

Mediterranean Diet Adherence and Cognitive Function in a sample of Portuguese Adults Aged 55–85: A Cross-Sectional Study

Adesão à Dieta Mediterrânica e Função Cognitiva numa amostra de Adultos Portugueses com Idades entre os 55 e os 85 anos: Um Estudo Transversal

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TRABALHO DE INVESTIGAÇÃO

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Resumo

Introdução: A dieta mediterrânica (DM) tem sido associada à preservação da função cognitiva, mas o seu impacto em idosos com elevado risco de demência permanece pouco explorado. Além disso, a classificação da adesão à DM com recurso ao *Mediterranean Diet Adherence Screener* (MEDAS) classifica o consumo diário de vinho como componente benéfica. Esta prática é cada vez mais questionada dado o seu potencial de ocultar verdadeiras associações entre a adesão à DM e a função cognitiva. **Objetivo:** Analisar a relação entre a adesão à DM, avaliada pelo MEDAS com a pontuação original (MEDAS-O) e invertida no item vinho (MEDAS-R), e a função cognitiva em idosos portugueses. **Metodologia:** A amostra incluiu 75 idosos portugueses (média de idade $70,5 \pm 7,0$ anos) com risco aumentado de demência. A adesão à DM foi avaliada pelo MEDAS-O e pelo MEDAS-R. A função cognitiva foi avaliada pelo Montreal Cognitive Assessment (MoCA), pelo Addenbrooke's Cognitive Examination-Revised (ACE-R) e pelo Mini-Mental State Examination (MMSE). **Resultados e Discussão:** Não se observou relação entre o MEDAS-O e a função cognitiva. O MEDAS-R apresentou associação positiva significativa com o MMSE e uma tendência próxima da significância com o MoCA, sugerindo a reponderação da pontuação do vinho. **Conclusão:** A adesão à DM, avaliada pelo MEDAS-O, não apresentou impacto na função cognitiva. Contudo, ao inverter-se a pontuação atribuída ao consumo de vinho, verificou-se uma associação positiva significativa com o desempenho cognitivo global.

Palavras-Chave: Idoso; Dieta Mediterrânea; Cognição

Abstract

Introduction: The Mediterranean diet (MD) has been linked to cognitive preservation, yet its impact in older adults at elevated dementia risk remains insufficiently explored. Moreover, the traditional Mediterranean Diet Adherence Screener (MEDAS) scoring system classifies daily wine consumption as a beneficial component, a practice increasingly questioned for its potential to obscure genuine diet-cognition relationships. **Objective:** To evaluate the association between adherence to the MD as measured by MEDAS, including the differential scoring of wine, and cognitive function in Portuguese older adults. **Methodology:** The sample comprised 75 Portuguese older adults (mean age 70.5 ± 7.0 years) at increased dementia risk. MD adherence was evaluated using the 14-item MD Adherence Screener Original (MEDAS-O) and Reverse scoring in wine (MEDAS-R). Cognitive function was assessed via the Montreal Cognitive Assessment (MoCA), Addenbrooke's Cognitive Examination Revised and Mini-Mental State Examination (MMSE). **Results/Discussion:** There was no significant association between MEDAS-O adherence and cognitive function. However, using MEDAS-R revealed a significant positive association with MMSE scores and a near-significant trend on the MoCA, suggesting the need to reweight the wine score. **Conclusion:** In Portuguese older adults at increased dementia risk, adherence to the MD as measured by MEDAS-O showed no association with cognitive function. Reversing the wine score uncovered a positive association with global cognition performance.

Keywords: Elderly; Diet, Mediterranean; Cognition

List of Abbreviations, Acronyms, and Initialisms

ACE-R - Addenbrooke's Cognitive Examination Revised

ANVOCA - Analysis of Covariance

BMI - Body-Mass Index

MD - Mediterranean Diet

MEDAS - Mediterranean Diet Adherence Screener

MEDAS-O - Mediterranean Diet Adherence Screener - Original

MEDAS-R - Mediterranean Diet Adherence Screener - Reverse Scoring in Wine

MMSE - Mini-Mental State Examination

MoCA - Montreal Cognitive Assessment

PCI - Probable Cognitive Impairment

SD - Standard Deviations

WHO - World Health Organization

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Introduction

The Mediterranean Diet (MD), originally characterised by Ancel Keys in the 1960s, is now recognised as one of the most thoroughly investigated dietary patterns and was inscribed in 2010 on UNESCO's Intangible Cultural Heritage of Humanity list^(1,2,3). It features a predominantly plant-based nutrient profile, including fruits, vegetables, whole grains, tubers, legumes and nuts, with extra-virgin olive oil as the principal fat source. Dairy, white meats, fish, and eggs are consumed in moderation, while red and processed meats and, as well as sweets, are limited; wine, when consumed, traditionally accompanies meals in low-to-moderate amounts^(2,3). Convivial, seasonal, and minimally processed cooking methods further characterise this eating pattern⁽³⁾.

Beyond its cultural and nutritional significance, the MD has gained increased attention for its potential role in promoting healthy ageing and preserving cognitive function. Currently, approximately 25% of Europeans are aged 60 years or older (the highest global proportion), and this is projected to double by 2050⁽⁴⁾. In Portugal, the ageing index reached 188 older adults per 100 young people in 2023⁽⁵⁾.

Ageing is associated with significant health challenges, among which cognitive decline is one of the most concerning⁽⁶⁾. A study of Portuguese adults aged 65-85 years estimated an incidence of 27 new cases of cognitive impairment per 1000 person-years⁽⁷⁾, with downstream increases in dementia, disability, hospitalization and mortality^(6, 8).

Robust epidemiological evidence links greater MD adherence to reduced risk of chronic disease and to preserved cognitive function, specifically improvements in global cognition, gait speed, lower limb strength and memory have been reported

among older adults without dementia^(9, 10,11,12). However, most studies target non-Portuguese cohorts and often rely on a single cognitive instrument, which limits external validity and the depth of cognitive characterisation in our population. Moreover, whereas the cross-national, validated 14-item Mediterranean Diet Adherence Screener (MEDAS)⁽¹³⁾ awards positive points for daily wine consumption, another national validation of the same questionnaire, conducted by telephone, reverses this scoring⁽¹⁴⁾. These inconsistencies in how wine consumption is scored reflect the ongoing debate regarding its role in cardiovascular and cognitive health. While moderate wine consumption, traditionally considered a component of the MD, has been associated with potential cardiovascular and neuroprotective benefits^(15,16), more recent research has highlighted possible neurotoxic effects of alcohol even at low amounts^(17,18).

In this context, this study aims to examine the association between adherence to the MD (with daily wine consumption scored positively vs. reverse-scored) and cognitive function in Portuguese older adults, using three complementary assessment tools: the Montreal Cognitive Assessment (MoCA), the Addenbrooke's Cognitive Examination Revised (ACE-R) and the Mini-Mental State Examination (MMSE).

Main Objective

To evaluate the association between adherence to the MD as measured by MEDAS, including the differential scoring of wine, and cognitive function in Portuguese older adults.

Methodology

Study Design and Participants

This cross-sectional analysis was conducted using preliminary baseline data collected between January and May 2025 from the NUTRIMIND project (ClinicalTrials.gov NCT06853405), and included a sample of 75 older adult participants from Porto, Portugal. Participants were recruited either through referrals by healthcare professionals from primary care units or through self-enrolment following publicity via community channels.

To be enrolled in the project, the individuals had to meet the following criteria: be aged between 55 to 85 years; have a higher risk of developing dementia based on their Cardiovascular Risk Factors, Aging and Dementia risk score (score ≥ 6 points)⁽¹⁹⁾, and have an educational attainment of at least 4 years. Exclusion criteria included a MoCA⁽²⁰⁾ score lower than the validated cutoff points (defined as 2 standard deviations (SD) below the normative reference value for the corresponding age and education in the Portuguese population); any medical condition that could limit the participation in the intervention (e.g., blindness, amputation...); lack of autonomy in performing daily activities or a confirmed diagnosis of dementia or major disability.

Ethical approval for the study was granted by the Ethics Committee of the Northern Region Health Administration (Approval Number: CE/2023/114) and by the Data Protection Officer of the Instituto de Saúde Pública da Universidade do Porto. All procedures involving human participants adhered to the principles of the Declaration of Helsinki, and written informed consent was obtained from all participants prior to inclusion.

Assessment of cognitive function

Cognitive function was assessed using three instruments, administered by a trained enquirer: the MoCA⁽²⁰⁾, the ACE-R^(21, 22) and the MMSE⁽²³⁾.

The MoCA is a preferred tool for detecting cognitive decline in its early stages. It has been culturally and linguistically adapted for the Portuguese population and validated in older adults. The MoCA evaluates eight cognitive domains. Higher total scores (maximum: 30 points) are indicative of better cognitive functioning. A score that falls more than 1.5 SD below the normative mean for age and education is considered suggestive of Probable Cognitive Impairment (PCI)⁽²⁰⁾.

The ACE-R has also been adapted and validated for Portuguese adults⁽²²⁾. This tool assesses five domains of neurocognitive functioning (Attention and Orientation, Memory, Verbal Fluency, Language, and Visual-Spatial Ability), and the final score ranges from 0 to 100 points. The total score is the sum of the domain scores, with higher scores reflecting better cognitive function. As with the MoCA, a score more than 1.5 SD below the normative mean for age and education was considered suggestive of PCI⁽²¹⁾. The ACE-R incorporates items from another well-known cognitive screening tool - the MMSE⁽²³⁾. The MMSE consists of six sections that assess various cognitive domains, with a maximum total score of 30 points. As with the previous tools, PCI was identified by an MMSE score more than 1.5 SD below the age and education-adjusted normative mean⁽²³⁾.

Adherence to the MD

Adherence to the MD was assessed using the MEDAS, developed within the framework of the PREDIMED study⁽²⁴⁾. This instrument consists of 14 questions related to dietary habits, each scored either 0 or 1, with a maximum total score of 14 points. A score of 10 or above was considered indicative of high adherence

to the MD. The MEDAS was initially validated for the Spanish population (aged 55-80 years)⁽²⁴⁾ and was later adapted for use in various populations⁽¹³⁾, including Portuguese adults, in both in-person and telephone formats; this Portuguese version demonstrated moderate reliability and validity⁽¹⁴⁾. In the present study, we used the original scoring scheme, in which 1 point is assigned for moderate wine consumption (7 to 14 glasses of 100 ml/week)^(13,20), and for clarity we will refer to this version as MEDAS-O (Original). The key alternative version, validated for telephone use in Portugal, applies reverse scoring for wine, assigning 1 point when the frequency of wine consumption is <1 portion per day⁽¹⁴⁾; we will refer to this as MEDAS-R (Reverse). To account for the wine component, we calculated adherence scores using both MEDAS-O and MEDAS-R scoring schemes to assess the impact of the wine component on the associations with cognitive outcomes.

Sociodemographic and lifestyle variables

Sociodemographic and lifestyle information was collected via structured questionnaires. Sex was self-reported as male or female. Age was recorded in years and grouped into three categories: < 65, 65-74, and ≥ 75 years. Measured Body-Mass Index (BMI) was calculated from weight and height and classified according to World Health Organization (WHO) criteria⁽²⁵⁾: underweight (< 18.5 kg/m²), normal weight (18.5-24.9 kg/m²), overweight (25.0-29.9 kg/m²), and obesity (≥ 30.0 kg/m²). Educational attainment was reported in completed years of schooling and categorized as ≤ 4, 5-9, and ≥ 10 years. Monthly income was self-reported and categorized as ≤ €1000, €1001-1500, €1501-2000, and > €2000. Smoking status was classified as current smoker, former smoker, or never-smoker. Physical activity level was determined from self-reported frequency of structured exercise, with “active” participants defined as those engaging in at least 20

minutes that induced sweating and breathlessness on two or more occasions per week⁽¹⁹⁾.

Statistical analysis

Continuous variables were assessed for normality by visual inspection of histograms and Q-Q plots. As none of the cognitive function measures were normally distributed, results are reported as medians and 25th-75th percentiles (P25-P75). Categorical variables were expressed as absolute and relative frequencies (n, %). Group differences in sociodemographic, lifestyle, and health-related characteristics according to adherence to the MD and cognitive function (both treated as a binary variable) were evaluated using the chi-square (χ^2) test or Fisher's exact test, as applicable. The comparison of the same participants' characteristics according to cognitive function (treated as a continuous score) was examined by the Mann-Whitney or Kruskal-Wallis tests, as appropriate.

Associations between adherence to the MD (both MEDAS-O and MEDAS-R, treated as continuous independent variables) and the scores of each cognitive assessment tool (continuous dependent variables) were examined using Analysis of Covariance (ANCOVA) models adjusted for age, sex, BMI, education, and physical activity level. Before this analysis, and due to their non-normal distribution, continuous cognitive outcomes were all log-transformed. Statistical significance was set at $p < 0.05$ (two-tailed). All analyses were performed using IBM SPSS Statistics, version 29.0.2.0 (IBM Corp., Armonk, NY, USA).

Results

This analysis included 75 participants, 84.0% of whom were female, with a mean age of 70.5 years (SD = 7.0) and 50.7% aged 65-74 years; 33.0% of participants were classified as overweight and 21.0% as obese. Educational attainment was $\leq$ 4 years in 13.3%, 5-9 years in 17.3%, and $\geq$ 10 years in 69.3%, and monthly income exceeded 2000€ in 56.7% of the sample. It was also found that only 4% were current smokers, and just 17% engaged in structured moderate-to-vigorous physical activity at least twice a week. Regarding MEDAS-O, 17.3% of participants exhibited high adherence. However, when the wine scoring was reversed, high adherence increased to 33.3%. Nonetheless, MEDAS scores showed no significant associations with any sociodemographic or lifestyle variable – sex, age, BMI, education level, monthly income, smoking status or physical activity level. PCI was observed in 9.3% on both the MoCA and ACE-R and in 54.7% on the MMSE. Based on bivariate analyses, education was significantly associated with cognitive scores across all measures (MoCA $p < 0.001$; ACE-R $p < 0.001$; MMSE $p = 0.001$). Monthly income (MoCA $p = 0.011$; ACE-R $p = 0.006$; MMSE $p = 0.011$) and smoking status (MoCA $p = 0.023$; ACE-R $p = 0.008$; MMSE $p = 0.03$) were also significantly associated with cognitive function. Age showed a significant association only with the ACE-R scores ($p = 0.013$). Whereas sex, BMI, and physical activity did not reach statistical significance in relation to any of the cognitive measures. These results are presented in Table 1.

Table 1 - Sociodemographic and lifestyle characteristics by Mediterranean Diet adherence and cognitive function assessed by MoCA, ACE-R and MMSE.

Monthly income (€)				0.11			0.354			0.006		0.011			0.317		0.006			0.128		0.011
≤1000	11 (18.3)	10 (21.3)	1 (7.7)		9 (25.0)	2 (8.3)		11 (19.6)	0 (0.0)		26.0 23.0-27.0		11 (19.3)	0 (0.0)		93.0 90.0-95.0		4 (12.9)	7 (24.1)		28.0 26.0-29.0	
1001-1500	12 (20)	11 (23.4)	1 (7.7)		7 (19.4)	5 (20.8)		9 (16.1)	3 (75.0)		22.5 20.5-24.8		10 (17.5)	2 (66.7)		89.0 83.0-91.0		4 (12.9)	8 (27.6)		25.5 24.0-27.0	
1501-2000	3 (5.0)	0 (0.0)	3 (23.1)		1 (2.8)	2 (8.3)		2 (3.6)	1 (25.0)		21.0 14.0-.		3 (5.3)	0 (0.0)		88.0 80.0-.		1 (3.2)	2 (6.9)		23.0 20.0-26.0	
>2000	34 (56.7)	26 (55.3)	8 (61.5)		19 (52.8)	15 (62.5)		34 (60.7)	0 (0.0)		26.0 24.8-27.0		33 (57.9)	1 (33.3)		92.0 91.0-94.0		22 (71.0)	12 (41.4)		27.5 26.0-29.0	
Smoking status				0.138			0.519			0.561		0.023			0.561		0.008			0.033		0.03
Smoker	3 (4.00)	1 (1.6)	2 (15.4)		1 (2.0)	2 (8.0)		3 (4.4)	0 (0.0)		29.0 27.0-.		3 (4.4)	0 (0.0)		96.0, 95.0-.		3 (8.8)	0 (0.0)		30.0 29.0-.	
Former smoker	25 (33.3)	21 (33.9)	4 (30.8)		17 (34.0)	8 (32.0)		24 (35.3)	1 (14.3)		25.0 22.0-27.0		24 (35.3)	1 (14.3)		92.0 88.5-95.0		14 (41.2)	11 (26.8)		28.0 26.0-29.0	
Never smoker	47 (62.7)	40 (64.5)	7 (53.8)		32 (64.0)	15 (60.0)		41 (60.3)	6 (85.7)		24.0 20.0-26.0		41 (60.3)	6 (85.7)		90.0 83.0-93.0		17 (50.0)	30 (73.2)		27.0 25.0-28.0	
Physical activity level				0.687			0.666			0.597		0.768			1		0.388			0.197		0.358
≥ 2 times per week	13 (17.3)	10 (16.1)	3 (23.1)		8 (16.0)	5 (20.0)		11 (16.2)	2 (28.6)		25.0 20.5-27.5		12 (17.6)	1 (14.3)		91.0 85.5-95.0		8 (23.5)	5 (12.2)		28.0 25.0-30.0	
< 2 times per week	62 (82.7)	52 (83.9)	10 (76.9)		42 (84.0)	20 (80.0)		57 (83.8)	5 (71.4)		25.0 22.0-27.0		56 (82.4)	6 (85.7)		90.0 84.0-93.0		26 (76.5)	36 (87.8)		27.0 25.75-29.0	

BMI - Body-Mass Index; MEDAS-O - Mediterranean Diet Adherence Screener - Original; MEDAS-R - Mediterranean Diet Adherence Screener - Reverse scoring in wine; MoCA - Montreal Cognitive Assessment; ACE-R - Addenbrooke's Cognitive Examination Revised; MMSE - Mini-Mental State Examination; PCI - Probable Cognitive Impairment.

Note: Percentages are calculated within columns and therefore sum to 100% in each column. “.” denotes that the percentile was not calculated due to insufficient data.

The ANCOVA models, adjusted for sex, age, education, BMI and physical activity level (Table 2), revealed no significant association between total MEDAS-O score and any cognitive measure. Specifically, MEDAS-O adherence was not related to MoCA performance ($B = 0.006$; 95% CI $[-0.001-0.014]$; $p = 0.107$), ACE-R total ($B = 0.003$; 95% CI $[-0.003-0.009]$; $p = 0.283$) or MMSE score ($B = 0.005$; 95% CI $[-0.001-0.011]$; $p = 0.087$). When examining the association with MEDAS-R, a slightly larger estimate was observed for the MoCA ($B = 0.008$; 95% CI $[-0.00005 \text{ to } 0.015]$; $p = 0.051$), yet this effect remained statistically nonsignificant. Similarly, the ACE-R estimate did not reach significance ($B = 0.003$; 95% CI $[0.003 \text{ to } 0.008]$; $p = 0.356$). In contrast, MEDAS-R demonstrated a statistically significant positive association with the MMSE ($B = 0.006$; 95% CI $[0.000 \text{ to } 0.012]$; $p = 0.043$).

Of the covariates examined, only years of education was significantly associated with cognitive outcomes ($p < 0.001$), accounting for 18.6%-35.5% of variance. Sex, age, BMI and physical activity level were non-significant contributors.

Table 2 - Associations between Mediterranean Diet adherence and cognitive function assessed by Moca, ACE-R and MMSE.

		MoCA Score			ACE-R Score			MMSE Score		
		B (95% CI)	p-value	η^2p	B (95% CI)	p-value	η^2p	B (95% CI)	p-value	η^2p
Adherence to the MEDAS-O		0.006 (-0.001 to 0.014)	0.107	0.039	0.003 (-0.003 to 0.009)	0.283	0.017	0.005 (-0.001 to 0.011)	0.087	0.044
Sex (ref: masculine)		-0.011 (-0.049 to 0.027)	0.569	0.005	0.003 (-0.024 to 0.030)	0.845	0.001	0.007 (-0.022 to 0.035)	0.653	0.003
Age		-0.001 (-0.003 to 0.001)	0.339	0.011	-0.001 (-0.003 to 0.000)	0.134	0.034	0.000 (-0.002 to 0.001)	0.665	0.003
BMI		0.001 (-0.004 to 0.002)	0.633	0.003	-0.002 (-0.004 to 0.000)	0.074	0.047	-0.002 (-0.004 to 0.001)	0.126	0.035
Education (ref: ≥ 10 years)	≤ 4 vs ≥ 10 years	-0.113 (-0.154 to -0.073)	< 0.001	0.319	-0.064 (-0.093 to -0.035)	< 0.001	0.227	-0.051 (-0.082 to -0.020)	0.002	0.142
	5-9 vs ≥ 10 years	-0.057 (-0.094 to -0.021)	0.003	0.129	-0.045 (-0.071 to -0.018)	0.001	0.149	-0.036 (-0.064 to -0.008)	0.013	0.089
Physical activity level (ref: < 2 times per week)		-0.004 (-0.41 to 0.032)	0.811	0.001	0.005 (-0.021 to 0.031)	0.702	0.002	0.010 (-0.017 to 0.038)	0.456	0.008
Model summary		$R^2 = 0.430$ Adj. $R^2 = 0.370$			$R^2 = 0.416$ Adj. $R^2 = 0.354$			$R^2 = 0.303$ Adj. $R^2 = 0.229$		

		MoCA Score			ACE-R Score			MMSE Score		
		B (95% CI)	p-value	η^2p	B (95% CI)	p-value	η^2p	B (95% CI)	p-value	η^2p
Adherence to the MEDAS-R		0.008 (-0.00005 to 0.015)	0.051	0.056	0.003 (-0.003 to 0.008)	0.356	0.013	0.006 (0.000 to 0.012)	0.043	0.060
Sex (ref: masculine)		-0.012 (-0.050 to 0.025)	0.523	0.006	0.002 (-0.025 to 0.029)	0.863	0.000	0.006 (-0.023 to 0.034)	0.700	0.002
Age		-0.001 (-0.003 to 0.001)	0.385	0.011	-0.001 (-0.003 to 0.000)	0.107	0.039	0.000 (-0.002 to 0.001)	0.645	0.003
BMI		-0.001 (-0.004 to 0.002)	0.649	0.003	-0.002 (-0.004 to 0.000)	0.076	0.047	-0.002 (-0.004 to 0.001)	0.129	0.035
Education (ref: ≥ 10 years)	≤ 4 vs ≥ 10 years	-0.106 (-0.147 to -0.065)	< 0.001	0.286	-0.062 (-0.092 to -0.032)	< 0.001	0.207	-0.046 (-0.077 to -0.014)	0.005	0.113
	5-9 vs ≥ 10 years	-0.054 (-0.090 to -0.017)	0.005	0.113	-0.044 (-0.070 to -0.017)	0.002	0.140	-0.033 (-0.061 to -0.005)	0.023	0.075
Physical activity level (ref: < 2 times per week)		-0.004 (-0.040 to 0.032)	0.814	0.001	0.005 (-0.021 to 0.030)	0.725	0.002	0.010 (-0.017 to 0.038)	0.449	0.009
Model summary		R ² = 0.441 Adj. R ² = 0.381			R ² = 0.413 Adj. R ² = 0.351			R ² = 0.315 Adj. R ² = 0.242		

BMI - Body-Mass Index; MEDAS-O - Mediterranean Diet Adherence Screener - Original; MEDAS-R - Mediterranean Diet Adherence Screener - Reverse scoring in wine; Ref. - Reference Category; Adj. - Adjusted; MoCA - Montreal Cognitive Assessment; ACE-R - Addenbrooke's Cognitive Examination Revised; MMSE - Mini-Mental State Examination.

Note: Adjusted for sex, age, BMI, education and physical activity level in 75 Portuguese adults at higher risk of dementia.

Discussion

The present study found no significant association between MEDAS-O score and the MoCA, ACE-R, or MMSE scores, which contrasts with earlier research linking higher MD adherence with better cognition^(26,27). However, when applying the MEDAS with reversed wine scoring (MEDAS-R), a statistically significant association with MMSE scores ($p=0.043$), and the association with MoCA performance approached statistical significance ($p=0.051$).

To the best of our knowledge, this is the first study to examine the relationship between adherence to the MD - assessed using both the MEDAS-O and the MEDAS-R - and cognitive function in older adults. The significant findings observed with the MEDAS-R, in contrast to the non-significant results with MEDAS-O, suggest that the scoring of wine consumption may meaningfully influence observed Mediterranean diet-cognition relationships in this population.

The broader influence of alcohol on health has been extensively debated. A United Kingdom analysis of 21000 participants aged 40-70 years demonstrated that even moderate alcohol intake (>50 g of ethanol per week) correlates with increased brain iron deposition and that elevated iron levels predict poorer executive function and slower information processing speed⁽²⁸⁾. Similarly, a longitudinal cohort study in China, involving 5354 older adults, reported that drinkers faced a 29% greater risk of cognitive decline vs. abstainers with risk proportional to alcohol doses consumption⁽²⁹⁾. However, there is evidence that contradicts these discoveries. In a prospective cohort of 19887 United States adults low-to-moderate alcohol consumption (defined as fewer than 8 standard drinks per week for women and fewer than 15 for men (14 g of ethanol per drink) was associated with preserved cognitive function as measured by the total cognitive score and by domain-specific scores in mental status word recall and vocabulary. Moreover, compared with abstainers low-to-moderate drinkers exhibited significantly slower rates of cognitive decline over time across all evaluated domains⁽³⁰⁾ and low-volume drinking (defined as 1.30-24.99 g/d of alcohol intake) is associated with the lowest risk of coronary heart disease in individuals over 55 years of age⁽³¹⁾. Nevertheless, consistent with the Global Burden of Disease Study 2021, alcohol consumption was responsible for approximately 2.4 million deaths in 2020 with nearly half of all alcohol-attributable cancer deaths in the European Region occurring among individuals who consumed up to one standard drink per day⁽³²⁾. In addition according to the WHO alcohol is classified as a carcinogen and is associated with various types of cancer, liver diseases, increased cardiovascular risk and mental health problems such as depression and suicide⁽¹⁸⁾.

This controversy in the literature raises the question of whether wine should continue to be promoted as an integral component of the MD, given its potential deleterious effects on health when considered from a holistic perspective.

It is important to note that our results supporting the association of MEDAS-R with cognitive function are in line with previous research. A recent meta-analysis reported that greater adherence to MD reduced the rate of cognitive decline by approximately 18%, and that participants following the MD maintained better cognitive function over time. These findings provide robust evidence supporting the protective role of the MD in lowering the risk of cognitive decline, dementia, and Alzheimer's disease⁽²⁶⁾. Additionally, a 2010 systematic review concluded that high MD adherence is associated with attenuated cognitive decline, lower conversion rates from mild cognitive impairment to Alzheimer's disease, and reduced Alzheimer's disease incidence^(33,34).

In addition, our study revealed a marked discrepancy emerged between sociodemographic status, lifestyle behaviours and MD adherence: although approximately 70% had a high educational attainment (≥ 10 years) and 57% reported a monthly income exceeding 2000€, overall, adherence to the MD and levels of physical activity were unexpectedly low, with only 17% meeting criteria for high MD adherence under the MEDAS-O scoring. This contrasts with numerous studies demonstrating that higher socioeconomic status, education and physical activity predict greater MD adherence in older populations⁽³⁵⁾.

However, low adherence to the MD among older adults has already been documented in the literature. For instance, a sample of 609 Portuguese older adults in the Nutrition UP 65 cross-sectional study found that only 43% of participants adhered to the MD⁽³⁶⁾. Likewise, the European Health Interview Survey

identified a weak but statistically significant negative correlation between age and MD adherence, thereby reinforcing the decrease in adherence with advancing age⁽³⁷⁾. After applying the MEDAS-R, the proportion of participants classified as high adherents increased from 17% to 33%, this rise may be attributable to the predominance of female participants in our sample, as according to the National Food, Nutrition, and Physical Activity Survey of the Portuguese General Population 2015-2016⁽³⁸⁾, elderly Portuguese women consume, on average, only 37 g of wine per day, compared with 270 g among their male counterparts. Moreover, the alcohol component effectively serves as a barrier, penalizing individuals who otherwise adhere to MD patterns but abstain from or restrict alcohol consumption. Regarding cognitive function, PCI was observed 9.3% on the MoCA and ACE-R and in 54.7% on the MMSE. Both the MoCA and ACE-R demonstrate broad construct validity by encompassing executive, attentional, and visuospatial domains. The ACE-R is even more comprehensive than the MoCA, assessing additional cognitive areas and thus being less susceptible to false positives, whereas the MMSE focuses on orientation and immediate recall, which may predispose it to such errors. Moreover, MMSE orientation items are highly sensitive to mental disorders such as anxiety and depression, and it has been demonstrated that older adults with elevated symptoms of these conditions exhibit significantly reduced orientation subscale scores⁽³⁹⁾. Finally, the predominance of women in our sample, and the higher prevalence of anxiety and depressive disorders among females⁽⁴⁰⁾, may further overestimate MMSE PCI detection relative to MoCA/ACE-R assessments. As regards education, it accounted for the largest proportion of variance in cognitive function in the multivariate models, followed by monthly income and smoking status. These findings are corroborated by studies showing that greater

years of formal education predict superior late-life cognitive performance⁽⁴¹⁾, higher income is associated with better cognitive outcomes in adults aged 65 years old or older⁽⁴²⁾ and current smoking confers a significantly increased risk of dementia and accelerates cognitive decline compared to former or never smokers^(43,44). Although physical activity had no significant effect on any cognitive measure in our sample, existing literature demonstrates that structured exercise induces measurable improvements in cognition and mental health⁽⁴⁵⁾.

Lastly, several limitations must be acknowledged. Our sample was predominantly self-selected via media channels and senior universities, with inclusion criteria requiring ≥ 4 years of education and excluding individuals with severe baseline cognitive impairment. These decisions introduce potential selection bias, restrict score variability and limit its representativeness of the Portuguese population. Coupled with a modest sample size and a cross-sectional design, statistical power was limited and causal or longitudinal inferences precluded, possibly obscuring subtle MD benefits. However, thorough covariate adjustment supports these cross-sectional findings.

Conclusion

In Portuguese older adults at increased dementia risk, adherence to the MD, as measured by MEDAS-O, showed no association with cognitive function. Reversing the wine score uncovered a positive association with global cognition performance. These findings highlight how wine weighting can shape diet-cognition associations and call for longitudinal work to clarify causal effects.

Supervision

This work was supervised by Professor Pedro Moreira, PhD, and co-supervised by Daniela Marques de Sousa, MSc (Annex A).

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Annex A - Supervisor's Report of the Complementary Project



Parecer

Enquanto equipa de orientação do Trabalho Complementar da estudante do 4º ano da licenciatura em Ciências da Nutrição da Faculdade de Ciências da Nutrição e Alimentação da Universidade do Porto, Andreia Alexandra Mesquita Conceição, vimos por este meio emitir o nosso parecer.

O trabalho de investigação intitulado *"Mediterranean Diet Adherence and Cognitive Function in a sample of Portuguese Adults Aged 55-85: A Cross-Sectional Study"* foi desenvolvido pela estudante entre fevereiro e junho de 2025 e teve como principal objetivo analisar a relação entre a adesão à Dieta Mediterrânica (avaliada por dois métodos de cotação diferentes face ao item vinho), e a função cognitiva em idosos portugueses.

Este estudo transversal utilizou dados baseline preliminares do projeto de doutoramento *"NUTRIMIND: Nutrition-based Interventions to Prevent Cognitive Decline in Adults at Higher Risk of Dementia"*, um ensaio clínico randomizado que visa avaliar a efetividade de uma intervenção baseada na nutrição para prevenir o declínio cognitivo em adultos com risco aumentado de demência.

Durante a realização do seu trabalho complementar, a aluna participou empenhadamente na definição do protocolo do estudo, na informatização e inserção de dados previamente recolhidos no âmbito das atividades do projeto NUTRIMIND, bem como no tratamento e análise de dados. Adicionalmente, a aluna esteve sempre disponível para colaborar noutras atividades pontuais do projeto, demonstrando assim grande espírito de interajuda e dedicação. A estudante provou ter um elevado grau de autonomia na redação do primeiro rascunho do manuscrito que apresenta, tendo evidenciado competências de espírito crítico, rigor científico e também resiliência.

A estrutura do trabalho cumpre as normas da instituição e reflete um conhecimento adequado do método de escrita científica, demonstrando a capacidade de reflexão crítica da estudante sobre os resultados encontrados e a sua implicação para a investigação futura.

Face ao exposto, considero que a estudante cumpriu com sucesso a conclusão deste trabalho e que o mesmo reúne as condições necessárias para ser apresentado ao júri atribuído, no âmbito da conclusão da sua Licenciatura em Ciências da Nutrição.

Saliento os meus votos de muito sucesso para a estudante, que certamente contribuirá para a excelência da profissão de nutricionista.

Porto, 4 de Julho de 2025

O orientador

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