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Correlates of Snacking with Stress and Depression in Obese and Non-obese Women

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Abstract

Background: The prevalence of obesity has steadily increased and now more than 50% of adults have obesity. The relation between obesity, psychological factors and snack consumption has been debated for decades.

Objective: Our study was conducted to investigate the relation between snacking with stress/depression among separate groups of obese and non-obese women.

Method: In this case-control study, 46 obese and 94 normal weight women, aged 17-44, were recruited using a convenience random sampling method. Participants completed the Beck Depression Inventory II, Depression Anxiety Stress Scale and food frequency questionnaires. Descriptive statistics and logistic regression were used for analysis.

Results: The adjusted odds ratio (OR) of obesity increased across tertiles of fresh fruits (OR: 14.1, 95% CI: 2.8-71.3). The adjusted OR of stress increased across tertiles of fruit juices (OR: 0.04, CI: 1.3-19.8) and the adjusted OR of depression decreased significantly in the third as compared to the first tertile of fresh fruits in the control group (OR: 0.03, 95% CI: 0.03-0.8).

Discussion: Fruit consumption increases the odds of obesity. The relation between snacks consumed and stress/depression is body weight dependent.

Keywords: Snack pattern; Obesity; Stress; Depression

Introduction

Obesity is one of today's most serious public health problems. The rising incidence of obesity in populations around the world suggests that certain environmental factors, such as lack of physical activity and poor dietary quality, are responsible for this epidemic [1]. Chronic psychological distress has been recently found to be an associated factor contributing to this problem [2]. However, based on non-clinical research, obese individuals do not differ from non-obese subjects with reference to psychological symptoms, psychopathology, or personality [3,4]. Furthermore, depressive symptoms can be magnified by stress and reinforce unhealthy dietary patterns that can cause greater psychological distress [5,6]. The relationship between psychological distress may be bidirectional; obesity may play a role in depression due to negative body image and social stigma [7]. Obese individuals report stress and depressive symptoms as psychological contributors influencing eating behaviors and food selections [8]. For some people, stress and depression may contribute to weight gain, whereas for others these psychological distress factors may lead to loss of weight [8,9].

According to previous studies, eating can be considered as a mechanism to cope with stress and emotions by either under-eating or over-eating [10]. Moreover, some investigations have shown that food choice can also be considered as a deliberate strategy to modify temperament and mood [11]. However, some other studies have revealed that dietary composition had no effect on mood and behavior [12].

Laboratory and self-report studies have demonstrated that the eating response of individuals to stress differs by gender, body weight and eating style variables, including restraint, emotional eating, external eating and disinhibition [13]. Among stress-driven eaters, Body Mass Index (BMI) tends to be greater compared to non-stress-driven eaters [14].

It is also shown that snacking can develop under both experimental stress and free living condition stress [15]. However, not all studies that investigated the relationship between energy intake and stress have resulted in conclusive outcomes [11].

It is shown that depression is associated with an increase in appetite, excess food intake, preferences for high-fat and high-carbohydrate foods, excess alcohol intake, and higher BMI in women [8].

The interpretation of the results of unpleasant emotion on food intake is more difficult because of the controversial findings related to moods and food consumption. Moreover, most of the studies were conducted with clinical or subclinical populations [11] and in laboratory settings which are limited to the testing of acute stressors, and not to chronic stressors. The latter may possibly have a greater impact on eating behavior [16].

Less is known about stress or depression and consumption of different snacks in non-laboratory settings, especially among women. We were interested in which categories of snack foods contribute to stress and depression and how closely the type of snack foods was correlated with stress and depression among Iranian women.

The current study was conducted to investigate the relation between the type of snack consumed and obesity. We also assessed whether the

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relationship of stress and depression to snack consumption outside the laboratory differs between obese and non-obese Iranian women.

Method

Participants

This case-control study was conducted on a sample of Tehrani women that had associated with the obesity club in district 4 of Tehran. In all, 140 healthy women (46 obese and 94 lean) were recruited using convenience sampling. Controls were matched with cases based on age. Age ranged from 17 to 44. We applied exclusion criteria to minimize any confounding factors connected with the relationship of obesity to psychological traits and dietary intake. Exclusion criteria were: a current habit of smoking; regular use of alcohol or medications, of antidepressants, oral contraceptives or hormonal drugs; recent or current history of cardiovascular disease, diabetes, an endocrine disorder, or any other self-reported significant disease; pregnancy, lactation, menopause, history of current or active dieting and the use of medications affecting neuro-endocrine functions, metabolism, or appetite. To assess the presence of any of these exclusion criteria, we relied on self-reporting in a face-to-face interview. To ensure that weight was measured with high validity, participants were required to have a history of stable weight (no weight change of more than 3 kg in the past four months) and not be taking weight-altering medications. Participants were engaged in physical activity for 30 minutes or more, 3 days per week.

The present study was approved by the Ethics Committee of the National Nutrition and Food Technology Research Institute, Iran. A signed hand-written informed consent was obtained from each individual before data collection.

Measurements

Assessment of Dietary intake

Trained dietitians gathered the dietary data using a validated 168-item semi-quantitative Food Frequency Questionnaire (FFQ) that was modified to include Iranian food items. This FFQ has shown relative validity and reproducibility for several nutrient intakes among Iranian adults [17]. The FFQ, included a list of foods (with standard serving sizes) usually consumed by Iranians. The reported frequency for each food item was then converted to a daily intake. Portion sizes of foods consumed were converted to grams by using household measures.

The snack food items included in the FFQ were categorized into seven snack food groups based on Iranian dietary habits: fresh fruits; fruit juices; nuts and seeds (such as peanut, almond, walnut); sweet beverage (such as syrup, soda or chocolate milk); salty snacks (such as crackers, puffs); sweet snacks (such as biscuits, cakes, pastries, chocolates) and fast food (like hamburger, sausage). Table 1 shows the food items categorized into the seven snack groups. Dietary habits of cases and controls during one year before the interview were collected. Since the Iranian food composition table (FCT) is not comprehensive (being limited to only raw foods and a few nutrients), each food and beverage was analyzed for energy intake using the US Department of Agriculture's (USDA) FCT [17].

To account for possible under-reporting of energy intake, Energy Intake (EI) to Basal Metabolic Rate (BMR), was calculated (EI/BMR) for each individual and used as a control variable in regression modeling. Estimates of BMR were calculated from standard equations, which relied on weight, age, and sex [18]. An EI: BMR<1.35 was considered to show under-reporting and an EI: BMR ≥ 2.4 as over-reporting of EI [19].

Food Groups	Food Items
Fresh fruits	Cantaloupe, Persian melon, watermelon, pear, apricot, apple, cherry, peach, nectarine, green plum, fig, grapes, kiwi, grapefruit, orange, persimmon, tangerine, pomegranate, dates, prune (yellow and red), sour cherry, strawberry, banana, sweet lemon, lime lemon, mulberry, dried fruits (fig, mulberry, peach and apricot), cranberry, pineapple (raw and canned), Lime juice, Raisins, Canned fruits
Fruit juices	grapefruit, orange, apple and cantaloupe
Nuts and dried fruits	Peanut, almond, walnut, pistachio, hazelnut, dried apricot, dried peach, dried figs, dried berries
Sweet beverage	All soft and sweet drinks, beer (non-alcoholic), syrup, cocoa and chocolate milk
Salty snacks	Pickles in vinegar and salty vegetables, Salted pickles, Puffs, crackers, corn
Sweet snacks	Sponge cake, other cakes, Yazdi cake (plain cake with rasins), chocolates, pastries (non-crème and creamy), all biscuits other than those made from whole grain, crackers, patties, Gaz, Sohan,, crème caramel, halvah (homemade and non-homemade), Ice cream (plain and traditional (high fat), honey, jams, sugar, cube sugar, Noghl, and candy, Canned fruits
Fast food	hamburger, sausage, potato chips, French fries

Table 1: Food Items categorized into Seven Snack Food Groups.

Assessment of anthropometric measurements

Measurements were obtained in the morning before breakfast. Body weight was measured to the nearest 100 grams, without shoes, while wearing light clothes. Height was measured to the nearest mm, without shoes. Obesity was defined as BMI ≥ 30 kg/m^2. BMI was calculated as weight (kg) divided by the square of height (m) [20].

Assessment of physical activity (PA)

A validated, self-reported-based inventory [21] was used for data collection and was expressed as Metabolic Equivalents (MET) hour/day (METs-h/d) in which nine different MET levels and questions on level of physical activity at work were ranged on a scale from sleep/rest (0.9 METs) to high intensity physical activities (≥ 6 METs). The Met-time was calculated by multiplying time spent on each activity level by the MET value of each level.

We corrected the self-reported time to 24 h per day, by adding the missing hours or subtracting over-reported hours. This 'correction time' was multiplied by the intensity factor of 2.0 MET, according to the mean of self-care=walking at home (2.5 MET) and sitting (eating, transportation, etc., 1.5 MET). This correction was based on the assumption that under-estimation of time might be due to these common activities not asked for in the questionnaire.

Depression Anxiety Stress Scale (DASS): The DASS-42 was used to assess the negative emotional symptoms among participants [22]. It is a 42-item self-report questionnaire designed to measure the presence and severity of symptoms of depression, anxiety and stress of an individual. Items on the DASS are rated on 4-point Likert - type, ranging from 0 (Did not apply to me at all) to 3 (Applied to me very much). This screening process and the outcome obtained reflect the experience of the person over the previous week. Persons were considered to be depressed, anxious, or stressed when they answered at least one item with "mild" (score ≥ 10 for depression, score ≥ 8 for anxiety and score ≥ 15 for stress). Afzali et al. [22] have translated the DASS scale into Persian and reported that the DASS has reliable and valid scales for assessing client changes in stress. Cronbach's alpha was 0.9 for the stress subscale of DASS-42, indicating internal consistency reliability of this instrument in measuring stress in this sample.

Beck Depression Inventory II (BDI II)

Depressive symptoms over the previous seven days were measured using the Beck Depression Inventory II (BDI-II), comprised of 21 items, including symptoms and attitudes, each of them comprising four assertions, with intensity levels from 0 (neutral) to 3 (maximum intensity). The BDI-II provides a continuous score of depressive symptoms ranging from 0 to 63, and a cutoff point of 10 or higher shows at least mild symptoms of depression [23]. Cronbach's alpha was 0.88 for the BDI-II, showing internal consistency reliability of this scale in measuring depressive symptoms in this sample. The Persian version of BDI-II was validated by Tashakkori et al. [23].

Eating Attitudes Test (EAT-26)

Abnormal eating attitudes were identified through the Persian version of an eating attitudes test (EAT-26) which was validated by Babaei et al. [24]. In our study, Cronbach's alpha was 0.78 which indicates the good reliability of the test. The items were scored 0-3 (for items 1-25; never, rarely, and sometimes=0, often=1, usually=2, always=3 and for item 26; never=3, rarely=2, sometimes=1, and often, usually, always=0). The EAT-26 total score ranges from 0-78. A cutoff at 20 is used to determine eating disorder cases from non-ED cases.

Additional covariate information including level of education, use of supplements and medical data were collected by self-report.

Statistical analysis

Data were analyzed using SPSS software (version 17; SPSS, Chicago, IL). Statistical significance level was considered at $p<0.05$. Normality of data distribution was tested using the Kolmogorov-Smirnov test. A chi-square test was used to check the differences of distribution of categorical variables. Comparison of means was done with Student's t test or, when the distribution was not normal, with Mann-Whitney U test. The independent association between obesity and psychological factors and snack groups was assessed by using Binary logistic regression analysis in different models controlling for job status in model I, for EAT-26 score in model II and for EI/BMR in model III.

Results

Descriptive characteristics of the participant by case/control status are shown in table 2. The BMI, EI/BMR values and eating attitude test scores had non-normal distribution and Mann-Whitney U test was used for their analyses. The other variables were analyzed with an independent sample *t*-test. The median (± IQR) BMI was 33.5 ± 5.8 in the obese group and 22.5 ± 2.6 in the lean group. Age, physical activity, energy intake, education level, DASS and BDI scores distribution were similar in cases and controls. 52.2% of cases and 20.2% of controls underreported their caloric intake. The percentages of underreporting between cases and controls were significantly different ($p<0.05$).

Distribution of snacks consumed across tertiles by case/control status is shown in table 3. A chi-square test was used for their analyses. In the third tertile of nuts and dried fruits and fruit juices, the percentage of controls was significantly higher than cases, while the percentage of cases was significantly higher than controls in the third tertile of fresh fruits.

Distribution of snacks consumed across tertiles by case/control according to stress level is shown in table 4. The percentage of cases with stress was higher than of those with no stress in the first tertile of salty snacks. The percentage of controls with stress was lower than of those with no stress in the third tertile of fresh fruits. The percentage of controls with stress in the first tertile of fruit juices was lower than in the no stress group. However, these results were not significant. Distribution of snacks consumed across the tertiles, according to depression level, were similar in cases and controls (the data are not shown).

In table 5, odds ratios of obesity and the corresponding 95% Confidence Intervals (CI) across the tertiles of snacks consumed are presented. The crude odds ratio of obesity showed a significant decreasing trend across the tertiles of sweet snacks. In the crude, first

Variables	Cases (n=46)	Controls (n=94)	p
Age[1](y)	30.7 ± 7.3	30.6 ± 7.2	0.93
BMI[2] (kg/m^2)	33.5 (5.8)	22.5 (2.6)	<0.05
Energy intake[1]	2367.2 ± 491.0	2341.0 ± 720.4	0.82
EI/BMR[2]	1.3 (0.4)	1.6 (0.6)	<0.05
Under-reporters (%)	52.2	20.2	<0.05
Physical activity[1] (MET)	36.3 ± 5/0	37.5 ± 6.1	0.24
university degree (%)	37.0	45.7	0.29
Employment status: employed (%)	8.7	27.7	<0.05
BDI-II score[1]	12.1 ± 9.0	9.3 ± 7.4	0.05
DASS score[1]	20.8 ± 10.1	17.8 ± 8.6	0.07
EAT-26 score[2]	16.0(13.2)	10.0(11.5)	<0.05

[1]Values are presented as mean ± SD.
[2]Values are presented as median (IQR).
p<0.05 was considered as significant.
Abbreviations: BMI, body mass index; EI/BMR, energy intake to basal metabolic rate; BDI-II, Beck Depression Inventory-II; DASS, Depression, anxiety, stress scale; EAT, Eating Attitude Test.

Table 2: Characteristics of participants by case/control status.

Food Groups	Cases (n=46)	Controls (n=94)	p
Salty snack			
Tertile 1	14 (30.4%)	32 (34.0%)	0.82
Tertile 2	15 (32.6%)	32 (34.0%)	
Tertile 3	17 (37.0%)	30 (31.9%)	
Sweet snack			
Tertile 1	16 (34.8%)	31 (33.0%)	0.36
Tertile 2	18 (39.1%)	28 (29.8%)	
Tertile 3	12 (26.1%)	35 (37.2%)	
Sweet drink			
Tertile 1	17 (37.0%)	30 (31.9%)	0.42
Tertile 2	12 (26.1%)	35 (37.2%)	
Tertile 3	17 (37.0%)	29 (30.9%)	
Fast food			
Tertile 1	14 (30.4%)	33 (35.1%)	0.15
Tertile 2	12 (26.1%)	35 (37.2%)	
Tertile 3	20 (43.5%)	26 (27.7%)	
Nuts and seeds			
Tertile 1	17 (37.0%)	30 (31.9%)	0.01
Tertile 2	21 (45.7%)	26 (27.7%)	
Tertile 3	8 (17.4%)	38 (40.4%)	
Fresh fruits			
Tertile 1	11 (23.9%)	36 (38.3%)	0.02
Tertile 2	13 (28.3%)	34 (36.2%)	
Tertile 3	22 (47.8%)	24 (25.5%)	
Fruit juices			
Tertile 1	23 (50.0%)	25 (26.6%)	0.008
Tertile 2	15 (32.6%)	32 (34.0%)	
Tertile 3	8 (17.4%)	37 (39.4%)	

[1]Data were analyzed using chi-square test.
p<0.05 was considered as significant.

Table 3: Distribution of snacks consumed across tertiles by case/control[1].

Food Groups	Cases		p	Controls		p
	no stress	with stress		no stress	with stress	
Salty snack						
Tertile 1	2 (14.3%)	12 (37.5%)	0.05	10 (28.6%)	22 (37.3%)	0.58
Tertile 2	8 (57.1%)	7 (21.9%)		14 (40.0%)	18 (30.5%)	
Tertile 3	4 (28.6%)	13 (40.6%)		11(31.4%)	19 (32.2%)	
Sweet snack						
Tertile 1	5 (35.7%)	11 (34.4%)	0.94	13 (37.1%)	18 (30.5%)	0.27
Tertile 2	5 (35.7%)	13 (40.6%)		7 (20.0%)	21 (35.6%)	
Tertile 3	4 (28.6%)	8 (25.0%)		15 (42.9%)	20 (33.9%)	
Sweet drink						
Tertile 1	4 (28.6%)	13 (40.6%)	0.57	11 (31.4%)	19 (32.2%)	0.84
Tertile 2	5 (35.7%)	7 (21.9%)		12 (34.3%)	23 (39.0%)	
Tertile 3	5 (35.7%)	12 (37.5%)		12 (34.3%)	17 (28.8%)	
Fast food						
Tertile 1	4 (28.6%)	10 (31.3%)	0.82	15 (42.9%)	18 (30.5%)	0.35
Tertile 2	3 (21.4%)	9 (28.1%)		10 (28.6%)	25 (42.4%)	
Tertile 3	7 (50.0%)	13 (40.6%)		10 (28.6%)	16 (27.1%)	
Nuts and seeds						
Tertile 1	6 (42.9%)	11 (34.4%)	0.11	9 (25.7%)	21 (35.6%)	0.58
Tertile 2	8 (57.1%)	13 (40.6%)		10 (28.6%)	16 (27.1%)	
Tertile 3	0 (.0%)	8 (25.0%)		16 (45.7%)	22 (37.3%)	
Fresh fruits						
Tertile 1	1 (7.1%)	10 (31.3%)	0.17	14 (40.0%)	22 (37.3%)	0.05
Tertile 2	4 (28.6%)	9 (28.1%)		8 (22.9%)	26 (44.1%)	
Tertile 3	9 (64.3%)	13 (40.6%)		13 (37.1%)	11 (18.6%)	
Fruit juices						
Tertile 1	7 (50.0%)	16 (50.0%)	0.91	14 (40.0%)	11 (18.6%)	0.05
Tertile 2	5 (35.7%)	10 (31.3%)		8 (22.9%)	24 (40.7%)	
Tertile 3	2 (14.3%)	6 (18.8%)		13 (37.1%)	24 (40.7%)	

[1]Data were analyzed using chi-square test.
p<0.05 was considered as significant.

Table 4: Distribution of Snacks consumed across Tertiles by Case/Control according to Stress Level[1].

and second models, the odds ratio of obesity decreased significantly in third tertile as compared to the first tertile of nuts and dried fruits. In all models, the odds ratio of obesity increased significantly in the third compared to the first tertile of fresh fruits, while the odds ratio of obesity decreased significantly in the third as compared to the first tertile of fruit juices in all models.

In the fully adjusted model, the odds ratio of stress showed a significant increasing trend across the tertiles of fruit juices in the control group (OR: 0.04, CI: 1.3-19.8) (the data are not shown). Also, in all models, the odds ratio of stress increased significantly in the second as compared to the first tertiles of fruit juices in the control group (the data are not shown).

In the obese group, in the crude and first model, the odds ratio of stress decreased significantly in the third as compared to the first tertile of fresh fruits (crude, OR:0.03, 95% CI: 0.001-0.7; model 1, OR: 0.03, CI: 0.001-0.7) (the data are not shown).

In the fully adjusted model, the odds ratio of depression decreased significantly in the third as compared to the first tertile of fresh fruits in the control group (OR: 0.03, 95% CI: 0.03-0.8) (the data are not shown).

Discussion

In our study, consumption of natural fruit juices was positively and significantly related to chronic stress, as measured by DASS-42, in non-obese women, whereas the intake of fresh fruits revealed a significantly negative relation in obese women, However, this inverse relation disappeared after adjusting for the eating attitude score and EI/BMR. Similarly, a significant inverse relation was found between fresh fruit and depression symptoms in non-obese women, after adjusting for all confounding factors, including job status, eating attitude score and EI/BMR.

It is a commonly held belief that stress can alter eating behaviors [25]. Although approximately 20% of people do not change eating patterns during stressful periods, the majority do; around 40% or more increase their calorie intake, whereas 40% or less decrease it when stressed [16,26-28].

Documented research has shown that acute stress stimulates dopamine secretion in both n. Accsh and prefrontal cortex [29], while chronic stress inhibits its secretion in these sites [30]. For many people, the typical response to chronic stressful situations is not to avoid food, but maybe to consume energy-dense food items [31,32].

In this study, we investigated the consumption of snacks, instead of main meals, related to stress and depression status. We found an increase in consumption of fruit juices as stress increases in non-obese women. Non-obese-no-stress women consumed more fresh fruit compared with non-obese-with-stress women. Intake of salty snacks was lower in the no-stress group than in the group of obese women with stress. However, all of these were close to significant.

		Crude	Model I[2]	Model II[3]	Model III[4]
Salty snack	Tertile 1	1	1	1	1
	Tertile 2	0.6 (0.2-1.9)	0.6 (0.2-2.0)	0.7 (0.2-2.3)	0.6 (0.1-2.1)
	Tertile 3	1.0 (0.3-3.1)	1.1 (0.3-3.5)	1.1 (0.3-3.8)	0.9 (0.2-3.7)
	P-trend	0.64	0.60	0.76	0.71
Sweet snack	Tertile 1	1	1	1	1
	Tertile 2	0.9 (0.3-2.9)	0.9 (0.3-3.1)	0.8 (0.2-2.8)	1.3 (0.3-5.2)
	Tertile 3	0.2 (0.08-0.8)	0.2 (0.07-0.91)	0.2 (0.08-1.1)	0.6 (0.7-14.1)
	P-trend	0.05	0.06	0.16	0.26
Sweet drink	Tertile 1	1	1	1	1
	Tertile 2	0.4 (0.1-1.2)	0.3 (0.09-1.1)	0.3 (0.07-1.2)	1.08 (0.2-4.1)
	Tertile 3	0.7 (0.2-2.3)	0.7 (0.2-2.4)	1.0 (0.2-3.7)	1.1 (0.1-1.7)
	P-trend	0.28	0.18	0.16	0.41
Fast food	Tertile 1	1	1	1	1
	Tertile 2	0.7 (0.2-2.3)	0.8 (0.2-2.7)	0.9 (0.2-3.1)	1.4 (0.3-5.5)
	Tertile 3	2.3 (0.7-7.7)	2.2 (0.6-7.6)	1.9 (0.5-7.4)	4.3 (0.9-19.4)
	P-trend	0.16	0.27	0.48	0.14
Nuts and dried fruits	Tertile 1	1	1	1	1
	Tertile 2	1.5 (0.5-4.5)	1.7 (0.5-5.3)	1.3 (0.4-4.2)	1.9 (0.5-7.05)
	Tertile 3	0.2 (0.08-1.0)	0.2 (0.06-0.92)	0.1 (0.02-0.5)	0.2 (0.05-1.5)
	P-trend	0.01	0.01	0.004	0.05
Fresh fruits	Tertile 1	1	1	1	1
	Tertile 2	1.4 (0.4-4.3)	1.6 (0.5-4.9)	1.8 (0.5-6.0)	2.3 (0.4-6.3)
	Tertile 3	4.7 (1.3-16.3)	5.3 (1.4-19.4)	7.2 (1.7-31.3)	14.1 (2.8-71.3)
	P-trend	0.03	0.03	0.02	0.005
Fruit juices	Tertile 1	1	1	1	1
	Tertile 2	0.4 (0.1-1.1)	0.4 (0.1-1.2)	0.5 (0.19-1.7)	0.6 (0.1-1.9)
	Tertile 3	0.2 (0.09-0.89)	0.2 (0.07-0.68)	0.1 (0.03-0.5)	0.2 (0.05-0.9)
	P-trend	0.06	0.02	0.01	0.11

[1] Values are OR (95% CI).
[2] Model I: adjusted for job status.
[3] Model II: additionally adjusted for EAT-26 score.
[4] Model III: further adjusted for EI/BMR.
p<0.05 was considered as significant.

Table 5: Odds Ratios for Obesity across Tertiles of Snacks consumed.

Interestingly, individuals who decrease their overall calorie intake during stressful situations, still show an increased preference for highly palatable food items [33]. A possible explanation for why energy intake is higher during stressful periods [34] may be independent of stress, but rather dependent on insufficient time to prepare foods and the increased use of convenience foods, which have typically high energy [35]. Oliver and Wardle found that most snacks, including sweets and chocolate, cake and biscuits, and other savory items, were eaten more in stressful situations, whereas foods such as fruits and vegetables, were eaten less during these periods [32]. Jeong and Kim also showed that the stress level had significant correlation with the frequency of night snacking among middle school girls. They found that chips, cookies, soft drinks and frozen sweets, were related to stress [36]. These snacks were also given high preference in previous studies [37,38]. Our results were not inconsistent with those presented. Chips-which were categorized as part of the fast food group-sweet snacks and sweet beverages did not show any relation to stress, neither among the obese, nor among the non-obese women, in our study.

There is inconsistency about the relation between snacks and stress level, in spite of many studies that showed positive relation between snacks consumption and stress [33-36] Grossniklaus et al. showed that perceived stress did not affect intake of food and beverage [8]. On the other hand, Liu et al. showed that consumption of fresh fruit had an inverse correlation to perceived stress, whereas the intake of fast food and snacks had a positive correlation [11]. In our study, the inverse relation between fresh fruits and stress disappeared in obese women, after adjusting for all confounding factors. Furthermore, we did not find the same relation in non-obese women. They also showed a significant inverse correlation between fresh fruit and depression symptoms [11]. We found similar results, but only among non-obese women.

Distribution of snacks consumed between non-depressed and depressed women was similar in our study. However, logistic regression showed that fresh fruits decrease the odds ratio for depression in non-obese women, after adjusting for all confounding factors. None of the snacks showed a significant relation to depression among obese women. There is no consensus on the relation between depression and snacks. For example, Fulkerson et al. found that the intake of snacks and fast food was not significantly associated with depressive symptoms [39], while investigating the potential changes in appetite and food preference among 50 outpatients, who showed a significant increase in their preferences to sweets (carbohydrate/fat rich foods) during depression periods, compared with periods when they recalled feeling well [40].

Literature regarding negative moods and carbohydrate consumption are inconsistent. A few studies showed an increase in carbohydrate consumption in an attempt to self-mediate against negative moods [11]. If we accept the mechanism by which an increase in carbohydrate intake improves mood, we may conclude that fresh fruits-which are rich in carbohydrates- could modify brain serotonergic status and affect moods positively like other carbohydrate-rich foods, such as sweet snacks, sweet beverages and natural fruit juices, which were considered as separate snack groups in our study. In addition, we only found this inverse relationship between fresh fruits and depression, similar to Liu et al. [11], but only among non-obese women.

We found no association between snacks consumed and stress/depression, when we did not group the women by their body weight, but when we examined them in order to assign them to obese and non-obese groups, the results changed. So, we may conclude that the relation between snacks consumed and stress or depression status may be partly explained by body weight, at least in women. Most of the previous studies investigated the relation between mood disorders and snack patterns or the relation between mood disorders and obesity. We also considered these relationships. Furthermore, we investigated the relation between snack patterns and stress/depression status in obese and non-obese women, separately. This may be the reason for the differences between our results and other researchers. On the other hand, we could not assess snack consumption on the onset of stress or depression periods. We should note that snack patterns may be different in these periods from other times.

To explore the relationship between obesity and the type of food consumed, rather than total energy intake, we investigated the relation between obesity and snacks consumed. There are some reasons that intake of snacks might promote weight gain. Snacks may be consumed in addition to, not instead of, main meals. On the other hand, some investigators suggest that the intake of high glycemic foods, such as snacks, may increase hunger and food intake, which, consequently, could lead to greater weight gain [41]. In the current study, intake of nuts and dried fruits, fruit juices and sweet snacks decreased the odds ratio for obesity, whereas consumption of fresh fruits increased this ratio, significantly. We showed a significant relation between sweet snacks and obesity only in the crude model, but it disappeared after adjusting our findings for all confounding factors. Since the result changed after adjusting for eating attitude score and EI/BMR, this relation might be dependent on eating attitude or energy intake reporting. The eating attitude score was higher among the obese than among the non-obese women, but it was still lower than the eating attitude disorder criteria [24]. There was not any significant relation between sweet beverages and obesity. This finding is similar to Phillips et al. [42], while Ludwig et al. [43] found an association between the consumption of sugar-sweetened beverages and the odds of obesity in adolescents. In contrast, some of the other studies do not support the notion that intake of junk food is higher in overweight adolescents than among the non-obese [44,45]. Field et al. also did not find any significant relation between the intake of snack foods and weight gain [46]. Our results were similar to theirs in relation to salty snacks and fast foods. Phillips et al. found that the consumption of energy-dense foods was similar between the obese and non-obese groups after adjustment for degree of under-reporting [42]. In our study, total energy intake was similar between obese and non-obese women, but after adjusting for degree of under-reporting, we found a significant difference in energy intake of the two groups. The percentage of under-reporting was 52.2% and 20.2% for obese and non-obese women, respectively. Because of the design of our study, we could not show the cause and effect relation between obesity and snacks consumed. The real cause and effect relation between obesity and snacks consumed should be assessed in clinical trials.

One of the reasons for the inconsistency in the literature may be due to the definition of snacks. There is no widely accepted definition of snack food [46]. When we categorized certain food items into other food groups, it was possible to obtain other relationships between snacks and obesity. For example, we put chips in the fast food group instead of that of salty snacks. We also considered fruits as a healthy snack, while they are not usually considered as snacks. Therefore, comparing the results of the literature may become more useful when most of the researchers accept a similar definition for snacks and categorize them into the same food groups. On the other hand, while certain snacks, such as donuts and cookies might be generally known as being unhealthy, there is no consensus on the definition of healthy snacks. Some snack foods, such as graham crackers, are low in fat, while they may have relatively high glycemic loads, thus some nutritional researchers may consider them

as unhealthy [46]. An interesting point of our study was the positive relation between fresh fruits and obesity. Most of previous studies which assess the relation between consumption of snacks and obesity, have not considered fruits as snacks [47]. As described above, we considered fruits as healthy snacks, in spite of our expectations; this increased the odds ratio for obesity. A possible reason for finding that may be due to the nutritional knowledge of our participants. Although current dieters were excluded from participation in this study, since the participants in our study were selected from obesity clubs, they might be more aware of the nutritional properties of food items. This may result in the over-consumption of fruits. In spite of energy intake under-reporting, we could not rule out the possibility of over-reporting of fruit consumption among obese women. Furthermore, it is possible that they may have decreased the intake of energy-dense food items due to their nutritional awareness, so they may have increased the intake of fruits to compensate their caloric needs or suppress their hunger. We should note that each food item has a defined calorie value. So, if we consume healthy food items above normal levels, obesity is inevitable, as with the over consumption of unhealthy foods.

Conclusion

To the best of our knowledge, no previous studies have investigated the relation between snack patterns and stress/depression status, among separate groups of obese and non-obese people. Our findings show that fruit consumption is associated with decreased depression among non-obese women. We also found that natural fruit juices are related to increased stress, among non-obese women. Although we found that fruit consumption increases the odds of obesity, it does not show any casual relationship between fruit consumption and risk of obesity. Because of the design of our study, we could only show that the obese women consume fruits more than non-obese women. The relation between snacks consumed and stress/depression is body weight dependent and if we consume food, properly and wisely, it may help us balance our mind and our moods.

Limitations and Suggestions

In this study, the correlation between stress/depression and snack frequency was assessed based on a relatively short period of time, due to its design. Longitudinal studies may better investigate the effect of chronic stress and depression on eating patterns; however, to collect accurate dietary data may be difficult over long periods.

Another limitation of our study was to measure stress on a general scale. In future studies, we suggest more specific types of stress be measured, such as work-related stress in order to understand how the intensity of stress may affect eating behaviors.

Furthermore, although the FFQ which was used in this study is a validated questionnaire for estimating food consumption of Iranian people, we should note that this questionnaire, like other dietary methodologies, is subject to measurement error. Differential reporting of food consumption is a concern in any study assessing the relation between self-reported food intake and body weight [42]. The relatively high percentage of energy intake under-reporting, especially among obese women, clearly reveals this problem too.

Finally, because our participations were selected from obesity clubs, it is possible that they are not representing a random sample of all Iranian females. However, the selection of women for both case and control groups from the same setting, might contribute to the decrease of any selection bias in our study.

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