

# Comparison of Vegan and Non-Vegan Diets on Memory and Sleep Quality

Pinar Sengul (✉ [psengu01@mail.bbk.ac.uk](mailto:psengu01@mail.bbk.ac.uk))

Birkbeck, University of London

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## Research Article

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# Abstract

It is widely acknowledged that the quality of nutrition affects many aspects of physical and mental performance. A vegan diet is associated with superior cardiovascular and cerebrovascular conditions. Mediterranean diets (high fruit and vegetable content) are linked with reduced risk of neurodegenerative diseases and improved performance on cognitive tests. In the present study, verbal memory and sleep quality were assessed in a cohort of 62 adults aged 40 and above. Using a modified Mediterranean Diet Adherence Screener, the participants were divided into the categories of vegan, vegetarian, pescatarian, omnivores with low meat/fish consumption, and omnivores with high meat/fish consumption. The California Verbal Learning Test was used to assess verbal learning memory, and the Pittsburg Sleep Quality Index was used to assess sleep quality. Diet was found to have a significant effect on memory but no significant effect on sleep quality. The sample size may have been insufficient to capture the effects of diet on sleep. To definitively establish the relationships between diet patterns and quality of cognitive functioning and sleep, further research is required. The results of this study cast doubt on the hypothesis that the consumption of animal products boosts memory performance.

## Introduction

Previous studies have indicated that the modern Western diet (high in animal fat and animal protein) is associated with raised incidences of obesity, diabetes, cardiovascular diseases, hypertension and cancer as well as mood and neurological disorders, (Wang & Beydoun,2009 ; Vang et al. ,2008 ; Key et al., 1998 ; Takahashi et al., 2006; Dinu et al., 2017). Evidence also exists of a correlation between macronutrient intake and the quality of sleep, (St-Onge et al., 2016), and that reductions in sleep quality are related to lower cognitive functioning, (Ferrie et al., 2011). Another study, (Null et al., 2017), suggests that a vegan diet is associated with improvements in mood and neurological disorders, such as Alzheimer's disease. Studies on the effects of a Mediterranean diet, (Wade, 2018), indicate that it is associated with improved mood and cognitive processing speeds.

There are, however, a number of conflicting findings and the levels of statistical significance of some of the results referred to above are low due to small participant numbers, short study periods and diverse nutritional patterns, (Sebekova et al.,2001; Franco-de-Moraes et al.,2017). The possible implications of the effects of diet on the physical, mental and emotional health of the general population makes a controlled study of the effect of specific classified diets on defined sleep quality measures and on objectively measured memory performance highly relevant.

For the present pilot study, the independent variable is diet over the last five years in five classifications: vegan, vegetarian, pescatarian, omnivore-low and omnivore-high, as established by the Mediterranean Diet Adherence Screener, (MEDAS) questionnaire. The two dependent variables are sleep quality, self-reported on the Pittsburg Sleep Quality Index, (PSQI), and memory performance measured by the California Verbal Learning Test, 3<sup>rd</sup> Edition, (CVLT-3).

# Methods

## Measures

The primary measures used in the study were the California Verbal learning Test – 3<sup>rd</sup> Edition, the Mediterranean Diet Adherence Screener and the Pittsburg Sleep Quality Index.

### CVLT-3

The CVLT-3, standard form, was used to measure memory performance. Participants were given word lists to memorise and recall was tested after a timed delay. Raw scores were standardised for age. For the current study the key outcome measure was total recall.

### MEDAS

The Mediterranean Diet Adherence Screener consists of 14 questions on food and drink consumption. For the present study an amended scoring system was used to categorise individuals to one of the five specified dietary groups.

### PSQI

The Pittsburg Sleep Quality Questionnaire assesses sleep quality and disturbances over the previous month. It contains a list of 19 questions giving scores for sleep quality, latency, duration and efficiency and also disturbances, use of medications and dysfunctions during daytime activities.

## Procedure

Once informed consent had been given by the participant and they have been given instructions to be focused as much as possible, the experimenter started the questionnaire booklet. This consisted of the CVLT test followed by the MEDAS and PSQI questionnaires. The delayed components of the CVLT were completed after the questionnaires. The entire procedure took between 40 and 60 minutes to complete.

The study was approved by the Ethics Committee of Birkbeck, University of London.

## Statistical Analysis

Analyses were performed using IBM SPSS Version 25. The main hypothesis concerning the effect of diet on memory was assessed using ANCOVA with dietary group as the independent variable and the memory score as the dependent variable with sleep quality as the covariate.

# Results

All participants were adults aged between 40 and 77 years of age. All were fluent English speakers, with English as their first or second language. There were 62 participants, 33 male and 29 female. Using the

diet questionnaire, each participant was placed in one of the five dietary categories as shown in Table 1.

**Table 1.** Number of participants by diet group.

OMN-H	OMN-L	PESC	VEGET	VEGAN	GRAND TOTAL
14	17	10	7	14	62

Table 2 shows the mean memory score for each diet group and the overall mean. Figure 1 shows the differences between the individual group scores and the overall mean. The statistical analysis confirmed that there was a marginally significant effect of diet on short-delay if and only there was no other independent or confounding variables taken into the statistical analyses. When an ANCOVA test was run with Gender added as the covariate, the significance of the diet was lost.

**Table 2.** Memory scores by diet group.

OMN-H	OMN-L	PESC	VEGET	VEGAN	GRAND TOTAL
104.7	109.5	118.2	117.6	116.0	112.2

Figure 1 shows the effect of diet on verbal memory.

Table 3 shows the mean scores for sleep quality for the individual diet groups together with the overall mean. Higher scores signify lower sleep quality.

**Table 3.** Mean scores for sleep quality.

OMN-H	OMN-L	PESC	VEGET	VEGAN	GRAND TOTAL
5.6	4.3	4.9	7.1	4.6	5.1

Figure 2 shows the differences between the individual group mean scores and the overall mean score – with positive differences indicating better sleep quality. The statistical analysis confirmed that there was no significant effect of diet on sleep quality.

The vegetarian group with the anomalous low sleep quality score was the smallest of the diet groups with 7 members.

## Discussion

The rates of cognitive disorders that impact the memory are increasing globally, and it is also increasingly recognized that diet-related pathological processes such as atherosclerosis and inflammation impact cerebrovascular health leading to cognitive deficiencies. There is limited evidence that feeding on a plant-based diet (which is high in dietary fibre and vitamins) can lead to functional protection or even improvement in human cognition. In this cross-sectional observational pilot study, the association between diet and verbal learning memory was evaluated. Consistent with most earlier findings, it was found that there was a significant effect on short-delay memory, with plant-based diets showing improved performance relative to the animal-based diets when diet was the only independent variable and no confounding variable is taken into account utilizing ANOVA (Analyses of Variance). However, when confounding variables (i.e. gender, sleep quality and education level) were added to the statistical analyses using ANCOVA (Analyses of Covariance), the significance of the effect was lost. A one-way ANOVA have shown no significant effect of diet on sleep quality. A chi-squared test showed that females in the sample showed significantly better verbal learning memory performances than the males in overall verbal learning memory, which is short-delay, long delay and recognition. The results of this pilot study strongly suggest that a similar study with a much larger sample size would make a major contribution to resolving the scientific uncertainties regarding the effects of vegan diet on memory and other cognitive functions.

## **Declarations**

### **Data availability**

All data generated or analysed during this study are included in the supplementary information files.

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### **Author information**

### **Affiliations**

## Corresponding Author

Correspondence to P. Sengul via [psengu01@mail.bbk.ac.uk](mailto:psengu01@mail.bbk.ac.uk)

## Ethics approval and consent to participate

Participants gave written informed consent before the experiment. The procedures were approved by the Department of Psychological Sciences Research Ethics Committee at Birkbeck, University of London. All procedures were in accordance with the principles of the Declaration of Helsinki. Written informed consent for the publication of anonymised data for academic purposes was obtained from all participants.

## Competing interests

The author declares that they have no competing interests.

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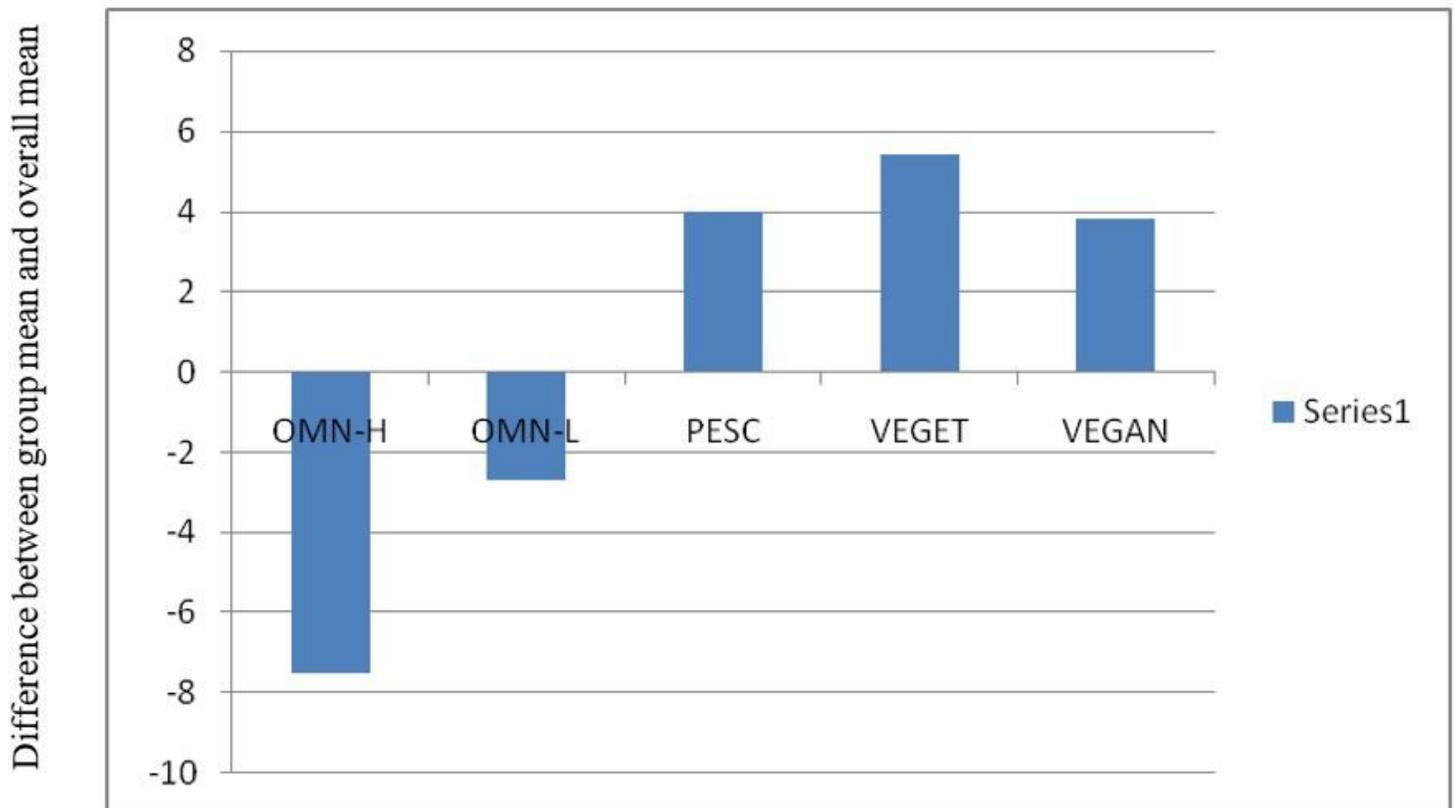
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## Additional Information

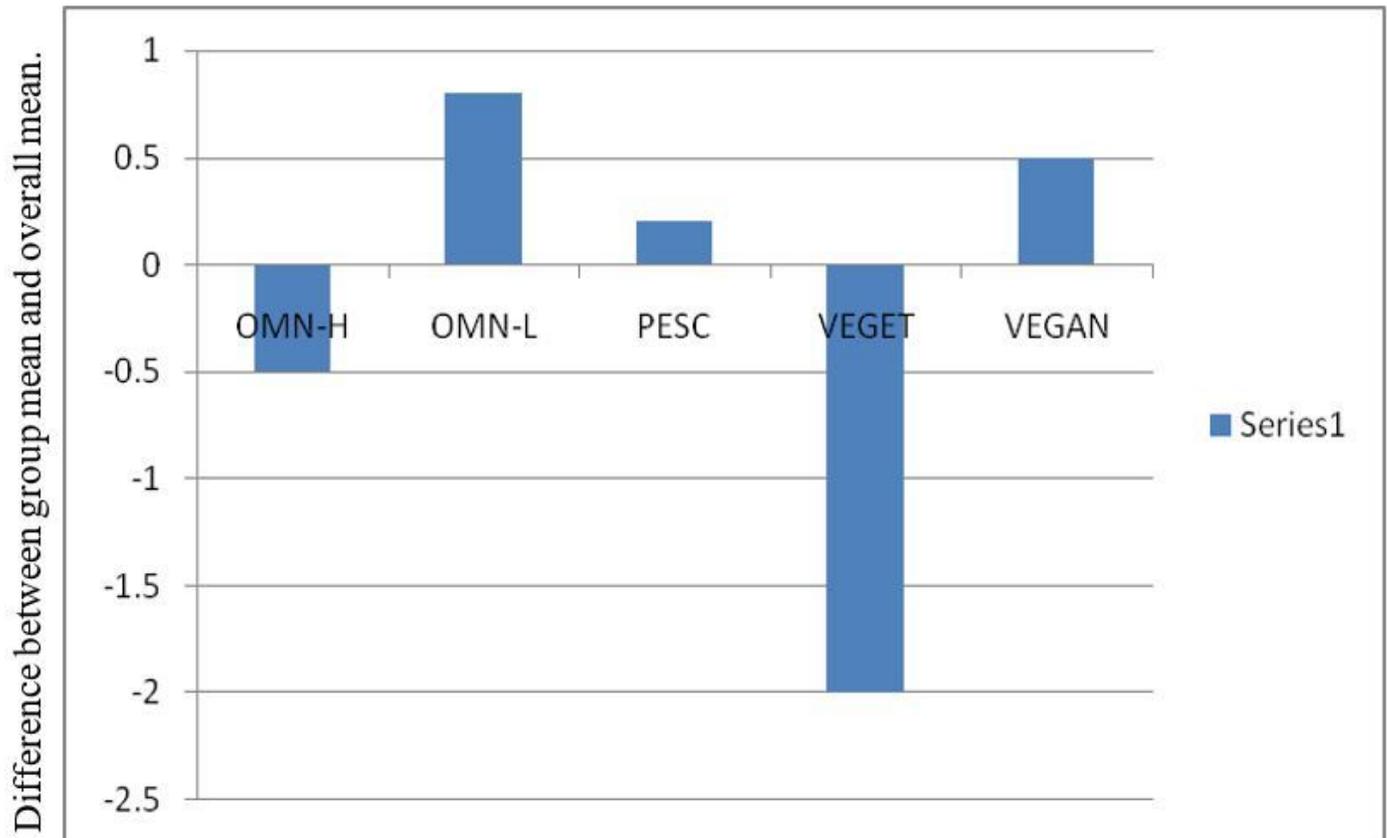
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## Figures



**Figure 1**

The effect of diet group on the difference between individual diet group mean and overall mean for verbal memory.



**Figure 2**

The effect of diet group on the difference between diet group mean and overall mean for sleep quality.

## Supplementary Files

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