



Effect of Diet and Sleep Quality on Internalizing Symptoms

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Introduction

- Depression, anxiety, and stress are prevalent mental health concerns that are associated with poorer quality of life and impaired daily functioning.¹ Emerging evidence suggests that lifestyle factors, particularly diet quality and sleep quality, are linked to internalizing symptoms.¹
- Nutritional factors such as omega-3 fatty acids and B vitamins (e.g., B6, B9/folate, and B12) have been linked to brain function, neurotransmitter synthesis, inflammation regulation, and mood.^{2,12} Lower intake of these nutrients has been associated with increased symptoms of depression, anxiety, and stress, while higher intake has been linked to improved mental health outcomes.⁷
- Sleep quality is linked to mental health and may influence how nutrition relates to mood and stress.⁵ Poor sleep quality has been associated with higher stress and worse mood,⁵ while better sleep may strengthen the mental health benefits of nutrients such as omega-3 fatty acids and B vitamins.^{6,7} Understanding whether sleep quality moderates the relationship between nutrition and mental health may clarify who benefits most from dietary interventions.¹³

Hypotheses

- Higher omega-3 fatty acid and B vitamin intake (B6, B9, and B12) will be associated with lower perceived stress, depression, and anxiety symptoms.
- These relationships will be moderated by sleep quality, such that higher nutrient intake will be associated with lower symptoms primarily among individuals with better sleep quality.

Methods

Participants

- Baseline data was collected from 65 community dwelling older adults aged 58-81 years participating in a Pilot randomized clinical trial. Participants with cardiovascular and cognitive risks for dementia were recruited.

Measures

- **Covariates** included age, sex (0=female, 1=male), education (0=no middle school – 8=professional degree), and income(0=<10,000 - 5=75,000-99,999+)
- **Diet Quality** was assessed at baseline using self-reported 24-hour food recall interviews. Nutrient intake was calculated using the Automated Self-Administered 24-Hour Dietary Assessment Tool (ASA-24; National Cancer Institute).
 - Omega-3 fatty acids (EPA, DPA, and DHA) were derived from the ASA-24 output and reported in grams per day (g/day); these values were summed to create a total omega-3 composite variable.
 - Vitamin B6 intake was reported in milligrams per day (mg/day), while folate and vitamin B12 were reported in micrograms per day (mcg/day); these variables were combined to create a B-vitamin compositescore.
 - Composite variables were created to represent overall omega-3 intake and total B-vitamin intake. These were created by recalculating each of the components to account for skewness and then Z-score theminto one variable. For omega 3 we combined EPA, DPA, and DHA and for vitamin B we combined B6, folate, and B12.
- **Depression** was assessed at baseline using the total score from the Patient Health Questionnaire-9 (PHQ-9), a validated measure of depressive symptom severity.⁸ PHQ-9 Total Score: Minimal (1-4), Mild (5-19), Moderate (10-14), Moderately Severe (15-19), Severe (20-27)
- **Anxiety** was assessed at baseline using the total score from the Generalized Anxiety Scale (GAS).⁹ GAS Total Score: Minimal (1-6), Mild (7-9), Moderate (10), Severe (12-30)
- **Stress** was assessed at baseline using the total score from the Perceived Stress Scale (PSS).¹⁰ Higher perceived stress higher score (0-27)
- **Sleep Quality** was assessed at baseline using the global score from the Pittsburgh Sleep Quality Index (PSQI).¹¹ Range from 1-15, higher score indicating worse sleep quality.

Analyses

- Hierarchical linear regression modeling using SPSS. Moderation was tested using Andrew Hayes' PROCESS macro (Model 1). The total scores from the PHQ-9, GAD-7, and PSS served as outcome variables in separate models.

Results

- Participants were predominantly female (74.6%), aged 56–85 years (M = 70.0), and highly educated, with most holding a bachelor's (25.4%) or master's degree (35.2%). Household incomes were mostly between \$30,000–\$99,999. On average, participants reported moderate sleep disturbance (PSQI M = 6.63), low depressive symptoms (PHQ-9 M = 2.55), moderate perceived stress (PSS M = 9.55), and mild anxiety (GAS M = 3.27).

Table 1

Descriptive Statistics for Study Variables

Variable	N	Min	Max	M/Per cent	SD/Frequency %
EPA	56	0.00	0.35	0.04	0.08
DPA	56	0.00	0.06	0.02	0.02
DHA	56	0.00	0.20	0.04	0.06
Omega-3 (combined)	56	-2.43	7.88	.000	2.65
Vitamin B12 (mcg)	56	0.01	16.23	3.43	3.21
Folate (mcg)	56	13.40	1125.98	328.06	192.47
Vitamin B6	56	0.01	3.50	1.69	0.91
Vitamin B (combined)	56	-4.55	9.73	.000	2.37
PSQI Global Score	56	1.00	15.00	6.63	3.53
PHQ-9 Total Score	56	0.00	13.00	2.55	2.69
PSS Total Score	56	0.00	27.00	9.55	5.67
GAS Total Score	56	0.00	12.00	3.27	2.84
Sex (female)	56	-	-	-	74.6%
Age	56	56.00	85.00	-	-

Note: Valid N (listwise) = 59. Higher PSQI scores indicate poorer sleep quality. Higher PHQ-9 and GAS scores indicate greater depressive and anxiety symptoms, respectively. EPA, DPA, DHA, and VB6 were recoded to reduce skewness

Table 2

Pearson Correlations Among Study Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. EPA	—											
2. DPA	.70**	—										
3. DHA	.75**	.56**	—									
4. Vitamin B12	.49**	.40**	.31*	—								
5. Folate	.16	.14	.05	.36**	—							
6. Vitamin B6	.12	.28*	.01	.44**	.51**	—						
7. Omega-3 (total)	.92**	.85**	.87**	.45**	.13	.16	—					
8. Vitamin B (total)	.33**	.35**	.16	.76**	.79**	.82**	.31*	—				
9. Perceived Stress	.11	−.16	.18	−.01	.09	−.13	.05	−.02	—			
10. Depression (PHQ-9)	−.01	−.14	.04	.07	−.11	−.19	−.04	−.09	.53**	—		
11. Anxiety (GAS)	.28*	.02	.23	.20	.07	−.11	.20	.07	.58**	.77**	—	
12. Sleep Quality (PSQI)	.06	−.12	.13	−.06	−.28*	−.24	.03	−.24	.43**	.60**	.44**	—

Note: N ranges from 59 to 65 due to missing data. EPA = eicosapentaenoic acid; DPA = docosapentaenoic acid; DHA = docosahexaenoic acid. EPA, DPA, DHA, and VB6 were recoded to reduce skewness.

Table 3

Moderation Analyses Examining Sleep Quality as a Moderator of Omega-3 and Vitamin B Intake on Mental Health Outcomes

Outcome Variable	Predictor	β	p
Perceived Stress (PSS)	Omega-3 intake	.063	.617
	Vitamin B intake	−.104	.411
	PSQI	.738	.001
	PSQI x Omega-3	.074	.362
	PSQI x Vitamin B	.066	.420
Depression (PHQ-9)	Omega-3 intake	−.016	.900
	Vitamin B intake	−.123	.338
	PSQI	.309	.003
	PSQI x Omega-3	−0.28	.413
	PSQI x Vitamin B	−0.45	.209
Anxiety (GAS)	Omega-3 intake	.230	.054
	Vitamin B intake	−.007	.957
	PSQI	.392	.001
	PSQI x Omega-3	.003	.938
	PSQI x Vitamin B	−.039	.325

Note: Scores were derived from the totals of the PSS, GAS, and PHQ-9. β = standardized regression coefficient.

Conclusions

- Contrary to our hypotheses, omega-3 fatty acids and vitamin B intake were not directly associated with lower depression, anxiety, and stress levels.
- Our findings add to a literature with already inconsistent findings. While publication bias should be considered, it may be that the effects of each nutrient are small or not clinically significant. It may also be the case that only specific components of each have an effect on mental health.¹³
- Our findings may also be due to limitations in measurement. Dietary assessment through a single 24-hour recall can introduce measurement errors and may not reflect habitual consumption, which may obscure a true effect. Further, self-report is subject to recall bias.
- However, consistent with prior research, poorer sleep quality was associated with higher levels of anxiety, depression, and stress across all models. This finding suggests that sleep quality plays a central and possibly independent role in the mental health of older adults.
- Sleep quality did not moderate the relationship between nutrient intake and mental health outcomes, which suggests that these factors may influence mental health through independent mechanisms.

Future Directions

- Future research should include a larger sample that includes individuals with higher levels of mental health symptoms.
- Further, use of additional objective and longer-term measurements of diet would aid in understanding the diet-mental health connections.

References

- 1.Lopresti, A. L., Hood, S. D., & Drummond, P. D. (2013). A review of lifestyle factors that contribute to important pathways associated with major depression: Diet, sleep and exercise. *Journal of Affective Disorders, 148*(1), 12–27. <https://doi.org/10.1016/j.jad.2013.01.014>
- 2.Parker, G., Gibson, N. A., Brotchie, H., Heruc, G., Rees, A.-M., & Hadzi-Pavlovic, D. (2006). Omega-3 Fatty Acids and Mood Disorders. *American Journal of Psychiatry, 163*(6), 969–978. <https://doi.org/10.1176/appi.ajp.2006.163.6.969>
- 3.Parletta, N., Zarnowiecki, D., Cho, J., Wilson, A., Bogomolova, S., Villani, A., Itsiopoulos, C., Niyonsenga, T., Blunden, S., Meyer, B., Segal, L., Baune, B. T., & O'Dea, K. (2017). A Mediterranean-style dietary intervention supplemented with fish oil improves diet quality and mental health in people with depression: A randomized controlled trial (HELFI-MED). *Nutritional Neuroscience, 22*(7), 474–487. <https://doi.org/10.1080/1028415x.2017.1411320>
- 4.Kiccott-Glaser, J. K., Belury, M. A., Andridge, R., Malarkey, W. B., & Glaser, R. (2011). Omega-3 supplementation lowers inflammation and anxiety in medical students: A randomized controlled trial. *Brain, Behavior, and Immunity, 25*(8), 1725–1734. <https://doi.org/10.1016/j.bbi.2011.07.222>
- 5.Monti, J. M., & Monti, D. (2000). Sleep disturbance in generalized anxiety disorder and its treatment. *Sleep Medicine Reviews, 4*(3), 263–276. <https://doi.org/10.1053/smrv.1999.0096>
- 6.Richardson, A. (2015). Omega-3 and sleep: New insights from the DHA Oxford Learning and Behaviour (DOLAB) study. *Lipid Technology, 27*(5), 103–106. <https://doi.org/10.1002/lite.201500014>
- 7.Tao, Y., Wu, M., Su, B., Lin, H., Li, Q., Zhong, T., Xiao, Y., & Yu, X. (2025). Impact of Vitamin B1 and Vitamin B2 Supplementation on Anxiety, Stress, and Sleep Quality: A Randomized, Double-Blind, Placebo-Controlled Trial. *Nutrients, 17*(11), 1821. <https://doi.org/10.3390/nu17111821>
- 8.Kroenke, K., Spitzer, R. L., & Williams, J. B. W. (2001). The PHQ-9: Validity of a Brief Depression Severity Measure. *Journal of General Internal Medicine, 16*(9), 606–613. <https://doi.org/10.1046/j.1525-1497.2001.0160960606.x>
- 9.Spitzer, R. L., Kroenke, K., Williams, J. B. W., & Löwe, B. (2006). A Brief Measure for Assessing Generalized Anxiety disorder: the GAD-7. *Archives of Internal Medicine, 166*(10), 1092–1097. <https://doi.org/10.1001/archinte.166.10.1092>
- 10.Harris, K. M., Gaffey, A. E., Schwartz, J. E., Krantz, D. S., & Burg, M. M. (2023). The perceived stress scale as a measure of stress: Decomposing score variance in longitudinal behavioral medicine studies. *Annals of Behavioral Medicine: A Publication of the Society of Behavioral Medicine, 57*(10), 846–854. <https://doi.org/10.1093/abnm/kaad015>
- 11.Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The pittsburgh sleep quality index: A new instrument for psychiatric practice and research. *Psychiatry Research, 28*(2), 193–213. [https://doi.org/10.1016/0165-1781\(89\)90047-4](https://doi.org/10.1016/0165-1781(89)90047-4)
- 12.Wani, A. L., Bhat, S. A., & Ara, A. (2015). Omega-3 fatty acids and the treatment of depression: a review of scientific evidence. *Integrative Medicine Research, 4*(3), 132–141. <https://doi.org/10.1016/j.imr.2015.07.003>
13. Martins J. G. (2009). EPA but not DHA appears to be responsible for the efficacy of omega-3 long chain polyunsaturated fatty acid supplementation in depression: evidence from a meta-analysis of randomized controlled trials. *Journal of the American College of Nutrition, 28*(5), 525–542. <https://doi.org/10.1080/07315724.2009.10719785>