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Original article

## Association between dietary satisfaction and depression, anxiety and stress in obese and overweight patients during the coronavirus pandemic

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### SUMMARY

**Background & aim:** The coronavirus disease-2019 (COVID-19) pandemic is a global health threat. The aim of this study was to evaluate the association between D-Sat and depression, anxiety and stress in obese patients during the coronavirus pandemic.

**Methods:** A cross-sectional study in 228 obese and overweight women on a weight loss diet was conducted through the use of two questionnaires. General characteristics, anthropometric indices, D-Sat and mental status were assessed in these patients.

**Results:** The greatest weight loss (WL) and waist circumference (WC) change was associated with the highest tertile of the D-Sat score in the first four months of the coronavirus pandemic ( $P < 0.05$ ). Participants with the highest tertile of all D-sat score compared to those with the lowest had an 84% decrease in odds of depression. The highest tertile was also associated with decreased odds of anxiety (OR: 0.32 95%CI: 0.14; 0.68) The adjusted odds of stress score were negatively associated to the highest tertile of the D-Sat score (OR: 0.09, 95%CI (0.03, 0.23). WL was inversely related to stress ( $P < 0.05$ ). Participants with higher WL and WC reduction had fewer depressive symptoms ( $P < 0.05$ ). Sleep time and family income were associated with obesity.

**Conclusions:** D-Sat and positive personal and family dynamics can improve the mental status of obese and overweight patients during quarantine.

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### 1. Introduction

The coronavirus disease-2019 (COVID-19) pandemic is a global health threat and has been the largest outbreak of atypical pneumonia since Severe acute respiratory syndrome (SARS) [1]. Studies show that the proportion of patients with obesity and severe

obesity who are infected with COVID-19 will be more prominent compared to the H1N1 outbreak, and the disease is likely to run a more severe course [2].

Overweight and obesity are medical conditions defined as excessive fat accumulation with negative implications on health and socioeconomic status [3]. The prevalence of obesity and overweight is increasing rapidly and in 2016, 61.6% of adults were overweight and 25.8% were obese in Iran [4]. Overweight and obesity are associated with several complications that have negative impacts on quality of life, such as diabetes, cardiovascular disease, cancer, and psychiatric disorders [5,6]. Depression and anxiety are two of the most common psychiatric disorders amongst these patients and have a higher likelihood of developing compared to the general

**Abbreviations:** D-Sat, Diet Satisfaction Questionnaire; COVID-19, Coronavirus disease 2019; BMI, Body Mass Index; WC, waist circumference; WL, Weight Loss; DASS, Depression, Stress and Anxiety scale.

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population [7]. Medications, behavioural therapy, diet therapy, and surgery are the most widely applied treatments [8].

A diet that helps control hunger through eating satisfactory amounts of food can increase diet adherence and lead to weight loss [9]. Therefore, measuring satisfaction with one's current diet is important in weight management. In behavioural weight-loss interventions, the degree of adaptation and maintenance of the prescribed diet is a strong predictor of the continuation of a long-term weight-loss trend [10]. This cross-sectional study sought to investigate the relationship between dietary satisfaction in overweight and obese patients and depression, anxiety and stress during the outbreak of coronavirus.

## 2. Methods

### 2.1. Study design and participants

This cross-sectional study was performed in the spring of 2020, during the coronavirus outbreak, on overweight and obese Iranian women on a weight loss diet who referred to an expert nutritionist in Shahrekord. The information of 228 participants was completed and analyzed (Fig. 1).

Inclusion criteria included the willingness to cooperate with the plan, literacy for reading and writing, obesity or overweight (BMI above 25), being on a weight loss diet under the supervision of a nutritionist and being in quarantine for 4 months (from February to May 2020). Because women made up a larger percentage of clients and had higher compliance in weight loss and quarantine, we only included women in the study. Patients with incomplete information, pregnant women, those who were under 18 years old, on a lower than 800 kcal diet, and those that had experienced unfortunate events in the last six months were excluded. Additional exclusion criteria were patients with a history of diabetes, heart disease, liver disease, and cancers, due to the impact of these diseases on inflammatory factors and clinical depression. All women participating in the study consented to the research method and data collection. The multi-stage random method was applied for sampling.

### 2.2. Instruments

General information of participants including age, level of education, level of physical activity, average sleep time and average sleep duration were collected using a questionnaire.

Individuals' weights were measured with a digital scale to the nearest 0.1 kg. Height was also measured using a tape measure with an accuracy of 1 cm. Body Mass Index (BMI) was calculated using the weight (kg) divided by height squared ( $m^2$ ). Waist circumference was measured using an inelastic tape measure without imposing any pressure and with an accuracy of 0.1 cm.

In addition, a low-calorie diet plan was recommended for each participant by experienced nutritionist based on age, weight, height and lifestyle. Mifflin formula was used to calculate resting energy expenditure of participants. 55–65% of calories were considered from carbohydrates, 10–15% from proteins, and 20–35% from fats, which was based on The United States Department of Agriculture (USDA) [11].

Diet satisfaction was evaluated using a 45-item D-Sat Questionnaire (DSat-45) including seven scales that measure the effects of weight loss diet on various aspects of life, namely healthy lifestyle, convenience, cost, family dynamics, preoccupation with food, negative aspects, and meal planning and preparation [12].

The 21-item Depression, Stress and Anxiety Scale (DASS) was used to assess participants' mental status. This questionnaire uses a four-point scale from 0 to 3 and is confirmed to be one of the most reliable tools for measuring the symptoms of negative emotions,

depression, anxiety and stress [13,14]. Each of the DASS-21 subscales contains seven questions; the final score of each is obtained through the sum of the scores of the related questions.

### 2.3. Sample size determination

The sample size was calculated to be 228 by taking the potential attrition into account. Considering the prevalence of depression to be 23.5% in obese subjects, based on previous studies [15], the required sample size was calculated to be 143 using the following formula. We considered 0.05 as type 1 error and 0.2 as type 2 error (power = 80%) and minimum difference of 5% and added 10% to sample size.

$$n = \frac{\left(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta}\right)^2 P(1-P)}{d^2}$$

### 2.4. Ethical considerations

The present study was approved by the medical ethics committee at the Shahrekord University of Medical Sciences. All collective data in this study were kept confidential by the researchers.

### 2.5. Data analysis

Quantitative variables were presented as mean and standard deviation. Independent sample t-tests were conducted to compare the two groups and analysis of covariance (ANCOVA) was performed and adjusted for baseline values. P-values < 0.05 were considered as significant. The Statistical Package for Social Science version 20 (SPSS Inc., Chicago, Illinois) was used to run statistical analysis in this study. Using binary logistic regression, predisposing mental health disorders across D-Sat tertiles were presented in different models. We intended to classify and compare people according to D-Sat scores, in which people with the lowest scores considered as reference group. Because the sample size was not large, the best choice was to make D-Sat tertiles. Age, education and income level, sleep time and duration, physical activity, and BMI were controlled in the adjusted model. Finally, linear regression as a continuous statistical method was used to present the association between weight change, WC change and BMI with and depression, anxiety, stress, aspects of D-Sat.

## 3. Results

The mean age of women was 32.39 years. The D-Sat scores were divided into tertiles. Total characteristics and anthropometric indices of participants across tertiles of D-sat scores are indicated in Table 1. Prevalence of depressive symptoms, anxiety and stress were 68.4%, 70.6% and 70.2%, respectively.

WL and WC change in the first four months of the coronavirus quarantine was greater in the highest tertile of D-sat score ( $P < 0.05$ ).

One of the objectives of our study was examining the relationship between mental status and D-sat. Table 2 illustrates the odds of mental health of DASS-21 across tertiles of D-sat scores. Participants with the highest tertile of D-sat score compared to women within the lowest tertile had an 84% decreased odds of depression (OR: 0.14, 95% CI: 0.06; 0.34). The adjusted odds of anxiety score negatively related to highest tertile of D-sat score compared to the first and second tertiles (OR: 0.32, 95% CI: 0.14; 0.68 and OR: 0.77,

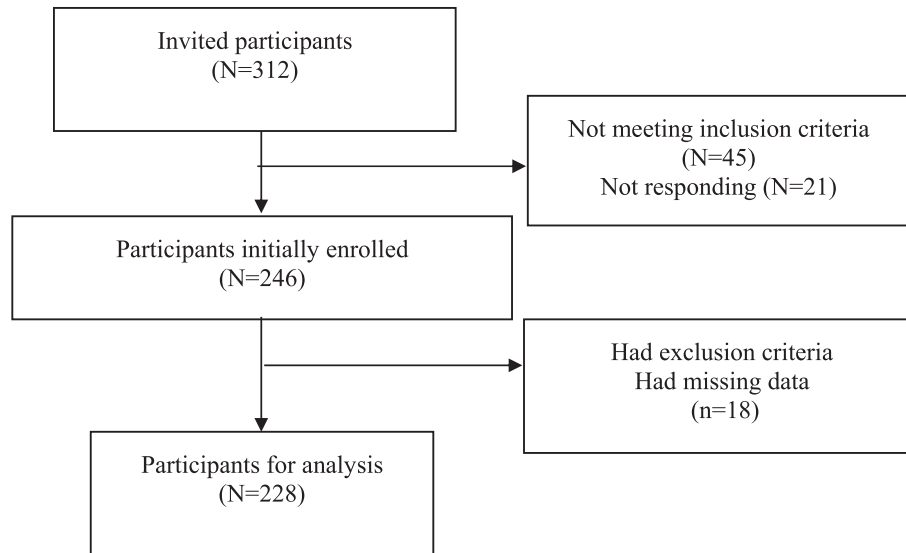


Fig. 1. Flow chart of the process of the study selection.

**Table 1**  
General characteristics of participants across D-Sat tertiles.

Variables	Total	D-Sat tertiles			P value*
		1 ( $<21.83$ )	2 ( $21.83-24.84$ )	3 ( $24.84-<$ )	
Number	228	76	76	76	
	<b>Mean <math>\pm</math> SD</b>				
Age (y)	$32.39 \pm 8.76$	$32.10 \pm 8.42$	$31.71 \pm 8.05$	$33.36 \pm 9.75$	0.478
Weight (kg)	$78.89 \pm 13.77$	$80.66 \pm 13.67$	$76.70 \pm 13.32$	$79.30 \pm 14.19$	0.198
BMI (kg/m <sup>2</sup> )	$29.70 \pm 5.02$	$29.91 \pm 4.97$	$29.13 \pm 4.40$	$29.96 \pm 5.66$	0.492
WC (cm)	$94.89 \pm 14.86$	$97.91 \pm 16.73$	$92.87 \pm 13.19$	$93.89 \pm 12.50$	0.073
Weight Change	$-1.25 \pm 4.77$	$0.09 \pm 3.92$	$-1.25 \pm 4.76$	$-2.59 \pm 5.22$	0.002
WC (cm) Change	$-1.22 \pm 6.11$	$0.30 \pm 5.92$	$-1.39 \pm 5.83$	$-2.57 \pm 6.30$	0.014
	<b>% (n)</b>				
PA					$<0.0001$
Without PA	31.1 (71)	54.9 (39)	23.9 (17)	21.1 (15)	
1-2 time/wk	20.6 (47)	21.3 (10)	38.3 (18)	40.4 (19)	
3-4 time/wk	21.9 (50)	34.0 (17)	30.0 (15)	36.0 (18)	
5-6 time/wk	7.9 (18)	22.2 (4)	22.2 (4)	55.6 (10)	
Every day	18.4 (42)	14.3 (6)	52.4 (22)	33.3 (14)	
Education					0.26
Under diploma	15.8 (36)	36.1 (13)	25 (9)	38.9 (14)	
Diploma	23.2 (53)	22.6 (12)	37.7 (20)	39.6 (21)	
Academic	61 (139)	36.7 (51)	33.8 (47)	29.5 (41)	
Income					0.68
Low	17.5 (40)	42.5 (17)	32.5 (13)	25.0 (10)	
Moderate	78.5 (179)	31.3 (56)	33.5 (60)	35.2 (63)	
High	4 (9)	33.3 (3)	33.3 (3)	33.3 (3)	
Sleep time					0.38
Before 1:00am		30.3 (46)	34.9 (53)	34.9 (53)	
After 1:00am		39.5 (30)	30.3 (23)	30.3 (23)	
Sleep duration					0.78
$<8$ h	66.2 (151)	31.8 (48)	33.8 (51)	34.4 (52)	
$\geq 8$ h	33.8 (77)	36.4 (28)	32.5 (25)	31.2 (24)	

BMI: body mass index; WC: waist circumference; PA: physical activity \*P-values is calculated by one-way ANOVA test.

95%CI: 0.34; 1.71 respectively). The adjusted odds of stress score negatively related to highest tertile of D-sat score compared to the first and second tertiles (OR: 0.31, 95% CI: 0.12, 0.81 and OR: 0.09, 95% CI: 0.03, 0.23, respectively). Our findings indicate that almost every scale of the satisfaction-sat questionnaire had a significantly negative correlation with depression, anxiety and stress (Table 3,  $P < 0.05$ ).

Another purpose of our study was to investigate the relationship between changes in weight and WC with mental health and D-sat. WL and WC changes were associated with lower mental health, sleep time, sleep duration and D-sat scores in the first four months of quarantine (Table 4). WL was inversely related to stress ( $P < 0.05$ ). Participants with higher WL and WC reduction had fewer depressive symptoms ( $P < 0.05$ ). Family income was inversely associated with BMI.

**Table 2**  
Depression, anxiety and stress scores of participants across D-Sat tertiles.

Variables	D-Sat tertiles			P trend
	1 ( $< 21.83$ )	2 ( $21.83-24.84$ )	3 ( $24.84<$ )	
Depression (n = 156)				
Crude model	1	0.24 (0.10; 0.56)	0.14 (0.06; 0.34)	$<0.0001$
Adjusted model	1	0.25 (0.10; 0.61)	0.15 (0.06; 0.36)	$<0.0001$
Anxiety (n = 161)				
Crude model	1	0.73 (0.34; 1.58)	0.32 (0.15; 0.66)	0.002
Adjusted model	1	0.77 (0.34; 1.71)	0.32 (0.14; 0.68)	0.002
Stress (n = 160)				
Crude model	1	0.28 (0.11; 0.72)	0.08 (0.3; 0.21)	$<0.0001$
Adjusted model	1	0.31 (0.12; 0.81)	0.09 (0.03; 0.23)	$<0.0001$

P trend is calculated by binary logistic regression.

Age, education and income level, sleep time and duration, physical activity, and BMI were moderated in the adjusted model.

Data has presented as odds ratio (OR) and confidence interval (95%CI).

**Table 3**  
Correlations among each seven-scale of Diet Satisfaction Questionnaire and Depression, Stress and anxiety.

Variables	Depression	Anxiety	Stress
Healthy Life style	-0.497 ( $<0.0001$ )	-0.440 ( $<0.0001$ )	-0.473 ( $<0.0001$ )
Convenience	-0.117 (0.077)	-0.038 (0.571)	-0.133 (0.045)
Cost	-0.310 ( $<0.0001$ )	-0.241 ( $<0.0001$ )	-0.275 ( $<0.0001$ )
Family dynamic	-0.252 ( $<0.0001$ )	-0.140 (0.035)	-0.231 ( $<0.0001$ )
Preoccupation with food	-0.286 ( $<0.0001$ )	-0.266 ( $<0.0001$ )	-0.335 ( $<0.0001$ )
Negative aspect	-0.401 ( $<0.0001$ )	-0.285 ( $<0.0001$ )	-0.331 ( $<0.0001$ )
Meal planning and preparation	-0.255 ( $<0.0001$ )	-0.163 (0.014)	-0.280 ( $<0.0001$ )

#### 4. Discussion

The purpose of the current cross-sectional study was examining diet-satisfaction in relation to mental status and anthropometric indices in women with overweight and obesity who had consulted a nutritionist before or at the time of the corona outbreak. Our findings indicate that all seven subscales of the D-Sat questionnaire were inversely related to participants' mental status. More specifically, increasing dietary satisfaction was associated with improved

mental health and higher WL and WC reduction were associated with a significant reduction depressive symptoms. The last evidence has shown a diet that leads to weight loss improves the quality of life. However; to the best of our knowledge, this is the first study that examined the score of depression, anxiety and stress in obese patients being on a weight-loss diet during coronavirus quarantine. It also measures the relationship between dietary satisfaction and mental health-related factors. On the other hand, it has been reported that low-calorie diets for weight loss affect all aspects of a person's life [16]. Therefore, it is important to evaluate dietary satisfaction to prevent depression, stress and anxiety. Amani A. Khalil et al.'s study showed that depressive symptoms were associated with less adherence to diet [17]. Studies have also shown that depression, stress and anxiety are associated with less adherence to diet. Therefore, a two-way relationship can be established between mood status and diet adherence, and this interprets the importance of dietary satisfaction in preventing mental problems [18].

According to the results of our study, WL and WC reduction were significantly associated with depression, but there was no significant relationship with stress and anxiety. A study by Fabricatore et al. also reported that weight loss is associated with improved mental health and quality of life [19]. In the weight loss process, It is known type and healthy of diet was more important than its effect on weight loss in the short term.

Studies have shown that quarantine caused by coronavirus outbreaks is associated with common health problems including depression, stress and anxiety [20]. Also, the study of Simon.G et al. showed that obesity to be associated with a 25% increase in the odds of mood disorders [21]. Similar to other studies, our findings showed that the coronavirus pandemic and resulting quarantine increases the prevalence of mental disorders, so the use of a diet satisfaction questionnaire in the weight loss program is relevant to gather insight into patient's mental health status. The results also showed that a varied diet that the patient is comfortable with is important in improving the mental health of obese and overweight people. Restricted and very low-calorie diets focus on high weight loss in a short period of time have psychological consequences, such as depression [22,23]. Low-calorie and low-carbohydrate diets may be related to some psychological symptoms such as depression [24]. Alternatively, higher activity levels and a broad food section have also been shown to improve mental health status in obese patients [25]. Prescribing a healthy diet that gives the patient satisfaction, especially during quarantine with the potentially elevated incidence of mental health disorder development, can ensure adherence to the diet and sustainable weight management [26,27]. This association illustrates how diet satisfaction can

**Table 4**  
P trend is calculated by linear regression. Age, education and income level, sleep time and duration, physical activity, were moderated in the adjusted beta.

Variables	Weight Change (kg)				WC Change (cm)				BMI (kg/m <sup>2</sup> )			
	Crude B	Adjusted Beta	95% C I for B	P	Crude B	Adjusted Beta	95% C I for B	P	Crude B	Adjusted Beta	95% C I for B	P
Depression	-0.089	-0.231	(-0.146, 0.002)	0.002	-0.107	-0.218	(-0.182, -0.032)	0.005	-0.031	-0.076	(-0.093, 0.032)	0.333
Anxiety	-0.066	-0.136	(-0.134, 0.003)	0.060	-0.039	-0.063	(-0.129, 0.052)	0.401	-0.015	-0.030	(-0.090, 0.059)	0.691
Stress	-0.080	-0.188	(-0.143, -0.017)	0.013	-0.076	-0.140	(-0.160, 0.007)	0.072	-0.026	0.035	(-0.094, 0.043)	0.466
Income	1.264	0.118	(-0.117, 0.073)	0.073	0.391	0.028	(-1.428, 2.209)	0.672	-1.767	-0.156	(-3.284, -0.251)	0.023
Sleep time	1.265	0.146	(0.185, 0.022)	0.022	1.108	0.100	(-0.314, 2.531)	0.126	1.088	0.119	(-0.098, 2.274)	0.072
Sleep duration	-0.447	-0.064	(-1.345, 0.328)	0.328	-1.128	-0.126	(-2.311, 0.055)	0.062	-0.014	-0.002	(-1.001, 0.972)	0.978
Healthy lifestyle	-1.332	-0.237	(-2.228, 0.004)	0.004	-1.752	-0.244	(-2.932, -0.572)	0.004	-0.973	-0.165	(-1.957, 0.011)	0.053
Convenience	-0.803	-0.094	(-1.938, 0.165)	0.165	-0.490	-0.045	(-1.986, 1.006)	0.520	-0.292	-0.032	(-1.539, 0.956)	0.645
Cost	-0.395	-0.074	(-1.262, 0.369)	0.369	-0.292	-0.042	(-1.433, 0.849)	0.615	-0.057	-0.010	(-1.008, 0.895)	0.907
Family dynamics	-0.445	-0.084	(-1.206, 0.250)	0.250	-0.553	-0.081	(-1.555, 0.449)	0.278	0.970	0.173	(0.135, 1.806)	0.023
Preoccupation with food	-0.467	-0.079	(-1.365, 0.306)	0.306	-0.162	-0.021	(-1.344, 1.021)	0.788	0.395	0.063	(-0.592, 1.381)	0.431
Negative aspect	-0.702	-0.113	(-1.759, 0.192)	0.192	-0.268	-0.034	(-1.661, 1.124)	0.704	-0.975	-0.149	(-2.137, 0.186)	0.099
Meal planning and preparation	0.470	0.086	(-0.441, 0.310)	0.310	-0.102	-0.014	(-1.302, 1.098)	0.867	0.255	0.044	(-0.746, 1.256)	0.616

improve mental health and quality of life and should be considered during the pandemic.

One limitation of our study was that we only included female patients and diet satisfaction might be different among male patients. Another limitation was that we did not collect a food record from participants, which might have led to less accurate results. Also, larger sample sizes report more reliable results.

Overall, diet satisfaction in obese and overweight women and positive individual and family dynamics can improve mental status during quarantine. Obese and overweight patients aiming to lose weight should be aided in diet management and ensure their satisfaction with the planned diet.

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### Author contribution

Fateme Moradi and Siavash Fazelian and Javad Heshmati: designed the study; Fateme Moradi and Siavash Fazelian conducted the data collection; Ali Ahmadi and Elnaz Daneshzad: conducted the statistical analysis, evaluated and reported the results; Javad Heshmati and Tina Jafari and Emma Persad: wrote the article's draft; and all authors: carefully evaluated the final draft of the manuscript and approved it.

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