accurately describing meal timing in the context of the internal circadian timing system. It should also be highlighted that the study's data on eating behaviors were self-reported and should be assessed with greater objectivity. Future cohort studies examining the relationships between eating behaviors and disease incidence are necessary to capture accurate information on the temporal relationship between meals and disease incidence. There is encouraging evidence that adjusting the time of day when meals are eaten can help individuals with chronic diseases manage their condition more effectively. At the same time, further study is needed to determine whether this approach also serves as a preventive dietary strategy in healthy individuals.

Conclusion

In conclusion, the overall study analysis suggests that the Jordanian population has undergone a shift toward adopting healthier dietary behaviors—Jordanian adults suffering from chronic diseases tend to adhere to more healthful eating behaviors than their disease-free counterparts. Our findings thus confirm our original theory that having persistent medical conditions causes patients to become more aware of and concerned about their health, leading them to modify all their eating behaviors. Nevertheless, a sizable portion of the study's participants did not consume dairy products, which is considered a potentially negative behavior and should be taken into account.

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