

# Effects of Mediterranean and Western dietary patterns on perceived stress and mental distress

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## Abstract

Compared to the Western diet, the Mediterranean diet has many known benefits for both mental health and physical health; however, little is known about the effect of these dietary patterns on perceived stress and mental distress. To assess the relationship between dietary patterns, perceived stress and mental wellbeing, an anonymous online questionnaire targeting adults 18 and older was distributed via several social media platforms and email listservs. The survey included demographic questions, the Food-Mood Questionnaire, the Perceived Stress Scale and the Kessler Psychological Distress scale (K-6). A total of 1591 participants completed the survey. The data was analyzed using Principal Component Analysis and Pearson Correlation Coefficient in SPSS version 28.0. The results showed significant negative correlations between perceived stress and mental distress with several components of the Mediterranean diet, such as whole grains, seafood, fruits, vegetables, and beans. Despite being attributed to the Western diet, meat produced a negative correlation with perceived stress and mental distress. However, significant positive correlations between perceived stress and mental distress and the Western diet, such as fast food and high glycemic index food, were detected. Our findings provide evidence that dietary patterns modulate the stress response and suggest that incorporating components of the Mediterranean diet is beneficial for mental wellbeing and stress reduction.

## Introduction

Nutritional neuroscience investigates the relationship between dietary components, neurochemistry, and neurotransmission. This emerging field explores the role of macro- and micronutrients on overall cognitive, emotional, and behavioral functions (Begdache et al., 2019). Despite comprising only 2% of body weight, the brain consumes 20% of energy expenditure, making proper nutrition essential for optimal brain function (Fioramonti and Pénicaud, 2019). Thus, a suboptimal intake of certain nutrients could disrupt neural pathways, impacting cognitive processes and modifying mental status (Tardy et al., 2020).

The interest in the relationship between stress and nutrition is growing. Stress is a response to an overwhelming situation that exceeds the adaptive ability to the stimuli (Khaled et al., 2020). While the existing literature has addressed the impact of stress on food intake, the reciprocal relationship has not been elucidated. In addition, most psychological stress is believed to be perceived. Perceived stress is a feeling associated with the lack of control when demands exceed the ability to cope (Epel et al., 2018), often leading to depression, anxiety, and burnout (Guruprakash et al., 2018). Perceived stress differentiates from psychological stress in that it emphasizes a lack of control over keeping up with stressors rather than an inability to deal with stressors (Epel et al., 2018).

College students are vulnerable to high perceived stress (Alsalem et al., 2021), as most juggle academia, work life, social life, and relationships (Graves et al., 2021).

Little is known about how food groups and dietary patterns can impact the physiology of stress. New trends in nutritional neuroscience research examine dietary patterns, rather than single foods, to account for the cumulative effects of nutrition on mental health (Kelly et al., 2018). Therefore, it would be plausible to apply this approach to study the impact of dietary patterns on perceived stress. Two of the most popular dietary patterns studied in relation to mental health are the Western and Mediterranean diets. Generally, the components of these diets differ significantly in their nutritional value, potentially impacting the physiological response to stress.

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The Western diet is known for its high concentration of high-glycemic and low-quality processed foods (Kopp, 2019). On average, Americans consume an excess of saturated fat, refined grains, and high-sugar sweets, and an inadequate amount of fruits, vegetables, and high-fibrous grains (Rakhra et al., 2020). Fast food, which is commonly consumed, is typically high in Omega-6 oils, which contribute to inflammation (D'Angelo et al., 2020). In contrast, the Mediterranean diet includes a spectrum of high-quality foods that are beneficial to the brain and overall health (García-Montero et al., 2021). Being primarily plant-based, the Mediterranean diet consists mainly of fruits, vegetables, whole grains, olive oil, beans, and legumes. A smaller portion of the diet comes from animal protein, such as red and white meat, fish, dairy, and other seafood (Martínez-González et al., 2015). Adherence to the Mediterranean diet has been shown to decrease insulin resistance and mental health issues (Gonder-Frederick et al., 1989; Shively et al., 2019).

The spectrum of nutrients in the Mediterranean diet promotes healthy brain function, which reduces the symptoms of depression and improves mental health (Parletta et al., 2019). Several nutrients support the synthesis and regulation of neurotransmitters and may act as precursors to these neurochemicals (Briguglio et al., 2018). Micronutrients, such as Vitamin D, are linked to the production of dopamine and serotonin, given that there is a high concentration of Vitamin D receptors (VDRs) in the neuronal brain tissue. Moreover, the Mediterranean diet contains high amounts of complex carbohydrates and fibers, as well as an abundance of unsaturated fatty acids like the Omega-3 types (García-Montero et al., 2021). Other essential vitamins and bioactive compounds, such as ascorbic acid, tocopherols, polyphenols and carotenoids scavenge free radicals are essential for gut microbiota, immune function, and enzyme regulation (García-Montero et al., 2021). Thus, adherence to the Mediterranean diet may also counteract the effect of stress by regulating inflammation and reducing the glycemic load (Carvalho et al., 2018). Therefore, it is speculated that the Mediterranean diet may modulate the physiological response to stress and help build mental resilience.

Although the relationship between diet quality and various chronic diseases has been established, little is known about the relationship between dietary patterns and perceived stress, specifically in the college-aged population. Thus, the aim of this study is to investigate the effects of Mediterranean and Western dietary patterns on perceived stress and mental distress, with a special emphasis on the college-aged population. It is hypothesized that adherence to the Mediterranean diet will be associated with a lower perceived stress score in comparison to the Western diet.

## Methods

### *Study design and participants*

The study protocol was reviewed and approved by Binghamton University's Institutional Review Board

(STUDY00000201). An anonymous survey was built using Google Forms. The survey consisted of demographic questions and three validated scales: The Food-Mood Questionnaire (FMQ), Kessler Psychological Distress Scale (K-6), and the Perceived Stress Scale (PSS). These scales assessed the connections between dietary patterns with mental distress and perceived stress from various perspectives. The Food Mood Questionnaire measured the frequency of food groups intake, while the K6 and PSS scales focused on mental distress and perceived stress, respectively. The intake of high-protein food, such as yogurt and beef, was assessed as well, through additional questions in the questionnaire, rather than a validated scale. The questionnaire additionally asked demographic questions, such as gender, age, GPA, and year in college. A built-in consent form was added to the survey and participants consented to the study by accepting access to the survey. Participants had the option to opt out of the study at any time. Research participation was completely voluntary and no compensation was offered to complete the study. Recruitment took place on Binghamton University campus through flyers with QR codes and the survey link was distributed using several social media platforms, such as Instagram and Facebook, to reach college students attending different universities. Although this study was primarily advertised toward undergraduate and graduate students at Binghamton University, any respondent over the age of 18 qualified as a participant. The questionnaire did not target college students particularly.

The FMQ is a short, valid, and reliable scale developed to evaluate the impact of food groups on mental distress (Begdache et al., 2019). It assesses average weekly servings of nine different food groups, which include components of the Western and Mediterranean Diets. It additionally measures the frequency of exercise throughout the week, as well as breakfast consumption. The Western diet is evaluated by the frequency of consumption of fast food, caffeinated beverages, and high glycemic (HGI) index foods, such as pasta, rice, meat, dairy, eggs, and cheese. The Mediterranean diet is assessed by the consumption of whole grains, dark green leafy vegetables, fruits, beans, fish, nuts, and fish oil. The intakes of these foods were quantified through the questionnaire responses, as students were able to select how many servings of the particular food they had consumed on an average week. The choices ranged from one to more than four times a week. To assess consumption of yogurt, milk, cheese, lean beef or lamb, fish, chicken and turkey, and eggs, the answer choices were as follows: never or less than once per month, 1–3 times per month, 1 time per week, 2–4 times per week, and 1–3 times per day. One of the questions directly asked whether the participant followed the Western or Mediterranean diet. The individual components of each diet were not used to produce a sum; however, they were grouped under a particular dietary pattern to allow for a mode of comparison when their specific correlations to mental distress and perceived stress were analyzed.

Mental distress was measured using both the individual scores and the total score of the K-6 Scale (Ko and Harrington, 2015). The PSS measured the perception of stress and the degree to which situations are perceived as stressful (Cohen et al., 1983). The total PSS score and individual items in the scale were analyzed to assess perceived stress in participants. The Food Mood Questionnaire has been used to assess diet intake for multiple cross-sectional studies, including one that determined the relationship between diet and dental anxiety (Begdache et al., 2023).

### Data coding

All responses to the questions in the questionnaire were numerically coded to draw correlations from the data set. The K-6 Scale assessed the level of mental distress in the participants by asking how often they felt hopeless, nervous, worthless, restless, or fidgety, so depressed that nothing could cheer [them] up, and that everything was an effort. Responses were provided on a Likert scale and were assigned the following codes: None of the time = 0, A little of the time = 1, Some of the time = 2, Most of the time = 3, or All of the time = 4.

Responses to the PSS questions were coded differently based on the nature of the question. The questions required respondents to affirm either positive or negative thoughts. The questions listed in Table 4 evaluated how often participants felt upset because of the unexpected, were unable to control the important things in their lives, felt nervous or stressed, were angered by things outside of their control, could not cope with all they had to do, and felt that difficulties were piling up higher than what they can overcome. Survey responses followed a five-point Likert scale. For negative items such as "... been upset because of something that happened unexpectedly", "Never" was coded as 0, "Almost never" was coded as 1, "Sometimes" was coded as 2, "Fairly often" was coded as 3, while "Very often" was coded as 4. Positive items such as "... Felt confident about your ability to handle personal problems" were reverse coded where "Never" was coded as a value of 4, "Almost never" was coded as 3, "Sometimes" was coded as 2, "Fairly often" was coded as 1, and very often was coded as a 0.

### Classification of dietary patterns

Although the Mediterranean diet is a well-researched dietary pattern, there is no standardized definition of what comprises the diet. The current study classified the Mediterranean diet based on recommendations by the 2020–2025 Dietary Guidelines for Americans (Dietary Guidelines for Americans, 2020). These guidelines specify that the diet consists of vegetables, beans, legumes, fruits, whole and refined grains, dairy products, poultry, seafood, nuts, seeds, and olive oil. Physical exercise was considered part of the Mediterranean diet/lifestyle pattern. The FMQ evaluated the frequency of consumption of dark leafy vegetables, fruits, whole grains, dairy

products, meat, starchy food, seafood, and nuts. The questionnaire assessed staple food consumption of the HGI foods as components of the Western diet. Not all components of the Western diet are inherently unhealthy; rather, its unbalanced nature makes it so.

### Statistical analysis

A multi-analyses approach was used to explore the individual and combined relationships between dietary patterns and individual food groups, and their association with perceived stress and mental distress. The first step was to reduce the dimensionality of the data by using Principal Component Analysis (PCA) and identifying the existing patterns. PCA is a data mining technique typically used for analyzing large datasets containing many features per observation. PCA condenses the large set of variables into a smaller number while conserving the most critical information that contributes most to the variance. The significance of a variable within a component is represented by the loading factor, which signifies the weight of the variable within the pattern (Varraso et al., 2012). This attribute explains the potential contribution of each variable within a dietary pattern to perceived stress and mental status. The next step was to perform a two-tailed Pearson's Correlation Coefficient (PCC) to further explore the relationships between the independent variables and perceived stress as well as mental distress. PCC and PCA were performed in IBM SPSS Version 28.0.

For this study, the primary outcomes measured were perceived stress and mental distress. These variables were tested by using the Perceived Stress Scale and Kessler-6 scale respectively. The responses obtained from these scales were then correlated with dietary consumption data to explore the potential relationships between dietary patterns, perceived stress, and mental distress. The secondary outcomes measured were exercise, breakfast patterns, and supplement patterns. The FMQ assessed these variables

**Table 1.** Baseline characteristics of the study population (n = 1591).

	Frequency	Percent %
Age		
18–29	1412	88.75
30+	179	11.25
Gender		
Male	1117	70.21
Female	450	28.28
Other	24	1.50
Education Completed		
High School	875	55.00
College Degree	610	38.34
Graduate	106	6.66
Region		
USA	1577	99.12
Outside of USA	14	0.88

along with diet consumption. Although the results pertaining to these secondary outcomes were collected as part of FMQ, they were not central to the primary focus of the study. Nevertheless, they were included in the analysis to provide additional insights. Correlations among responses from the dietary consumption component of the FMQ, against the PSS, and K6 scale were utilized to investigate the relationships between these secondary outcomes and perceived stress and mental distress.

### Principal component analysis

PCA was used to identify the dietary and mental distress patterns among respondents. The Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were used to test sample adequacy and inter-correlation of variables. The Eigenvalue  $\geq 1.0$  criterion was adopted to determine the number of principal components (PCs). The ideal number of components is based on the highest variance in the dataset. Additionally, PCs selection was confirmed by visually examining the scree plot, which is considered a stringent approach. PCs were orthogonally rotated using varimax rotation to enhance the interpretability of the results (Abdi and Williams, 2010). Variables with loading factors of  $\geq 0.3$  were considered vital to the patterns and were retained in the PC solution (Schulze et al., 2003). Positive and negative loadings propose direct and inverse relationships with the PCs, respectively.

**Table 2.** Principal component analysis reflecting Mediterranean diet and western diet patterns.

	Mediterranean diet	Western Diet
Leafy Vegetables	0.632	
Nuts	0.603	
Fruits	0.532	
Whole Grains	0.526	
Oats	0.52	
Exercise	0.509	
Seafood	0.471	
Beans	0.465	
Breakfast	0.459	
Fish	0.445	
Fast-food	-0.407	
Mental Distress	-0.398	
Perceived Stress Scale	-0.327	
Yogurt	0.305	
Caffeine		
Meat		
White meat		0.745
Dairy		0.64
Red meat		0.611
Cheese		0.583
Milk		0.522
Eggs		0.505
High Glycemic Index		0.453

Mental Distress (K-6) and Perceived Stress (PSS)

## Results

A total of 1591 participants completed the survey, of which 1117 participants (70.2%) identified as female and 450 participants (28.3%) identified as male (Table 1). Most respondents (1412 participants) were within the age range of 18–29 and 179 participants were 30 years or older (Table 1).

### Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity (BTS)

The KMO test produced a value above the accepted range of 0.6 (KMO = .704), which indicated that the strength of the relationships among variables was considerable. BTS produced a p-value of 0, confirming the suitability of the data for dimension reduction.

### Principal component analysis

Considering the highest variances, PCA produced two PCs comparable to the Mediterranean and Western diets. PC 1 excluded fast food and included leafy vegetables, nuts, fruits, whole grains, oats, exercise, seafood, beans, breakfast, fish, and yogurt. This PC explained 13.752% of the variance. PC 2 included white meat, dairy, lean red meat, cheese, milk, eggs, and high glycemic index food. It explained 11.316% of the variance. The total score of the PSS and K-6 were negatively associated with PC 1, the Mediterranean dietary pattern (Table 2). The classification obtained from PCA helped further categorize common food groups consumed in both patterns in the interpretation of the correlation analysis results.

Results from the correlation study supported the PCA findings. Several negative correlations with various components of the Mediterranean diet and the total scores of the K-6 Scale and PSS, respectively, surfaced. These components include eating breakfast ( $r = -.266$ ,  $p < .01$ ;  $r = .149$ ,  $p < .01$ ), nuts ( $r = -.119$ ,  $p < .01$ ;  $r = -.080$ ,  $p < .01$ ) dark leafy green vegetables ( $r = -.117$ ,  $p < .01$ ;  $r = -.091$ ,  $p < .01$ ), and fish ( $r = -.117$ ,  $p < .01$ ;  $r = -.076$ ,  $p < .01$ ). Whole grains and yogurt produced significant negative associations between mental distress ( $r = -.094$ ,  $p < .01$ ;  $r = -.073$ ,  $p < .01$ ) but not perceived stress. Meat, typically attributed to the Western diet, produced a negative association ( $r = -.068$ ,  $p < .01$ ) only with mental distress scores. In contrast, several positive associations were obtained between components of the Western diet and the total scores of the K-6 Scale and PSS, such as high-glycemic index food ( $r = .055$ ,  $p < .05$ ;  $r = .60$ ;  $p < .01$ ) and fast-food ( $r = .205$ ,  $p < .01$ ;  $r = .187$ ,  $p < .01$ ) (Table 3).

### Dietary patterns and attributes of the K-6 scale

Several components of the Mediterranean diet, such as breakfast, nuts, fish, and oats, produced negative associations with every attribute of the K-6 Scale ( $p < .01$ ) (Table 4). Breakfast was associated with every feature on

the scale. Most of the Mediterranean diet components had a negative association with depressive symptoms rather than with anxious behaviors, especially whole grains (Table 4).

As for the Western diet, interesting findings were detected. Fast food was strongly associated with every aspect of mental distress ( $p < .01$ ) (Table 4). Caffeine was linked to anxious feelings, such as nervousness ( $r = .072$ ,  $p < .01$ ) and restlessness ( $r = .105$ ,  $p < .01$ ) more so than

depressive symptoms except for “everything is an effort” ( $r = .058$ ,  $p < .05$ ) (Table 4).

### Dietary patterns and negative attributes of the PSS

For the Mediterranean diet, exercise produced strong negative correlations with every aspect of the PSS. Exercise was followed by breakfast, fish/seafood, nuts, and dark green vegetables, which produced negative correlations with five out of the six attributes mostly related to anger and being nervous. Oats produced a weak correlation with perceived stress characteristics. As for the Western diet, fast food produced a positive correlation with every characteristic of perceived stress ( $p < .01$ ) (Table 5). Meat had one negative association with “could not cope with things in life” ( $r = -.064$ ,  $p < .05$ ) (Table 5). Multivitamins produced a positive association with being nervous and stressed ( $r = .053$ ,  $p < 0.01$ ), while fish oil consumption was negatively correlated with being “unable to control” oneself ( $r = -.060$ ,  $p < 0.01$ ) (Table 5).

**Table 3.** PCC analysis of dietary components with mental distress and perceived stress total scores.

	Mental Distress	Perceived Stress
Exercise	-.177**	-.167**
Breakfast	-.266**	-.149**
Whole Grains	-.094**	-0.044
Caffeine	.064*	.075**
Nuts	-.119**	-.080**
High Glycemic Index food	.055*	.060*
Meat (all types)	-.068**	-0.028
LGV	-.117**	-.091**
Beans	-.070**	-.069**
Fish	-.117**	-.076**
Fast-food	.205**	.187**
Yogurt	-.073**	-0.009
Red meat	-.085**	-.081**

\*  $P < 0.05$  level (2-tailed).

\*\*  $P < 0.01$  level (2-tailed).

### Discussion

The goal of this study was to compare the potential effect of the Mediterranean diet versus the Western diet on perceived stress and mental distress. For perceived stress in particular, the aim was to evaluate the differences between positive and negative attributes of perceived stress. Generally, the results indicate that following the Western diet was

**Table 4.** PCC analysis between food groups categorized by dietary patterns and attributes of mental distress.

	Hopeless	Nervous	Restless	So Depressed	Everything is an effort	Worthless
<b>Mediterranean Diet</b>						
Exercise	-.159**	-.125**	-.085**	-.138**	-.189**	-.162**
Breakfast	-.221**	-.133**	-.225**	-.252**	-.234**	-.225**
Whole Grains	-.113**	-0.015	-0.018	-.113**	-.095**	-.098**
DLV	-.113**	-0.039	-.072**	-.094**	-.153**	-.094**
Fruits	-0.01	0.02	0.02	-0.008	-0.044	-0.008
Nuts	-.124**	-.052*	-.077**	-.100**	-.107**	-.117**
Beans	-.062*	-0.03	-.069**	-.054*	-.062*	-.062*
Meat	-.065**	-0.028	-.065**	-.065**	-0.036	-.068**
Fish	-.113**	-.081**	-.084**	-.107**	-.124**	-.136**
Oats	-.085**	-.058*	-.068**	-.102**	-.103**	-.114**
Yogurt	-.050*	-.052*	-.100**	-0.049	-.056*	-.049*
<b>Western Diet</b>						
Caffeine	0.033	.072**	.105**	0.028	.058*	0.017
HGI	0.038	0.047	.071**	0.011	.088**	0.009
Fast-food	.164**	.170**	.163**	.156**	.208**	.134**
Milk	-0.018	-.064*	-0.039	-0.018	0.003	-0.026
Cheese	-.053*	0.024	-0.009	-0.027	-0.014	-.069**
Red meat	-.065**	-.110**	-.074**	-.053*	-0.044	-.071**
Eggs	-.098**	-.055*	-0.042	-.123**	-.052*	-.116**
White meat	-.064*	0.01	-.059*	-.082**	-0.039	-.079**
Others						
MV	-.067**	0.046	0.011	-0.024	-.067**	-.079**

\*  $P < 0.05$  level (2-tailed).

\*\*  $P < 0.01$  level (2-tailed).

**Table 5.** PCC analysis between food groups categorized by dietary patterns and negative attributes of perceived stress.

	Upset	Unable to Control	Nervous and Stressed	Angered	Could not Cope	Difficulties pile up
<b>Mediterranean Diet</b>						
Exercise	-.105**	-.110**	-.133**	-.073**	-.163**	-.157**
Breakfast	-.107**	-.136**	-.098**	-0.031	-.131**	-.158**
Whole Grains	-0.040	-0.027	-0.011	-0.005	-0.048	-.065*
DLV	-.056*	-.080**	-0.032	-.053*	-.078**	-.105**
Nuts	-.082**	-.049*	-0.046	-.059*	-.074**	-.054*
Beans	-.079**	-0.045	-0.044	-.074**	-0.036	-0.043
Meat	0.002	-0.020	-0.030	0.027	-.064*	-0.034
Fish	-.080**	-.064*	-.069**	-0.010	-.061*	-.060*
Seafood	-.083**	-.084**	-.086**	-0.010	-.093**	-.077**
Oats	-.059*	-0.024	-.079**	-0.005	-0.029	-0.031
<b>Western Diet</b>						
Caffeine	.055*	.074**	.083**	.069**	0.049	0.014
Fast-food	.131**	.156**	.122**	.117**	.139**	.176**
HGI	.053*	0.049	.071**	-0.030	0.037	.083**
Milk	-0.006	0.013	-.050*	-0.017	0.023	.069**
Red Meat	-.058*	-.067**	-.113**	-0.011	-.062*	-.051*
Eggs	-0.045	-.087**	-.059*	0.018	-.091**	-0.025
<b>Others</b>						
MV	0.004	-0.025	.053*	0.022	-0.004	-0.038
Fish Oil	-0.039	-.060*	-0.042	-0.007	-0.040	-0.026

\* P &lt; 0.05 level (2-tailed).

\*\* P &lt; 0.01 level (2-tailed).

associated with higher levels of perceived stress, mental distress, and overall stress in comparison to following the Mediterranean diet. The purpose of PCA analysis was two-fold. First, to assess the association of food groups within a pattern with total scores of mental distress and perceived stress. Second, to aid in further defining these dietary patterns. PCA produced two components representative of the diets. Mental distress and perceived stress total scores had a negative loading within the Mediterranean diet pattern. It was expected that they would produce a positive loading within the Western diet pattern. This finding could be due to the power of these food groups in modulating the stress response and mental well-being. This notion was further supported by the correlation analyses that showed robust inverse relationships between Mediterranean components and K-6 and PSS attributes. Compared to the components of the Western diet, the Mediterranean diet had more negative correlations with negative attributes of the K-6 and PSS. It also had more positive correlations with positive attributes of the PSS. Specifically, dark leafy greens were negatively correlated with almost all negative factors of the K-6 and PSS, except for "Nervous" and "Nervous and stressed" respectively. Dark leafy greens additionally had all positive correlations for the positive attributes of the PSS. Many plant foods, such as fruits, vegetables, roots, and botanicals, contain natural sources of neurotransmitters like acetylcholine (ACh), glutamate, GABA, dopamine, serotonin, and histamine (Briguglio et al., 2018). These neurotransmitters moderate the nervous system, which impacts mental health and the stress response. In addition, animal food is a good source of several precursors for

serotonin, dopamine, and glutamate, such as tryptophan, tyrosine, and glutamic acid, respectively (Briguglio et al., 2018), which contribute to the mental state.

Some plant food is particularly rich in Vitamin B<sub>1</sub> (Fitzpatrick and Chapman, 2020), which is a precursor for ACh (Calderón-Ospina and Nava-Mesa, 2019). Meat and eggs provide choline, an integral part of ACh (Gibb, 2017). Although it is not directly linked to stress, ACh is believed to be a neuromodulator with adaptive properties (Higley and Picciotto, 2014). This may explain the strong association detected between plant and animal sources of choline and perceived stress indicators. Interestingly, fast food was associated with every mental distress characteristic. The other food items displayed a differential pattern. HGI food and caffeine had positive associations with anxious feelings, whereas animal proteins produced negative associations. This was puzzling, as the literature ties animal food to a higher risk of mental health ailments (Beezhold and Johnston, 2012; Zhang et al., 2017). However, more recent reports are hinting otherwise (Hibbeln et al., 2018; Meesters et al., 2017). Dairy, eggs, and chicken are good sources of tyrosine, a dopamine precursor (Kühn et al., 2019). Dopamine plays a critical role in locomotion, motivation, and reward.

While the Western Diet partially consists of food that are nutritionally dense and have health benefits, such as white meat and eggs, it is the low-nutrient foods that ultimately are positively correlated with mental distress and perceived stress. Although white meat, eggs, and even red meats produce negative correlations with questions assessing mental distress and perceived stress, caffeine, fast food,

**Table 6.** PCC analysis between food groups categorized by dietary patterns and positive attributes of perceived stress.

	Confident to handle problems	Things going your way	Able to control irritations	On top of things
<b>Mediterranean Diet</b>				
Exercise	.146**	.127**	.161**	.197**
Breakfast	.149**	.175**	.116**	.193**
Whole Grains	.070**	.068**	.068**	.087**
Fruits	0.020	0.032	.056*	0.046
Nuts	.090**	.115**	.057*	.082**
Meat	.058*	0.003	0.029	.076**
GLV	.072**	.100**	.082**	.136**
Beans	.052*	.096**	0.046	.088**
Seafood	.072**	0.040	.066**	.102**
Fish	.072**	0.029	.072**	.114**
Oats	.089**	.061*	.072**	.103**
<b>Western Diet</b>				
Fast-food	-.081**	-.080**	-.048	-.145**
Cheese	0.039	0.040	-.007	.066**
Red meat	.066**	0.021	0.040	.090**
Eggs	0.047	.074**	0.021	0.036
<b>Others</b>				
MV	.055*	.073**	.068**	.097**
FO	0.038	.052*	0.037	0.025

\* P &lt; 0.05 level (2-tailed).

\*\* P &lt; 0.01 level (2-tailed).

and HGI foods are positively correlated with such questions. Another worthy observation is that animal proteins and flesh, such as meat, seafood, milk, and eggs, had a negative association with being “Nervous or stressed”. Upon further investigation, lean red meat had negative associations with all attributes of perceived stress except for being “Angered”. The controversial reports explaining the association between animal protein and mental status could be explained in part by the composition of the microbiota established by dietary patterns as modulators of the gut microbiome. The microorganisms in the human gastrointestinal tract contribute to the production of neurotransmitters (Briguglio et al., 2018). Many non-communicable diseases are caused by or are associated with changes in the gut microbiota. The Western diet is partly linked to an increased risk of chronic disease potentially through inflammation, while the Mediterranean diet positively modulates the immune system (García-Montero et al., 2021). Higher levels of stress in individuals following the Western diet could be described by the role of inflammatory cytokines in the development and progression of stress (Carvalho et al., 2018). Consuming low-nutrient foods may activate inflammatory pathways and increase the risk for mental health issues (Lahouti et al., 2021). Inflammation induces oxidative stress, which exacerbates mental disorders (Carvalho et al., 2018; Xu et al., 2020). Knight et al. (2021) proposed an allostatic load model explaining the connection between psychosomatic health, mainly perceived stress, and inflammation. A high-fat

diet, like the Western diet, supports higher cortisol production, which increases the risk of metabolic dysfunctions (Statovci et al., 2017) and adds to negative mental health outcomes (Zahedi et al., 2014). Overconsumption of sugar alters neuroplasticity, which reduces impulse control and disturbs neural pathways involved in emotion regulation (Jacques et al., 2019). Consequently, mental disorders, such as anxiety and depression, become more eminent.

The physiological effects of several Mediterranean dietary components have been explored. These components possess anti-inflammatory and anti-oxidative properties, with beneficial metabolic effects on the brain (Bayes et al., 2020; Liu et al., 2020; Ribeiro et al., 2017). The high polyphenol content in the diet also has a positive effect on mental health (Bayes et al., 2020). By consuming a spectrum of nutrients, the functioning of the nervous system is optimized, leading to the effective synthesis of neurotransmitters and mood enhancement (Zahedi et al., 2014). Interestingly, components of the Mediterranean diet produced mostly robust associations with positive attributes of the PSS. Exercise, breakfast, whole grains, nuts, green leafy vegetables, and oats strongly ( $p < .01$ ) correlated with every positive feature (Table 6). All of the food groups, except fruits, had a significant association with “feeling confident” ( $p < .01$ ) (Table 6). This suggests that the diet may have a relationship with resilience and positive stress mindset.

### Strengths and limitations of the study

A major strength of this study is that it fills a gap in the literature by assessing the role of dietary patterns on perceived stress. Another strength is the large sample size. However, the cross-sectional nature of the study is a limitation, as only correlations can be detected. There is no definite evidence that dietary patterns induce a change in mental functioning. The survey methodology additionally limits the understanding of the mechanism of action that the dietary components play on inflammation and brain functioning. Additionally, surveys are susceptible to reporter bias, as participants may possibly provide inaccurate information. Future research should implement a longitudinal study with a cross-over design to effectively assess the effect of each diet on mental distress and perceived stress.

### Conclusion

Consuming components of the Mediterranean diet was associated with lower levels of perceived stress and mental distress, while consuming Western dietary components was positively correlated with perceived stress and mental distress. However, it should be noted that animal protein, which is typically considered part of the Western diet, was negatively correlated with perceived stress and mental distress, which warrants further investigation. Most foods comprising the Mediterranean diet are rich in antioxidants and anti-inflammatory agents. They also consist of nutrients that are

building blocks for neurotransmitters that regulate mood and stress. On the other hand, the Western diet lacks these nutrients and includes a higher ratio of Omega-6 to Omega-3 fats, which fuel inflammation. Consuming processed, high-sugar food and caffeine has also been associated with higher levels of cortisol, which adds to the stress response. Overall, the results of the study pave the way for future research on the effects of dietary patterns and their association with different components of stress response and mental distress.

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### Author contributions

Author sequence follows the “sequence-determines-credit” (Tschamtko et al., 2007). All authors developed the presented idea, discussed the results, and contributed to the final manuscript.

### Availability of data and materials

Survey and responses are available in Google Drive.

### Consent for publication

Yes

### Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.


### Ethics approval


The study protocol was reviewed and approved by Binghamton University’s Institutional Review Board (STUDY00000201).

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