Is meat-free diet related to anxiety, depression and disordered eating behaviors? A cross-sectional survey in a Turkish sample

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Abstract

Aim: The foods that we eat don't just impact our physical health. The link between what we eat and how we feel has become a trending topic. However, knowledge on the effects of diet types on this relation is still limited. The first aim of this study is to reveal the possible link between diet types and eating behaviors, anxiety and depression. Second one is to predict possible variables (demographic, health-related and medical) which cause higher depression scores among individuals following a meat-free diet and an omnivore diet.

Materials and Methods: A questionnaire-based survey cross-sectional study was conducted among individuals with a meat-free diet and an omnivore diet (N = 836 with a vegan or a vegetarian diet, N = 519 with an omnivore diet) using an online questionnaire. Demographic, health-related and medical characteristics, The Three-Factor Eating Questionnaire-R 21, Hospital Anxiety and Depression Scale were used to assess variables.

Results: A meat-free diet group showed significantly lower anxiety and depression scores, lower cognitive restraint, lower emotional eating and lower uncontrolled eating than omnivore diet group. Shared predictors of depression were dissatisfaction with physical appearance, uncontrolled eating and smoking in both meat-free diet group and omnivore diet group. Lower cognitive restraint and lower education level were predictors of depression in only omnivore diet group.

Conclusion: This study revealed that an omnivore diet may be more associated with anxiety, depression, and some disordered eating behaviors than a meat-free diet.

Introduction

An omnivore diet is the most common dietary type that includes both plant and animal foods. On the other hand, vegetarianism and veganism (i.e. avoidance of red meat, fish, poultry or all animal products) with a long history in Far Eastern cultures has become more popular worldwide in recent years. There has been some reasons such as ethical, environmental, health-related issues and animal rights for the increase in these trends [1, 2].

Diets with lower intake of animal products and increased consumption of meat-free products have received a lot of attention for their positive effects on physical health outcomes. It has been widely reported that a meat-free diet decreases the risks of cancers, heart diseases, stroke, type 2 diabetes and obesity [3, 4]. Although much research has been done on diet types and physical health, diet types and mental health have received scant attention in the research literature. The relationship of meat consumption or avoidance with mental health has become a controversial topic [5]. Some studies suggested that restriction of red meat, fish and poultry consumption had a positive effect on mental health [6, 7]. However, a meta-analysis suggested that a meat-free diet were directly associated with a greater risk of mental health issues [8]. Previous studies presented a number of proposed mechanisms to identify the potential relationship between a meat-free diet and positive or negative mental health outcomes. These include the defi-

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ciency of essential nutrients such as vitamin B12, folate, omega-3 fats or increased consumption of omega-6 fats, dietary fiber, some antioxidants (e.g. beta-carotene, vitamin C, vitamin E) [9, 10]. Further, several studies from different countries reported no differences in mental health were found between meat-free diet and omnivore diet [11, 12].

Eating behaviours are individual motives and thoughts associated with dieting and eating habits [13]. Disinhibition is the tendency to overeat in response to positive and negative emotional states. Uncontrolled eating and emotional eating can be conceptualized as a form of eating disinhibition and both of them involve in impulsivity, binge eating, weight gain and obesity. Cognitive restraint is the restriction of food intake for intentional weight control [14]. Individuals with dietary restraint tendencies are vulnerable to disinhibition and they may be engaged in overeating behaviors in response to negative emotions [15]. There have been very little published research on the relationship between eating behaviors and diet types in the literature. One of these studies reported that people following meat-free diet showed significantly lower scores on all subscales of eating behaviors than omnivores [16].

Given the uncertain relationship between a meat-free diet and mental health, we planned to determine whether a meat-free diet was associated with depressive and anxiety symptomatology and eating behaviors. In several studies, Instagram use, healthy lifestyle, regular exercise, diet, smoking, alcohol consumption, some psychiatric disorders, history of eating disorders and satisfaction with physical appearance were associated with a meat-free diet [17-19]. Therefore, we measured these relevant covariates. Body mass index (BMI) was also measured, as it is considered a relevant measure in studies on diet and health [20].

This study will make a significant contribution to the literature in terms of shedding light on the effects of diet types, which are less considered in our daily psychiatry practice but are known to be directly related to mood, on our mental health. The research hypotheses that a meat-free diet is associated with a lower risk of symptoms of depression and anxiety, and also lower level of disordered eating behaviors. In summary, the first aim of the present study was to reveal the possible link between diet types, eating behaviors and symptoms of anxiety and depression. The second one was to predict possible variables (demographic, lifestyle, health-related and medical) which cause higher depression scores among individuals following a meat-free diet and omnivore diet.

Materials and Methods

Study design and participants

The study adopted the cross-sectional research design which data were collected using an online self-report from 31 August to 30 September of 2022. Ethical approval for the study was taken from Istanbul Medipol University (E-10840098-772.02-4840). Informed consent was obtained from all participants in the study. All participants were informed about the purpose of the study and the privacy policy. Participants aged between 18 and 65 years were invited to fill out an online survey via Instagram,

Twitter and YouTube. Exclusion criteria were being outside this age range or following any types of a plant-based diet other than meat free diet (ovo/lacto/lacto-ovo vegetarian or vegan). In this study, non-probability sampling method was used. Invitations to participate were posted within meat-free diet or plant-based diet in Instagram and Twitter pages, and Youtube channels, and permission was sought from each group's administrators prior to posting. There were no promotions or advertisements on social media other than messaging. "Is a meat-free diet (vegan or vegetarian) related to poor mental health and disordered eating behaviors? Or vice versa?" message were used with the survey link. Online forms were tested electronically before the study was conducted. Multiple participation was prevented by placing a cookie on their browser when participants submit a response. The questionnaires consisted of 50 questions in total and took an average of 8 minutes to fill. People were not paid any fees for their participation. Filling out every question in the questionnaire was not mandatory and participants had a chance to go back. Based on a priori sample size calculations, N=222 was identified using G*Power to detect a medium effect size with 15% power. It was suggested that up to 20% of the data could be lost (incorrect coding, incomplete information or contradictory content, etc.). Therefore, the smallest sample size to be reached was 278 participants. A total of 1652 participants responded to the study. Of these, 86 reported following any other types of plant-based diet, such as a pescetarian diet (eating fish, but no other meat), flexitarian diet (mostly vegetarian, but sometimes includes red meat, fish, or poultry) and they were excluded from the data analysis, leaving 1566 participants. Data with missing or contradictory markings were excluded from the analysis. Of the 1566 participants, 211 did not complete all the questions on the form, leaving 1355 participants. Of these, 836 self-identified as vegetarian or vegan, and 519 self-identified as an omnivore. The survey contained additional items on Instagram use, BMI, body image satisfaction, current physical or psychiatric disorders, diet, regular exercise, smoking, alcohol consumption.

Measurements

Demographic, medical and health-related characteristics

Some demographic characteristics such as age, gender, education level and marital status were included. Participants also reported medical characteristics such as current physical diseases, current psychiatric disorders, history of eating disorders, satisfaction with physical appearance and health-related characteristics such as regular exercise, regular diet, smoking, and regular alcohol consumption over the last month. The BMI was calculated on self-reported height and weight. According to a recent study, it has been revealed that those who use social media for more than 3 hours a day are heavy social media users [21]. Therefore, we designed the time spent on Instagram from less than 3 hours or more.

Hospital Anxiety and Depression Scale (HADS)

HADS [22] is a 14-question self-report questionnaire and consists of two subscales: anxiety and depression. Each

subscale consists of seven items and scoring for each item ranges from 0 to 3. The cut-off points for the Turkish version of the HADS [23] is 10 for anxiety and 7 for depression. In the current study, Cronbach's alpha of the anxiety subscale was .87 and the depression subscale was .78.

The Three-Factor Eating Questionnaire (TFEQ-R21)

Eating behaviour was measured by the TFEQ-R21 [24], translated and validated for the Turkish population [25]. The TFEQ-21 uses 21 Likert-scale questions to assess three cognitive and behavioural domains of eating behaviour (cognitive restraint, uncontrolled eating and emotional eating). Higher scores indicate greater eating behaviour for each subscales of questionnaire. Cronbach's alpha of cognitive restraint was .84, uncontrolled eating was .89 and emotional eating was .95.

Statistical analysis

The data of the study were analyzed using SPSS version 23.0. Descriptive statistics were expressed as frequency, percentage, mean and standard deviation. The Chi-Square test and, where necessary, Fisher's exact test was used for the comparison of qualitative data. Since the skewness and kurtosis values of the numerical variables varied between ±1.5, it was assumed that the data showed normal distribution [26]. Analysis of Variance (ANOVA) was used for the significance of the model. The adjusted R^2 value was used for the performance estimation of the model. It was found that the model created in the regression analysis was significant (F=10.873, p<.001) and the independent variables explained 14% of the variance. The relationship between continuous variables was evaluated with Pearson correlation analysis. Independent sample t-test was used in the comparison of continuous variables between the two groups. Anxiety and depression subscale scores of HADS were evaluated as dependent variable in multiple linear regression analysis and Enter method was used in these analyses. Model adequacy was assessed with the Durbin Watson value. Since this value was below 2.5, it was determined that there was no autocorrelation. In multiple linear regression analyses, Durbin-Watson values were between 1.996 and 2.140. When the Tolerance & Variance Inflation Factor (VIF), and Condition Index (CI) values were examined, it was observed that there was no multicollinearity problem. CI, Tolerance and VIF were between 29.151-30.582, .465-.949 and 1.054-2.137, respectively. The Cronbach's alpha was used for estimating internal consistency reliability. A result was considered statistically significant if p<0.05.

Results

The demographic, health-related and medical characteristics of the sample are shown in Table 1. Age (t(1353)=-.916, p=.360, η^2=.05), gender (X^2=1.926, p=.382), marital status (X^2=.572, p=.449), education level (X^2=1.851, p=.611), presence of current psychiatric disorder (X^2=1.75, p=.186), history of eating disorder (X^2=.422, p=.516), presence of physical diseases

status (X^2 =.077, p=.781) and time spent for Instagram (X^2=2.674, p=.263) were not statistically significant. However, it was observed that there was a significant difference between a meat-free diet group and omnivore diet group in terms of satisfaction with physical appearance (X^2=24.31, p<.001), regular exercise (X^2=6.789, p=.009), dieting (X^2=21.07, p<.001), alcohol consumption (X^2=16.46, p<.001) and BMI variables (t(1353)=-2.838, p=.005, η^2=.16). Those who were not satisfied with their physical appearance were 4.2% in a meat-free diet group and 8.3% in the omnivore diet group. 22.2% of a meat-free diet group and 30.4% of the omnivore diet group were smokers. 41.4% of a meat-free diet group and 34.3% of an omnivore diet group were exercising regularly. 26% of a meat-free diet group and 37.8% of the omnivore diet group were following any diet program.

The comparison of the groups in terms of anxiety, depression and eating behaviours is shown in Table 2. Cognitive restraint (t(1353)=-3.319, p=.001, η^2=.18), emotional eating (t(1353)=--2.797, p=.005, η^2=.15) and uncontrolled eating (t(1353)=-3.063, p=.002, η^2=.17) scores were significantly higher in omnivore diet group. Similarly, anxiety (t(1353)=-4.007, p<.001, η^2=.22) and depression (t(1353)=-4.635, p<.001, η^2=.25) scores of HADS were significantly higher in omnivore diet group.

The evaluation of the variables predicting the depression subscale of HADS by multiple linear regression analysis is shown in Table 3. It was found that the created model in a meat-free diet group was significant (F=10.783, p<.001) and the independent variables explained 14% (Adjusted R^2) of the variance. Predictors of depression in a meat-free diet group were, in order of importance; lower satisfaction with physical appearance (β=-.267, t=-7.292, p<.001), higher uncontrolled eating scores (β=.109, t=2.380, p=.018) and smoking (β=.078, t=2.314, p=.021). The created model in the omnivore diet group was also significant (F=11.452, p<.001) and the predictors explained 22% of the variance. Predictors of depression in an omnivore diet group were, in order of importance; lower satisfaction with physical appearance (β=-.283, t=-6.194, p<.001), higher uncontrolled eating scores (β=.183, t=3.195, p=.001), lower cognitive restraint scores (β= -.143, t=3.325, p=.001), lower education level (β=-.124, t=-3.059, p=.002) and smoking (β=.105, t=2.411, p=.016).

Discussion

The first objective of this study was to investigate the possible associations between diet types, eating behaviors, symptoms of anxiety, and depression. The second one was to reveal possible predictors for higher depression scores in both meat-free diet group and omnivore group.

It is estimated that 4.4% of the global population suffer from depressive disorder, and 3.6% from anxiety disorders. The number of people with depression and anxiety disorders is going up, particularly in low- and middle-income countries [27]. Although diet is known as a potentially modifiable risk factor among environmental factors of mental disorders, knowledge on the effects of diet types on this relation are still limited. In the present study, we found

Table 1. Demographic, health-related and medical characteristics of participants.

Variables	Meat-free diet (n=836)		Omnivore diet (n=519)		Total		Group differences	
	n	%	n	%	n	%	X²	p
Gender							1.926	0.382
Women	571	68.3	350	67.4	921	68.0		
Men	250	29.9	164	31.6	414	30.6		
Other	15	1.8	5	1.0	20	1.5		
Marital status							0.572	0.449
Single	507	60.6	304	58.6	811	59.9		
Married	329	39.4	215	41.4	544	40.1		
Education level							1.851	0.611
Primary	3	0.4	4	0.8	7	0.5		
High school	54	6.5	31	6.0	85	6.3		
University	534	63.9	342	65.9	876	64.6		
Master	245	29.3	142	27.4	387	28.6		
Current psychiatric disorder*	114	13.6	58	11.2	172	12.7	1.750	0.186
History of eating disorders*	38	4.5	19	3.7	57	4.2	0.422	0.516
Current physical diseases*	156	18.7	100	19.3	256	18.9	0.077	0.781
Satisfaction with physical appearance							24.31	**<0.001**
Not at all	35	4.2	43	8.3	78	5.8		
Not really	174	20.8	149	28.7	323	23.8		
Undecided	194	23.2	101	19.5	295	21.8		
Somewhat	384	45.9	199	38.3	583	43.0		
Very much	49	5.9	27	5.2	76	5.6		
Time spent on Instagram							2.674	0.263
None	83	9.9	50	9.6	133	9.8		
<3 hours	637	76.2	380	73.2	1017	75.1		
≥3 hours	116	13.9	89	17.1	205	15.1		
Smoking*	186	22.2	158	30.4	344	25.4	11.35	**0.001**
Alcohol consumption							16.46	**<0.001**
None	263	31.5	219	42.2	482	35.6		
Social drinker	468	56.0	250	48.2	718	53.0		
Regular	105	12.6	50	9.6	155	11.4		
Regular exercise*	346	41.4	178	34.3	524	38.7	6.789	**0.009**
Dieting*	217	26	196	37.8	413	30.5	21.07	**<0.001**
Age (mean-sd)	33.38	10	32.86	10.38	33.18	10.14	0.916	0.360
BMI (mean-sd)	22.93	7.06	24.01	6.29	23.35	6.79	-2.838	**0.005**

* Only "Yes" option, M = mean, SD = standard deviation, BMI = Body mass index.

Table 2. Comparison of diet types in terms of anxiety, depression and eating behaviours.

Measurements	Meat-free diet		Omnivore diet		Statistical analysis		
	M	SD	M	SD	t(1353)	p	Cohen's d
TFEQ-R21- Cognitive restraint	12.60	4.57	13.44	4.51	-3.319	0.001	.18
TFEQ-R21- Emotional eating	12.32	6.03	13.27	6.21	-2.797	0.005	.15
TFEQ-R21- Uncontrolled eating	18.52	6.78	19.70	7.08	-3.063	0.002	.17
HADS-Anxiety	7.61	5.22	8.79	5.25	-4.007	<0.001	.22
HADS-Depression	7.34	4.37	8.49	4.57	-4.635	<0.001	.25

M: Mean, SD. Standard Deviation, HADS: Hospital Anxiety and Depression Scale, TFEQ-R21: Three Factor Eating Questionnaire.

that a meat-free diet was negatively associated with anxiety and depressive symptoms. These results seem consistent with other systematic reviews and meta-analytical results which found a meat-free diet preventive aspects against depression and anxiety [8, 28]. However, there have been also systematic reviews and meta-analytical

Table 3. Evaluation of variables predicting depression symptoms with multiple linear regression analysis.

	Meat-free diet			Omnivore diet		
	β (95% CI for B)	t	p	β (95% CI for B)	t	p
Age	-0.034 (-0.047; .017)	-.920	.358	-0.057 (-0.065; 0.015)	-1.228	.220
Gender	0.020 (-0.405; 0.743)	.578	.563	0.008 (-0.685; 0.827)	.184	.854
Education level	-0.051 (-0.891; 0.110)	-1.532	.126	-0.124 (-1.639; -0.357)	-3.059	.002
Marital status	-0.025 (-0.856; 0.406)	-.699	.485	-0.014 (-0.963; 0.695)	-.318	.751
Reguler exercise	-0.059 (-1.126; 0.082)	-1.697	.090	0.022 (-0.604; 1.019)	.502	.616
Dieting	-0.042 (-1.123; 0.279)	-1.182	.238	-0.036 (-1.140; 0.468)	-.821	.412
Smoking	0.078 (0.124; 1.516)	2.314	.021	0.105 (0.193; 1.890)	2.411	.016
Alcohol consumption	-0.003 (-0.478; 0.438)	-.086	.932	-0.024 (-0.779; 0.437)	-.552	.581
Satisfaction with physical appearance	-0.267 (-1.494; -0.860)	-7.292	.000	-0.283 (-1.552; -0.804)	-6.194	.000
Time spent on Instagram	0.010 (-0.511; 0.685)	.286	.775	0.021 (-0.532; 0.909)	.513	.608
TFEQ-R21- Cognitive restraint	-0.009 (-0.079; 0.061)	-.255	.799	-0.143 (-0.231; -0.059)	-3.325	.001
TFEQ-R21- Emotional eating	0.030 (-0.046; 0.089)	.630	.529	-0.004 (-0.086; 0.079)	-.077	.939
TFEQ-R21- Uncontrolled eating	0.109 (0.012; 0.128)	2.380	.018	0.183 (0.045; 0.191)	3.195	.001

HADS: Hospital Anxiety and Depression Scale, TFEQ-R21: Three Factor Eating Questionnaire, CI: Confidence Interval.

studies that produce arguments against this finding [29, 30].

Although the mechanisms regulating the relationship between diet and mental health are not yet well understood, different theories exist in the literature [31]. First, it has been suggested that emotional stress is associated with increased oxidative damage and it may increase the prevalence of depression and anxiety [32]. Vegan and vegetarian diets contain a range of nutrients and foods (fiber, vitamins, minerals, antioxidants, magnesium, flavonoids and phytochemicals) that reduce chronic inflammation, oxidative stress and increase beneficial gut microbiota, which also improves communication between brain and gut [33]. Secondly, chronic inflammation plays an established etiological role in the pathogenesis of some mental disorders [34]. Immune system dysregulation, elevated pro-inflammatory cytokines, hyperactive hypothalamic–pituitary–adrenal axis and increased cortisol synthesis has been found associated with the pathogenesis of depression and anxiety [31].

Our findings showed that people following a meat-free diet showed significantly lower cognitive restriction than those following an omnivore diet. Previous studies indicated that cognitive restriction for weight control purposes was significantly higher in omnivores than in vegetarians, similar to current findings [35]. Cognitive restraint for omnivores may be signs for attempts to control intake to lose weight, adverse appetitive traits and overeating tendencies. Consistent with this inference, diet, uncontrolled eating and BMI were significantly higher in the omnivores in this study. In contrast, people following a meat-free diet may have lower cognitive restraint as they are accustomed to restricting the food because of its quality [35]. People who follow a meat-free diet may tend to a more health-conscious lifestyle compared to omnivores. Another important finding from the current study was that a meat-free diet group spent more time exercising and smoked less compared to the omnivore diet group. These results accords with the previous study, which showed vegans might be less likely to smoke and more likely to maintain a nor-

mal BMI, exercise regularly [36]. In our study, an omnivore diet group showed higher emotional eating than a meat-free diet group. A possible explanation for this might be that people following a meat-free diet experienced significantly less negative emotions than omnivores [37].

People with a negative body images and self-image problems may suffer from depression [38]. The definition of body image for the current research is "perceptions, thoughts and feelings about one's own body" [39]. The main focus of body image was dissatisfaction with physical appearance (a measure of negative body image) in this study. The most prominent predictors of higher depression scores were dissatisfaction with physical appearance and higher uncontrolled eating in both an omnivore diet and a meat-free diet group. It was quite surprising that the same variables predicted depression the most in both groups which have different eating motivations. It can be suggested that depressive symptoms could be related to weight and physical appearance concerns of people following with a meat-free diet or an omnivore diet by this finding.

Cognitive restraint has been correlated with a healthier food choices, lower energy, fat and weight regulation [40]. It has been shown that increased severity of depressive symptoms is associated with more uncontrolled eating and less cognitive restraint [41]. The coexistence of less cognitive restraint, more uncontrolled eating and dissatisfaction with physical appearance without a higher BMI as predictors of depression may be associated with negative subjective interpretation of impairment in body image and weight regulation for omnivores in this study. Vegan or vegetarian diet is restrictive and controlled eating by nature. Research showed that vegans and vegetarians had lower BMI scores and leaner body types than omnivores [42]. Individuals who have body image problems and want to lose weight may have motivations for a vegetarian or vegan diet [43]. Therefore, it was not surprising that dissatisfaction with physical appearance and uncontrolled eating were the predictors of depression for people following a meat-free diet in this study. Therefore, individuals with

eating disorders may follow a meat-free diet to mask their disordered eating behavior.

The findings in this study were subject to at least three limitations. First, the major limitation was the study's cross-sectional design, and therefore a causal link between diet types, psychological disorders and eating behaviors could not be implied. Second, our scales were only based on self-reported and subject to recall bias. Third, the nature of the study was online. Finally, the scale used for anxiety and depression merely assesses symptoms and do not represent an official diagnosis.

Conclusion

Our findings suggest that some of eating behaviours and diet types could be a part of depression treatment. We found an inverse link between a meat-free diet and the risk of anxiety and depression. This study showed that both disinhibition and restrictive eating traits were less on a meat-free diet. In addition to the eating behaviors, this study also revealed other risk factors such as some demographic, medical and health-related characteristics to emerge depressive symptoms in both meat-free diet group and omnivore diet group. The findings of the study emphasize the importance of further information and investigation into the relationship of diet types, mood and eating behaviors.

Ethical approval

Ethical approval for the study was taken from Istanbul Medipol University (E-10840098-772.02-4840).

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