

Mediterranean diet and mental health symptoms among Brazilian adults from a health care center

Mediterranean Journal of

Nutrition and Metabolism

1–7

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DOI: 10.1177/1973798X251348259

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Abstract

Background: Mediterranean diet (MD) may have many health benefits for depression and anxiety symptoms on adults.

Aim: to evaluate the adherence to the MD and mental health symptoms.

Methods: Cross-sectional study with 199 adults ($M_{age} = 31.35 \pm 9.12$; 71.36% female) from a health care center in São Paulo, Brazil. Mental health symptoms were evaluated using the Beck's Depression and Anxiety Inventory and MD via 78-item food frequency questionnaire. Sleep patterns were also evaluated as potential influences. Chi-square and ANOVA analysis were used to evaluate differences between mental health symptoms and MD.

Results: The average dietary MD scores of participants was 4.86 ± 1.45 out of 7 requiring improvement. Higher adherence to the MD was associated with lower depression scores ($T1 = 12.88 \pm 8.51$ vs. $T3 = 10.19 \pm 7.96$). Mean anxiety ($M = 10.27$) and sleepiness scores ($M = 7.96$) were below cut-offs for moderate to severe symptoms. Significant differences in depression symptoms were found for saturated fat intake and the MUFA/SFA ratio.

Conclusion: Greater severity of depression and anxiety symptoms was associated with lower MD adherence. Larger studies are needed to confirm these findings.

Keywords

Mediterranean diet, mental health, adults, Brazil, cross-sectional study

Received: 10 February 2025; accepted: 22 May 2025

Introduction

The Mediterranean diet is an anti-inflammatory dietary pattern and has been positively associated with mental health, specifically to depression disorders.¹ The Mediterranean diet was first described by Ancel Keys in the seven Countries Study² as characterized by high consumption of fruits, vegetables, whole cereals, olive oil, nuts and seafoods, moderate consumption of poultry, dairy products and red wine, and low consumption of red meat. This diet pattern was widespread in Greece and South of Italy in the 1960s² due to the potential antioxidant components of this diet. A high adherence to this dietary pattern is associated with reduced risk for several chronic non-communicable diseases³ and more recently has been associated with improvement on mental health.^{4,5}

Existing studies from Brazil and other middle- and low-income countries provides little evidence on the association between Mediterranean dietary patterns and risk of mental health disorders. The majority of the studies were conducted

with older adults (≥ 60 years old) from high-income countries and based on depression and their associated symptoms. High and moderate adherence to the Mediterranean diet were associated with reduced chances on occurrence of depression.⁶ Other study with over 89,000 Brazilian adolescents and adults described food patterns in relation to depression and other mental health disorders (without specifying the type),⁷ but could not evaluate Mediterranean dietary patterns

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due to the nature of the dietary data. For this Brazilian study, similar patterns, with except for evaluating fish, nuts/seeds and olive oil, demonstrated greater chances in reducing symptoms of depression and other common mental health disorders. The Netherlands Study of Depression and Anxiety (n = 1634) study demonstrated that the Mediterranean Diet was worse among subjects with depressive and anxiety disorders ($\beta = -0.41$, 95% CI -0.60 , -0.21). The more severe and chronicity of the symptoms, the poorer was the diet quality.^{8,9} Other prospective studies worldwide, including in Brazil, are needed to increase generalizability and to treat depression and anxiety as separate variables. Depression and anxiety are the most prevalent mental health issues worldwide.¹⁰ Therefore, the present study aim to evaluate the adherence to the Mediterranean dietary score and mental health symptoms among adults attending a health care facility in São Paulo.

Methods

This was a cross-sectional study with 199 adults from first appointment at a health care setting from May to June 2020. A validated 78-item food frequency questionnaire (FFQ)¹¹ was used to calculate the Mediterranean Diet Score (MDS), which ranged from 0 to 9 based on intake of fruits, vegetables, legumes, cereals, fish/seafood, dairy, meat, alcohol (wine), and the MUFA/SFA ratio.¹² One point was assigned for each component meeting dietary recommendations.¹³ Nutrient intake (e.g., sodium, saturated fats, free sugars) was estimated using Brazilian and USDA food composition databases.

Zero point was considered not meeting the recommendation. The cut-off point of MD total score was based on the median, i.e., <4 a diet needs improvement, i.e., higher scores denoting better adherence. The FFQ was manually examined to perform the conversion of food intake into MDS equivalents. Other nutrients of concern was evaluated.^{14–19} Sodium, fatty acids and free sugars (i.e., added + naturally sugars present in foods/drinks, with exception for lactose and galactose added as ingredients)²⁰ were obtained from the Brazilian Food Composition Table,²¹ and USDA Food Data Central.²² The MD has been previously validated for the Brazilian population.²³ The 21-item Beck's Anxiety Inventory (BAI) ($\alpha = 0.89$) and Beck's Depression Inventory (BDI) ($\alpha = 0.87$),²⁴ and Epworth sleepiness scale (ESS) ($\alpha = 0.68$)²⁵ were applied to individuals participating in the study, and used to calculate their respective scores. The BAI ranged from 0 to 7 points indicating minimal, 8–15 mild, 16–25 moderate and 26–63 severe anxiety. The BDI ranged from 0–13 indicating minimal, 14–19 mild, 20–28 moderate, and 29–63 severe. Finally, the ESS scores from 0–5 demonstrating lower/normal, 6–10 higher normal, 11–12 mild excessive, 13–15 moderate excessive and 16–24 severe excessive daytime sleepiness.

Demographic and lifestyle characteristics of individuals were included in the statistical analyses: age, sex, educational attainment and race/ethnicity.²⁶ Anthropometric measures of participants referring to weight and height were collected during the appointment, being used to calculate the body mass index (BMI), and classify their weight status according to World Health Organization thresholds.²⁷ The study was approved by the university's Research Ethics Board. Statistical analyses included descriptive statistics referring to mean and 95% confidence interval for continuous data with normal distribution, and frequencies for categorical data. Data from continuous variables were normally distributed according to skewness curves. Chi-square and ANOVA (with Bonferroni post-hoc analysis) were used to verify differences between terciles of mental health scores and Mediterranean diet components and total scores. Data were analyzed using R Studio (version 2023, Posit Software, PBC, Boston, MA, USA).

Results

The average age of participants was $31.34 \pm \text{SE } 0.65$ years old and 71.36% self-identified as female, 69.35% had some college/graduate degree and 37.58% were overweight. Nearly one-third (33%) of all participants scored below the cut-off point for low adherence to MD. The average MD was 4.89 ± 1.45 out of 9. Younger participants ($M_{\text{age}} = 29.57 \pm 8.74$) had higher MDS than older participants (1st tercile: $M_{\text{age}} = 33.18 \pm 9.52$ vs. 2nd tercile: $M_{\text{age}} = 30.55 \pm 8.45$). Non-overweight (vs. overweight) individuals had fewer symptoms for mental health problems and higher income individuals had a better adherence to MD (**data upon request**). **Figure 1** shows the distribution of the EES, BAI, and BDI scores by terciles of MDS. Although results were not statistically significant, individuals in the highest tertile (T3) for adherence to MD scored higher for daytime sleepiness ($M = 9.07$, 95%CI 7.38, 10.76) vs. those in the lowest tertile ($M = 7.64$, 95%CI 6.70, 8.58). For the BAI, participants at the highest tertile (T3) showed similar score ($M = 10.48$, 95%CI 7.98, 12.98) as those in the lowest tercile ($M = 10.48$, 95%CI 7.50, 13.46). For the BDI, as increased the terciles for adherence lower was the scores ($M = 10.85$, 95%CI 7.85, 13.85 in T3, $M = 11.82$, 95%CI 10.24, 13.40 in T2 and $M = 11.79$, 95%CI 9.84, 13.73 in T1). Significant differences were observed for saturated fats (T1 = 33.33 g vs. T2 = 42.37 g vs. T3 = 51.67 g) and the ratio MUFA/SAT (T1 = 33% vs. T2 = 50% vs. T3 = 16%) according to terciles of depression. Differences between fish/seafoods and anxiety symptoms were observed according to terciles of anxiety (T1 = 24.46 g, T2 = 58.27 g, and T3 = 17.27 g). There were no significant differences in consumption of Mediterranean diet components according to severity of sleepiness behaviors (Table 1).

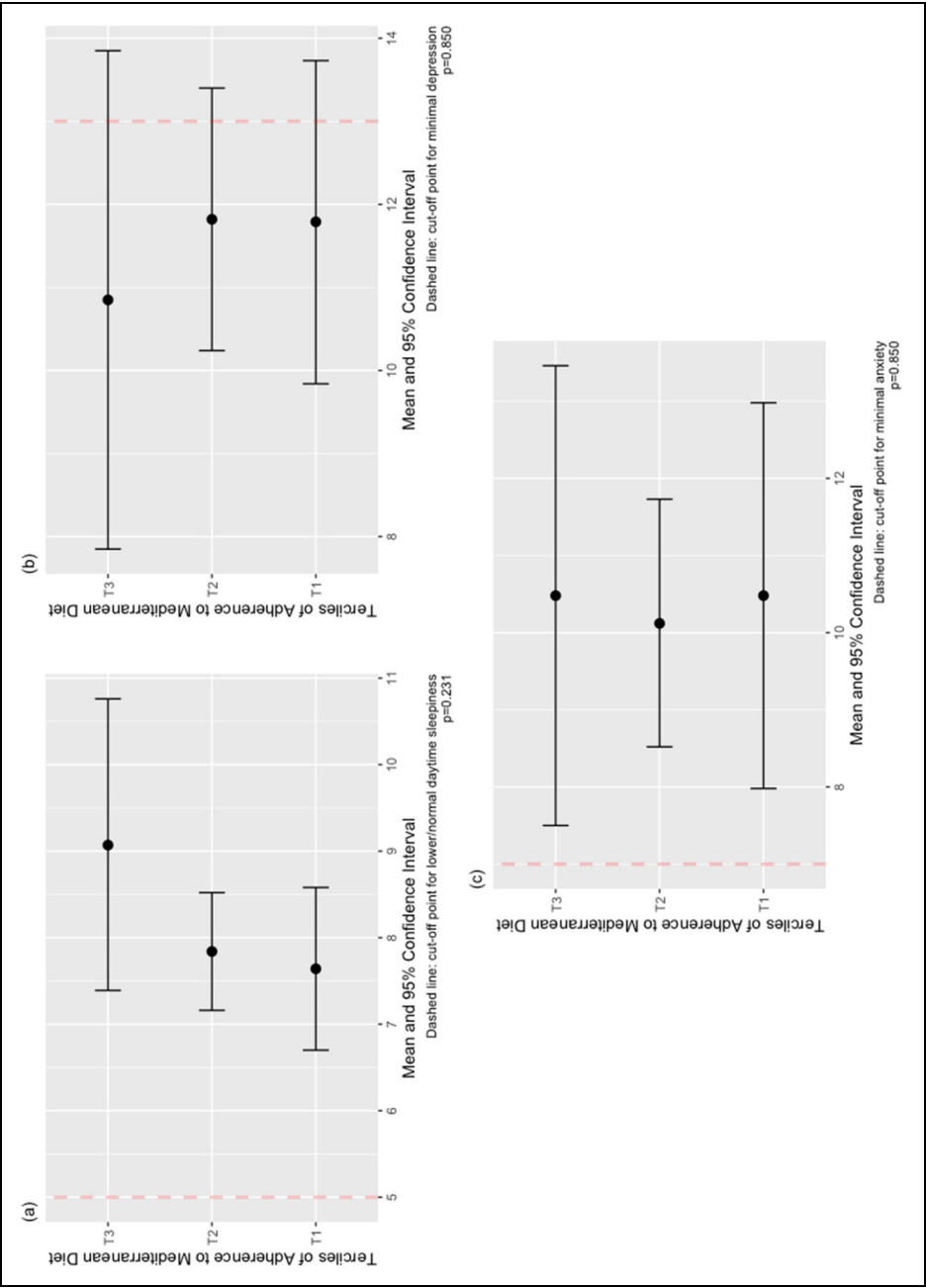


Figure 1. Mean and 95% Confidence intervals for (a) Epworth sleepiness scale (ESS), (b) Beck's anxiety (BAI) and (c) depression inventory (BDI) scores by tertiles of adherence to the Mediterranean diet score.

Table 1. Dietary characteristics of adult individuals in the sample (n = 199), according to terciles of mental health disorders. São Paulo, 2020.

	T1	T2	T3	p-value
Sleepiness				
Mean $\pm$ SD				
Energy intake (kcal/day)	2182.82 $\pm$ 1102.27	2320.18 $\pm$ 1132.10	2438.08 $\pm$ 1216.43	0.470
Saturated fats (g/day)	40.62 $\pm$ 34.73	42.84 $\pm$ 30.45	44.98 $\pm$ 25.83	0.738
Free sugars (g/day)	76.83 $\pm$ 36.68	84.18 $\pm$ 40.35	94.86 $\pm$ 83.79	0.199
Sodium (mg/day)	2864.26 $\pm$ 1542.11	2985.76 $\pm$ 1587.36	3007.82 $\pm$ 1380.62	0.845
Proportion of individuals meeting recommendations to MD				
Fruits (%)	30.30	40.40	29.29	0.575
Vegetables (%)	32.32	41.41	26.26	0.679
Beans (%)	33.33	40.40	26.26	0.823
Cereals (%)	29.29	38.38	32.32	0.262
Fish/seafoods (%)	33.33	40.58	26.09	0.584
MUFA/SAT (%)	39.00	39.00	22.00	0.133
Dairy products (%)	36.00	36.00	28.00	0.748
Meats (%)	33.00	38.00	29.00	0.924
Alcohol (%)	31.85	40.74	27.41	0.568
Anxiety				
Mean $\pm$ SD				
Energy intake (kcal/day)	2155.24 $\pm$ 1136.05	2339.77 $\pm$ 1082.39	2387.29 $\pm$ 1283.43	0.549
Saturated fats (g/day)	35.37 $\pm$ 24.48	45.18 $\pm$ 34.52	44.77 $\pm$ 26.81	0.151
Free sugars (g/day)	75.63 $\pm$ 35.00	82.38 $\pm$ 40.54	99.32 $\pm$ 89.24	0.090
Sodium (mg/day)	2813.58 $\pm$ 1556.57	3014.59 $\pm$ 1520.49	2943.99 $\pm$ 1447.19	0.741
Proportion of individuals meeting recommendations to MD				
Fruits (%)	26.26	51.52	22.22	0.950
Vegetables (%)	25.00	52.00	23.00	0.973
Beans (%)	32.00	47.00	21.00	0.117
Cereals (%)	26.00	50.00	24.00	0.932
Fish/seafoods (%)	24.46	58.27	17.27	<0.01
MUFA/SAT (%)	30.69	49.50	19.80	0.207
Dairy products (%)	28.00	47.00	25.00	0.482
Meats (%)	27.00	48.00	25.00	0.647
Alcohol (%)	25.93	50.37	23.70	0.932
Depression				
Mean $\pm$ SD				
Energy intake (kcal/day)	2133.44 $\pm$ 1027.01	2275.99 $\pm$ 1067.22	2556.41 $\pm$ 1430.29	0.205
Saturated fats (g/day)	33.33 $\pm$ 19.79	42.37 $\pm$ 31.1 [†]	51.67 $\pm$ 36.85	<0.05
Free sugars (g/day)	71.95 $\pm$ 40.25	81.74 $\pm$ 37.49	100.92 $\pm$ 93.05	0.099
Sodium (mg/day)	2715.13 $\pm$ 1340.76	2960.63 $\pm$ 1534.50	3178.98 $\pm$ 1655.99	0.346
Proportion of individuals meeting recommendations to MD				
Fruits (%)	25.77	54.64	19.59	0.640
Vegetables (%)	25.77	50.52	23.71	0.835
Beans (%)	28.42	51.58	20.00	0.497
Cereals (%)	25.00	50.00	25.00	0.661
Fish/seafoods (%)	25.19	55.56	19.26	0.252
MUFA/SAT (%)	33.33	50.51	16.16	<0.01
Dairy products (%)	27.84	49.48	22.68	0.607
Meats (%)	23.96	54.17	21.88	0.901
Alcohol (%)	24.81	53.49	21.71	0.929

Note: MD: Mediterranean Diet, SD: Standard Deviation.

Terciles of adherence to MD were denoted as T1 to T3, as higher adherence were represented by T3.

[†]Post-hoc Bonferroni differences.

Discussion

There is a paucity of the literature regarding the association between mental disorders like anxiety, depression, and daytime sleepiness in relation to Mediterranean diet

among adults, especially from low and middle-income countries. The present study showed that participants with mild-severe symptoms of anxiety and depression had lower Mediterranean diets scores as well as among those

who average mild excessive daytime sleepiness. There were significant differences between mental health and daytime sleepiness and Mediterranean diet component scores. Other dietary metrics, such the Alternative Healthy Eating and Healthy Eating Indexes²⁸ showed similar results for depression and anxiety issues. There was a lack of studies that evaluated daytime sleepiness. Most of the participants in the present study were categorized as higher normal daytime sleepiness, with a large proportion of female with high education attainment ($M_{age}=32yo$) and this might have a relationship between anxiety and/or depression, which in turn can influence the diet quality. This sample is more likely to deal with work schedule and sometimes post-secondary studies, which can disrupt their eating patterns, i.e., choosing palatable, calories foods.^{29,30}

In line with previous studies, differences between mental health and Mediterranean components and total scores were in the hypothesized direction. Thus, there was increased intake of (red and processed) meats and alcohol and lower intake of fruits and vegetables among those in the highest tercile for anxiety and depression. On the other hand, cereals presented a similar pattern in the 1st and 3rd terciles. Cumulative and synergic effects of nutrients from different food groups might be linked to depression and anxiety and this can explain the differences found in the Mediterranean diet components and total scores.⁹ Higher depression scores were associated with a lower proportion of individuals meeting the recommended mono-unsaturated to saturated fat (MUFA/SFA) ratio. High and low intake of MUFA and saturated fats, respectively are one of the most prominent aspects of the Mediterranean diet. MUFA/SAT ratio can be attributed to the presence of phenolic and antioxidant compounds, preventing free radicals and enzyme modulators, indicating the inflammatory protective potential intake of mono-unsaturated sources. Furthermore, fish consumption was associated with anxiety symptoms in the present study. A longitudinal study with over 12,000 Brazilian adults,³¹ the consumption of polyunsaturated fats, such as omega-3 was inversely associated with anxiety. Therefore, one of the sources of omega 3 is fish, justifying the results of the current study where fish is associated to mental health.

There are several underlying mechanisms on the effects of Mediterranean diet with depression and anxiety, changes on appetite, weight, and motivation are typically identified in individuals living with depression. The mechanisms by which the Mediterranean diet may influence depression and anxiety are not fully understood, but anti-inflammatory properties presented on fruits and vegetables, fish/seafoods and nuts have been linked to improvement on depression and anxiety symptoms in the overall population.^{32–34} This all can partially be explained by physiological aspects, such gut microbiome and neurotransmitter systems.³⁵ Furthermore, mental health disorders are associated with reduction in personal health behaviors, e.g., being

discourage and feeling sad, can be associated to less satisfaction for cooking, and thus reducing cooking skills, where high-palatable, calorie foods are more consumed, affecting the diet quality.³⁶

Moreover, effects on mental health might have consequences on sleep features, including daytime sleepiness, because MD is mainly composed of a plant-based dietary pattern, characterized by antioxidant vitamins (i.e., vitamin C and D) and polyphenols, might be associated to reduction of pro-inflammatory cytokine production and inhibit neuroinflammation.²⁹

Strengths of this study were the ability to analyse symptoms of depression and anxiety and the use of the FFQ to accurately estimate the usual servings. However, some limitations should be noticed. Firstly, the cross-sectional design precludes any assumptions about temporal directions. Secondly, there is a possibility of residual confounding due to use of observational data. Thirdly, assessing dietary intake with FFQ (or other recall methods) is prone to misreporting and recall bias. Finally, the sample of the study was recruited in one health care center in the largest city of Brazil, which limits its generalizability.

Conclusion

Overall, the study participants had dietary patterns requiring improvement in terms of Mediterranean Diet adherence. Lower adherence was associated with increased severity of anxiety and depression symptoms. Further studies with larger, more representative samples are needed to confirm these findings. Given the consistent links between diet quality and mental health, dietary interventions should be considered by health professionals and policymakers to promote mental well-being.

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Funding

This work received funding from FAPESP - Grant 2022/07278-3 and CNPq - Grant 303733/2022-5. The Ethical protocol nº 29105919.9.0000.5421; released date Mai/2020.

Declaration of conflicting interests

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

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