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Cross-sectional Analysis of the Relationship Between Adherence to the Mediterranean Diet and Mental Wellness

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Abstract

The Mediterranean Diet (MD) is a well-known healthy dietary pattern that continues to be recommended by literature due to its benefits of preventing chronic diseases and enhancing the overall health of the general public. With an abundance of literature focusing on the physical health benefits of MD, this study aimed to assess whether there is an association between adherence to MD and mental wellness, specifically levels of depression and anxiety. A random sample of 100 participants consented to complete an online survey to assess their adherence to MD and levels of depression and anxiety through the validated questionnaires of 14-item Questionnaire of Mediterranean Diet Adherence, Generalized Anxiety Disorder-7 (GAD-7), and Beck's Depression Inventory (BDI) assessment. Spearman's rank correlation coefficient analysis was used to identify the possible correlations between MD and depression as well as MD and anxiety. The results demonstrated a significant negative correlation for both indicating that adherence to MD is associated with lower levels of depression and anxiety.

Key Words: Mediterranean diet, mental well-being, diet, anxiety, depression

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Introduction

The overall purpose and importance of this research study was to determine if there was a relationship between adherence to the Mediterranean diet and mental wellness. This study used the basis of the Mediterranean diet to measure the quality of participants' daily dietary patterns, while also looking at participants levels of anxiety and depression to measure their overall mental well-being. Analyzing the relationship between dietary patterns and mental health can promote better public health efforts to improve healthy eating habits. The survey itself also acted as a reflective mechanism for participants, as they reflected on their mood, what they typically consume daily, and if they experience symptoms of anxiety and depression. The study provided an opportunity to self-reflect on one's mood and diet and potentially allowed subjects to identify goals for improvement. The results of the study can also potentially draw significant conclusions about the importance of nutrition in both mental and physical well-being.

Review of Literature

Mediterranean Diet

First described by Ancel Keys, the Mediterranean Diet (MD) is a well-known diet consisting of healthy foods such as fruits, vegetables, whole grains, legumes, fish, and nuts.[1] It is rich in fiber, antioxidants, and omega-fatty acids. The diet limits or avoids consumables such as processed foods, red meats, refined grains, and added sugars.[1] First observed in Greece and Italy in the 1960s, the MD has become a popular and recognized diet over the last several decades.[1] Overall, there is a plethora of research indicating the benefits of MD, including preventing cardiovascular disease and reducing the risks associated with diabetes, hypertension, and obesity.

[1, 2,3] In the article, *Association between adherence to the Mediterranean diet and prevalence of cardiovascular risk factors,* the authors conducted a cross-sectional descriptive study on a cohort of 23,729 individuals with a high prevalence of cardiovascular risk factors such as alcohol and smoking use.[2] Using the Mediterranean Diet Adherence Screener (MEDAS-14), the authors determined that 51.3% of the participants showed to adhere to the MD.[2] The authors also found an inverse and significant relationship between adherence to the MD, abdominal obesity, dyslipidemia, and metabolic syndrome.[2] The authors concluded the MD can be an effective tool in promoting one's cardiovascular health.[2]

Another article entitled, *Mediterranean Diet Nutrients to Turn the Tide Against Insulin Resistance and Related Diseases,* looked at the relationship between insulin resistance (IR) and adherence to the MD. IR, a dysmetabolic condition, is often found in individuals with obesity and type II diabetes, as well as pathological conditions such as non-alcoholic fatty liver disease (NAFLD) and chronic kidney disease (CKD).[3] The authors extrapolate the importance of the MD and the insulin-sensitizing nutritional supplements derived from the diet.[3] It is shown that polyunsaturated fatty acids from olive oil, anthocyanins from purple fruits and vegetables, resveratrol from grapes, and oleocanthal found in extra-virgin olive oil can positively modulate pathognomonic traits of IR-related conditions. The components of the MD can also play a role in gene expression.[3] Overall, the authors conclude that partaking in MD can positively contribute to the management, prognosis, and treatment of IR-related conditions.[3]

Mental Wellness

On the contrary, what about mental health? Can adherence to the MD reduce levels of anxiety and depression? As research evolves, there is growing evidence that partaking in the MD can be beneficial to not only physical health but mental health as well.[1] One group of researchers analyzed the emotional well-being of university students using two different assessments. A 14-point questionnaire on adherence to the MD was given to the students along with a questionnaire measuring various positive and negative moods. Based on the results, the authors determined a statistically significant and inverse relationship between adherence to the MD and emotional well-being.[4] When a participant reported adherence to the MD, the participant also reported lower levels of anxiety and depression.[4] The authors also suggested that the high intake of key parts of the MD such as olive oil, fish, fruits, vegetables, and legumes particularly contributed to the reported lower levels of anxiety and depression.[4] It was also found that the participants who had higher scores on the diet assessment proved to have improved scores on the mental well-being assessment.[4] Overall, it was shown that adherence to the MD is positively correlated to a more positive outlook and quality of life.[4] This emerging evidence continues to promote and encourage future studies to evaluate the relationship between diet and mental well-being.

Adherence to the MD has also been shown to reduce the severity of depressive symptoms in adults living in the United States. In 2019, the National Institute of Mental Health Information Resource Center reported that 19.4 million adults, or 7% of U.S adults, experienced a major depressive episode.[5] Depression is also a leading cause of disability with pharmaceutical mechanisms often producing ineffective results or related side effects.[5] Genetic, social,

psychological, environmental, and biochemical factors can all play a role in the development and progression of depression.[5] Specifically, diet can drastically affect the onset and prognosis of depression.[5] There is recent evidence supporting the hypothesis that a pro-inflammatory diet, such as the MD can prevent or reduce the symptoms of depression.[5] Another group of researchers studied the effects of MD adherence on feelings of depression. The authors collected detailed information about participants' diet using a food frequency questionnaire and other variable factors such as body mass index, level of physical activity, and smoking use.[6] Data was collected from 49, 261 Swedish women, where 1,677 of the participants were already diagnosed with depression.[6] The results of the study found that adherence to the MD was correlated with lower levels of depression.[6] Since depression is so prevalent in the United States, there must be more evidence supporting the MD and the positive effect it can have on one's overall mental well-being.

Despite the MD being recommended to the general population as the overall healthy dietary pattern to follow, there have been some discrepancies in adhering to it, especially between different racial/ethnic groups. A group of researchers indicated that positive effects, such as cardiovascular disease benefits, had been achieved for only individuals at higher socioeconomic levels.[7] This possibly indicates that the MD may not be available to certain racial/ethnic groups with well-documented socioeconomic disparities and poor food security. Despite this affordability concern, it has been shown that such populations may still be able to adhere to Mediterranean-like foods that are both culturally appropriate and cost-effective. Such

foods include beans, canned tuna, corn oil, and frozen or canned fruits and vegetables.[8,9] These concerns should be kept in consideration when assessing adherence to the MD across all racial/ethnic groups. The well-being of the general public regarding nutrition should be of high priority to healthcare professionals, especially to the most vulnerable groups due to their risk of significant health disparities and disproportionally high multimorbidity.[9]

Based on the growing evidence between diet and mood, patients and healthcare professionals need to consider diet when evaluating one's lifestyle and well-being.[10] It is also important for healthcare providers to implement diet and the use of a food diary into one's treatment and care plan. Various nutritional deficiencies, including zinc and B vitamins, can also play a role in a low mood. By partaking in a food diary, patients can write down and reflect on what they are consuming daily. Patients can also report foods that trigger symptoms or unpleasant effects, while also reporting which foods produce "feel good" effects. Since the MD encourages the consumption of multiple food groups, people who adhere to it often consume a nutrient-dense diet, while also being at a reduced risk of developing a deficiency, compared to those who consume a Western diet.[11] Overall, it is important that more research is done on the relationships between one's diet, in particular the MD, and levels of anxiety and depression.

Research Question/Aims of the Project

The purpose of this research study was to answer the question of whether or not adherence to the MD is correlated with lower levels of anxiety and depression. The project aimed

to collect an efficient amount of data from anonymous participants to determine if there is a significant correlation between diet, specifically the MD, and overall mental well-being.

Hypothesis

The hypothesis of the research study was that there is a negative correlation between adherence to MD and depression, and MD and anxiety.

Methodology

Institutional Review Board Approval

To conduct the survey, prior approval was granted through the Nova Southeastern Institutional Review Board.

Recruitment

Participants were required to be at least 18 years old to be eligible to partake in the survey. Recruitment of participants was conducted by marketing the survey on bulletins at fitness clubs and on social media (Facebook and Instagram). The survey was able to be accessed by scanning a mobile device over the quick response code on the marketing flier or by going to the website link.

Instruments

Before the start of the survey, participants were presented with the online Informed Consent Form. If consent was given, participants selected the ‘I agree’ button which then brought them to the beginning of the survey. The online survey consisted of four separate sections: Demographics and three separate validated questionnaires including the 14-item

Questionnaire of Mediterranean Diet Adherence [12], Generalized Anxiety Disorder-7 (GAD-7) [13], and Beck's Depression Inventory (BDI).[14]

Participants answered the 3 demographic questions including age, gender, and ethnicity, the 14-item Questionnaire of Mediterranean Diet Adherence, the 7-item GAD-7, and the 21-item BDI. [12-14] The entire survey took approximately 10 minutes to complete. Upon completion, participants submitted the survey and exited the browser.

Data Collection

The anonymous data from the survey was collected through REDCap. The goal was to collect data from approximately 150-200 participants, however, there was a 300 limit for the number of subjects that could complete the survey. The survey was planned to be terminated when 300 participants completed the survey.

Data Analysis

Spearman's rank correlation coefficient was used to analyze the strength and direction of association of the ordinal data between Mediterranean Diet Adherence assessment and GAD-7 anxiety assessment as well as Mediterranean Diet Adherence assessment and BDI. [15]

Data Storage

The de-identified data was exported from REDCap and is stored on the principal and co-investigators' password-protected personal laptops. Upon completion of the study on 08/07/2022, the project on REDCap, including all of its data, will be permanently deleted. Exported data will remain stored on the investigators' laptops for at least 36 months.

Results

Sample

A sampling of the study was acquired randomly and consisted of 100 participants ranging from ages 19 to 77, with a mean age of 37. Involving gender, 61% were women and 31% were men. Upon participant self-report, ethnicity/race breakdown included 79% White, 10% Hispanic, 5% 2 or more different ethnicities/races, 3% Asian, 2% African American or Black, and 1% Other.

Findings

Scores received by the participants on the 14-item Questionnaire of Mediterranean Diet Adherence, BDI, and GAD-7 were calculated by the researchers. Each assessment was then further ranked individually to prepare for data analysis via Spearman's correlation coefficient (r_s).

The Spearman's rank correlation coefficient analysis was used to identify any possible correlations between MD and depression as well as MD and anxiety. As reported in Table 2, the results of the analysis show Sig. (2-tailed) = 0.0001 for depression and Sig. (2-tailed)= 0.0191 for anxiety. Both values are less than 0.05, indicating that there is a significant correlation between both MD and depression as well as MD and anxiety. Additionally, both depression and anxiety have negative r_s values, indicating a negative correlation with MD for both. Due to MD and anxiety having an r_s value (-0.234) closer to zero compared to MD and depression (r_s=-0.369), MD and anxiety demonstrate a weaker association between their ranks. Upon further examination, the data analysis supports the hypothesis of there being a negative correlation between adherence to MD and depression, and MD and anxiety.

Discussion

The main purpose of the study was to determine if there was a correlation between adherence to the MD and levels of anxiety and depression. The participants anonymously completed the survey, answering questions about their diet and overall mental well-being. The data revealed a negative correlation between adherence to the MD and depression, as well as adherence to the MD and anxiety. Based on the analysis, adherence to the MD was correlated with lower levels of anxiety and depression. These findings suggest that one's diet can potentially play a role in one's overall mental well-being. The results of the study support the hypothesis that there is a negative correlation between adherence to MD and depression, and MD and anxiety. The most interesting result of the survey was the significant correlation between adherence to the MD and depression. The results showed that adherence to the MD was more closely related to lower levels of depression than anxiety. This may be because the MD is filled with anti-inflammatory foods such as fruits, vegetables, and omega-fatty acids. It may also be since the MD avoids processed, fast foods.

When looking at the results of the study, it is important to note the sample size and its limitations. Only 100 participants' data were used for analysis, which could affect the results of the study. In addition, 61% of the participants were women and 79% of the participants were white. Since the sample size was not significantly diverse, the results of the study could have been skewed. Being marketed at fitness facilities, the participants completing the survey could also be actively participating in physical activity. Although not directly asked, whether the participant was participating in physical activity weekly could play a role in the results of the study. It is also difficult to know whether or not participants reported accurate answers. For example, a participant may select what they think is the best answer, rather than selecting what

they are actually feeling and consuming on a daily basis. Despite the survey being anonymous, participants may feel judged by the questions and avoid answering the questions truthfully due to the potentially triggering questions involving anxiety and depression.

Despite the potential limitations in the research study, the study yielded interesting results that could be further explored. For example, it would be interesting to incorporate the level of physical activity in which the participant engages. In addition, it would be interesting to see if the participant participated in any mind-body techniques such as yoga, tai-chi, or meditation. The present study did not look at the physical activity level of the participant, which could potentially leave out interesting data and its relationship to diet and mental well-being. A future study, with a longer time frame, could aim to ask the participants questions that analyze their entire well-being. Important factors such as alcohol consumption, smoking, level of activity, medication use, and sleep patterns could all potentially affect the results of the study. Expanding knowledge on the relationship between adherence to the MD and anxiety and depression can positively influence the field of nutrition, as well as promote the importance of diet and lifestyle changes that can positively impact one's overall mental well-being.

Conclusions and Future Implications

Overall, the data analysis supports the hypothesis of a negative correlation between adherence to MD and depression, and MD and anxiety. Based on the growing evidence between diet and mood, patients and healthcare professionals need to consider diet when evaluating one's lifestyle and well-being. Healthcare providers must implement diet and the use of a food diary into one's treatment and care plan. In addition, healthcare professionals should also consider lifestyle factors such as physical activity, smoking, and alcohol consumption that could

potentially play a role in one's mental well-being. It is essential, however, for individuals to understand that overall mental well-being and diet are not a "one size fits all". Some individuals may significantly benefit from the MD, while others may not notice any positive effects on their mental state. It is important for individuals to determine what diet and lifestyle are beneficial for them and to talk to their healthcare provider for further guidance. To conclude, it is integral that more research is done on the relationships between one's diet, in particular the MD, and levels of anxiety.

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Appendices

Table 1. Validated 14-Item Questionnaire of Mediterranean Diet Adherence

Questions	Criteria for 1 point
1. Do you use olive oil as main culinary fat?	Yes
2. How much olive oil do you consume in a given day (including oil used for frying, salads, out-of-house meals, etc.)?	≥4 tbsp
3. How many vegetable servings do you consume per day? (1 serving : 200 g [consider side dishes as half a serving])	≥2 (≥1 portion raw or as a salad)
4. How many fruit units (including natural fruit juices) do you consume per day?	≥3
5. How many servings of red meat, hamburger, or meat products (ham, sausage, etc.) do you consume per day? (1 serving: 100–150 g)	<1
6. How many servings of butter, margarine, or cream do you consume per day? (1 serving: 12 g)	<1
7. How many sweet or carbonated beverages do you drink per day?	<1
8. How much wine do you drink per week?	≥7 glasses
9. How many servings of legumes do you consume per week? (1 serving : 150 g)	≥3
10. How many servings of fish or shellfish do you consume per week? (1 serving 100–150 g of fish or 4–5 units or 200 g of shellfish)	≥3
11. How many times per week do you consume commercial sweets or pastries (not homemade), such as cakes, cookies, biscuits, or custard?	<3
12. How many servings of nuts (including peanuts) do you consume per week? (1 serving 30 g)	≥3
13. Do you preferentially consume chicken, turkey, or rabbit meat instead of veal, pork, hamburger, or sausage?	Yes
14. How many times per week do you consume vegetables, pasta, rice, or other dishes seasoned with sofrito (sauce made with tomato and onion, leek, or garlic and simmered with olive oil)?	≥2

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Table 2. Spearman's Rank Correlation Coefficient Analysis

		Depression	Anxiety
Mediterranean Diet	r_s	-0.369	-0.234
	N	100	100
	T-value	3.93	2.38
	df	98	98
	Sig.(2-tailed)	0.0001	0.0191

Figures

Figure 1. GAD-7 Anxiety Survey to Measure Mental Wellness

GAD-7 Anxiety

Over the last two weeks, how often have you been bothered by the following problems?	Not at all	Several days	More than half the days	Nearly every day
1. Feeling nervous, anxious, or on edge	0	1	2	3
2. Not being able to stop or control worrying	0	1	2	3
3. Worrying too much about different things	0	1	2	3
4. Trouble relaxing	0	1	2	3
5. Being so restless that it is hard to sit still	0	1	2	3
6. Becoming easily annoyed or irritable	0	1	2	3
7. Feeling afraid, as if something awful might happen	0	1	2	3

Column totals _____ + _____ + _____ + _____ =

Total score _____

If you checked any problems, how difficult have they made it for you to do your work, take care of things at home, or get along with other people?

Not difficult at all	Somewhat difficult	Very difficult	Extremely difficult
☐	☐	☐	☐

Source: Primary Care Evaluation of Mental Disorders Patient Health Questionnaire (PRIME-MD-PHQ). The PHQ was developed by Drs. Robert L. Spitzer, Janet B.W. Williams, Kurt Kroenke, and colleagues. For research information, contact Dr. Spitzer at ris8@columbia.edu. PRIME-MD® is a trademark of Pfizer Inc. Copyright© 1999 Pfizer Inc. All rights reserved. Reproduced with permission

Scoring GAD-7 Anxiety Severity

This is calculated by assigning scores of 0, 1, 2, and 3 to the response categories, respectively, of "not at all," "several days," "more than half the days," and "nearly every day."
GAD-7 total score for the seven items ranges from 0 to 21.

0–4: minimal anxiety

5–9: mild anxiety

10–14: moderate anxiety

15–21: severe anxiety

Figure 2. Beck's Depression Inventory to Measure Mental Wellness

Beck's Depression Inventory

This depression inventory can be self-scored. The scoring scale is at the end of the questionnaire.

1.
- 0 I do not feel sad.
- 1 I feel sad
- 2 I am sad all the time and I can't snap out of it.
- 3 I am so sad and unhappy that I can't stand it.

2.
- 0 I am not particularly discouraged about the future.
- 1 I feel discouraged about the future.
- 2 I feel I have nothing to look forward to.
- 3 I feel the future is hopeless and that things cannot improve.

3.
- 0 I do not feel like a failure.
- 1 I feel I have failed more than the average person.
- 2 As I look back on my life, all I can see is a lot of failures.
- 3 I feel I am a complete failure as a person.

4.
- 0 I get as much satisfaction out of things as I used to.
- 1 I don't enjoy things the way I used to.
- 2 I don't get real satisfaction out of anything anymore.
- 3 I am dissatisfied or bored with everything.

5.
- 0 I don't feel particularly guilty
- 1 I feel guilty a good part of the time.
- 2 I feel quite guilty most of the time.
- 3 I feel guilty all of the time.

6.
- 0 I don't feel I am being punished.
- 1 I feel I may be punished.
- 2 I expect to be punished.
- 3 I feel I am being punished.

7.
- 0 I don't feel disappointed in myself.
- 1 I am disappointed in myself.
- 2 I am disgusted with myself.
- 3 I hate myself.

8.
- 0 I don't feel I am any worse than anybody else.
- 1 I am critical of myself for my weaknesses or mistakes.
- 2 I blame myself all the time for my faults.
- 3 I blame myself for everything bad that happens.

9.
- 0 I don't have any thoughts of killing myself.
- 1 I have thoughts of killing myself, but I would not carry them out.
- 2 I would like to kill myself.
- 3 I would kill myself if I had the chance.

10.
- 0 I don't cry any more than usual.
- 1 I cry more now than I used to.
- 2 I cry all the time now.
- 3 I used to be able to cry, but now I can't cry even though I want to.

Figure 2. Beck's Depression Inventory to Measure Mental Wellness (Continued)

11.
- 0 I am no more irritated by things than I ever was.
- 1 I am slightly more irritated now than usual.
- 2 I am quite annoyed or irritated a good deal of the time.
- 3 I feel irritated all the time.

12.
- 0 I have not lost interest in other people.
- 1 I am less interested in other people than I used to be.
- 2 I have lost most of my interest in other people.
- 3 I have lost all of my interest in other people.

13.
- 0 I make decisions about as well as I ever could.
- 1 I put off making decisions more than I used to.
- 2 I have greater difficulty in making decisions more than I used to.
- 3 I can't make decisions at all anymore.

14.
- 0 I don't feel that I look any worse than I used to.
- 1 I am worried that I am looking old or unattractive.
- 2 I feel there are permanent changes in my appearance that make me look unattractive
- 3 I believe that I look ugly.

15.
- 0 I can work about as well as before.
- 1 It takes an extra effort to get started at doing something.
- 2 I have to push myself very hard to do anything.
- 3 I can't do any work at all.

16.
- 0 I can sleep as well as usual.
- 1 I don't sleep as well as I used to.
- 2 I wake up 1-2 hours earlier than usual and find it hard to get back to sleep.
- 3 I wake up several hours earlier than I used to and cannot get back to sleep.

17.
- 0 I don't get more tired than usual.
- 1 I get tired more easily than I used to.
- 2 I get tired from doing almost anything.
- 3 I am too tired to do anything.

18.
- 0 My appetite is no worse than usual.
- 1 My appetite is not as good as it used to be.
- 2 My appetite is much worse now.
- 3 I have no appetite at all anymore.

19.
- 0 I haven't lost much weight, if any, lately.
- 1 I have lost more than five pounds.
- 2 I have lost more than ten pounds.
- 3 I have lost more than fifteen pounds.

Figure 2. Beck's Depression Inventory to Measure Mental Wellness (Continued)

20.

0	I am no more worried about my health than usual.
1	I am worried about physical problems like aches, pains, upset stomach, or constipation.
2	I am very worried about physical problems and it's hard to think of much else.
3	I am so worried about my physical problems that I cannot think of anything else.

21.

0	I have not noticed any recent change in my interest in sex.
1	I am less interested in sex than I used to be.
2	I have almost no interest in sex.
3	I have lost interest in sex completely.

INTERPRETING THE BECK DEPRESSION INVENTORY

Now that you have completed the questionnaire, add up the score for each of the twenty-one questions by counting the number to the right of each question you marked. The highest possible total for the whole test would be sixty-three. This would mean you circled number three on all twenty-one questions. Since the lowest possible score for each question is zero, the lowest possible score for the test would be zero. This would mean you circles zero on each question. You can evaluate your depression according to the Table below.

Total Score	Levels of Depression
1-10	These ups and downs are considered normal
11-16	Mild mood disturbance
17-20	Borderline clinical depression
21-30	Moderate depression
31-40	Severe depression
over 40	Extreme depression