

Mediterranean diet habits in older individuals: Associations with cognitive functioning and brain volumes [☆]



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ABSTRACT

To examine the association between dietary habits, cognitive functioning and brain volumes in older individuals, data from 194 cognitively healthy individuals who participated in the Prospective Investigation of the Vasculature in Uppsala Seniors cohort were used. At age 70, participants kept diaries of their food intake for 1 week. These records were used to calculate a Mediterranean diet (MeDi) score (comprising dietary habits traditionally found in Mediterranean countries, e.g. high intake of fruits and low intake of meat), with higher scores indicating more pronounced MeDi-like dietary habits. Five years later, participants' cognitive capabilities were examined by the seven minute screening (7MS) (a cognitive test battery used by clinicians to screen for dementia), and their brain volumes were measured by volumetric magnetic resonance imaging. Multivariate linear regression analyses were constructed to examine the association between the total MeDi score and cognitive functioning and brain volumes. In addition, possible associations between MeDi's eight dietary features and cognitive functioning and brain volumes were investigated. From the eight dietary features included in the MeDi score, pertaining to a low consumption of meat and meat products was linked to a better performance on the 7MS test ($P = 0.001$) and greater total brain volume (i.e. the sum of white and gray matter, $P = 0.03$) when controlling for potential confounders (e.g. BMI) in the analysis. Integrating all dietary features into the total MeDi score explained less variance in cognitive functioning and brain volumes than its single dietary component meat intake. These observational findings suggest that keeping to a low meat intake could prove to be an impact-driven public health policy to support healthy cognitive aging, when confirmed by longitudinal studies. Further, they suggest that the MeDi score is a construct that may mask possible associations of single MeDi features with brain health domains in elderly populations.

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1. Introduction

Dietary habits may play a role in cognitive aging, and the Mediterranean diet (MeDi) might help slow aging effects on cognition (Barak and Aizenberg, 2010). High intake of fish and a regular but moderate intake of alcohol are components of a MeDi and these factors have been linked to slower cognitive decline and reduced Alzheimer's Disease (AD) risk (Aberg et al., 2009; Stampfer et al., 2005). Moreover, higher adherence to MeDi may not only reduce the risk for AD (Scarmeas et al., 2006, 2009) but also lower mortality rates and speed of disease progression in those already afflicted (Scarmeas et al., 2007). Conversely, in a prospective cohort study of 1410 older adults, a higher adherence to MeDi did not lower the risk for incident dementia (Féart et al., 2009). In another study, a higher adherence to MeDi failed to delay the transition from a cognitively healthy status to mild cognitive impairment (Cherbuin and Anstey, 2012). One possible reason for these contrasting

Abbreviations: AD, Alzheimer's Disease; CI, Confidence interval; EPN, Ethics Committee of Uppsala; FWE, Family Wise Error; MRI, Magnetic resonance imaging; MeDi, Mediterranean diet; MCI, Mild cognitive impairment; MMSE, Mini-mental state examination; PIVUS, Prospective Investigation of the Vasculature in Uppsala Seniors; 7MS, Seven minute screening; SEM, Standard error of mean; SPM, Statistical parametric mapping; TFE, Turbo Field Echo; VBM, Voxel Based Morphometry.

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findings might be that the MeDi score, which is commonly used to explore correlations between MeDi and health outcomes in elderly cohorts, may mask health related effects of certain dietary components by including others that are not relevant for the health domain of interest.

Thus, in the present community-based study involving elderly men and women who were all first examined at age 70, possible associations between MeDi and cognitive functioning were studied. In addition, the relation between MeDi and brain volume was examined in an exploratory manner. Potential associations between single MeDi components and target measures were also separately explored.

2. Methods and materials

2.1. Study population and design

Data were obtained from the 'Prospective Investigation of the Vasculature in Uppsala Seniors' (PIVUS). This study initially included 1016 (50% females) individuals aged 70 living in the community of Uppsala, Sweden. The primary aim of PIVUS was to identify determinants of endothelial function and arterial compliance in a random sample of elderly individuals (Lind et al., 2005). At the time of the inclusion (between 2001 and 2003), a 7-day food diary was obtained for each 70-year-old individual (for description, please see below). Out of the initial cohort, 827 individuals agreed to participate in a follow-up investigation 5 years later (81.4% response rate), i.e. when they were 75 years old. Among the individuals who were re-investigated at the age of 75 years, a subsample of 409 elderly agreed to participate in a magnetic resonance imaging (MRI) scan of their brains (i.e. 49.5% of the re-investigated individuals), and their global cognitive function was assessed by means of the seven minute screening test (for description, please see Section 2.3). Of this number, 194 elderly men and women satisfied all criteria for this study, including cognitively normal clinical status (identified by a mini-mental state examination (MMSE) score greater than 26) (Folstein et al., 1975), absence of stroke or neurologic disease (e.g., tumors) at ages 70 and 75, valid measures from the magnetic resonance imaging (MRI) brain scan, and reliable food records at the age of 70 (flow-chart, see Fig. 1). Exclusions were administered to minimize the confounding effects of variables related to our main question: does adherence to the MeDi at the age of 70 years relate to cognitive function and brain structure 5 years later among cognitively healthy older adult? Importantly, patients who suffered from mild cognitive impairment and dementia were not considered for a separate analysis because sample size was severely underpowered ($n = 8$). Exclusions were administered because diseases such as diabetes, stroke, and cognitive impairment can induce changes in diet and lifestyle.

The study was approved by the Ethics Committee of Uppsala (EPN) and the participants gave informed consent to participate.

2.2. Assessment of adherence to MeDi

Dietary habits were recorded at the age of 70 years. They were not re-assessed at the age of 75 years, the time point at which our dependent variables (brain volume, global cognitive function) were measured. A detailed description of the dietary recall procedure can be found elsewhere (Sjögren et al., 2010). Briefly, each participant was instructed by a dietitian on how to perform the 7-day dietary registration, and the amounts consumed were self-reported in household measurements or specified as portion sizes. Non-adequate reports of energy intake were determined by means of the Goldberg cutoff (as modified by Black, 2000). In this procedure, an acceptable range of energy intake is identified for each subject in relation to estimated energy expenditure – i.e., producing a 95% confidence interval (CI) for energy intake that is required for weight maintenance. Energy expenditure was calculated by adding basal metabolic rate (according to the age adjusted Schofield formula) and exercise-dependent metabolic rate (derived from

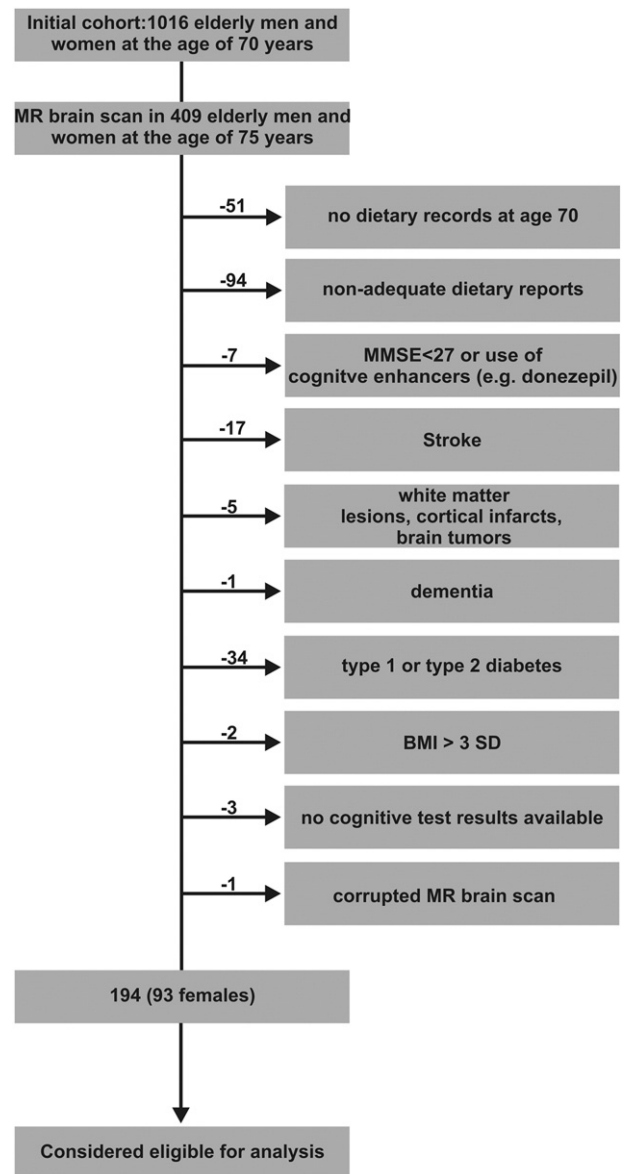


Fig. 1. Subject exclusion criteria and sample size.

questionnaires). Individuals with a reported energy intake outside the 95% CI were regarded as non-adequate reporters.

Based on the 7-day dietary registration, the adherence to MeDi was defined as a scale ranging from 0 (not adherent at all to MeDi) to 8 points (very adherent to MeDi). The median intake in the population served as the cutoff for each dietary variable; hence cutoffs are population specific moreover men and women were scored separately. For instance, those whose weekly fish consumption was below the population median were assigned a value of 0, whereas those whose fish intake was above the median a value of 1 was assigned. Reverse scoring was applied for intakes not considered a part of the Mediterranean diet (e.g. high intake of meat- and milk-products). In terms of alcohol intake, a value of 1 was assigned for moderate alcohol consumption, which was defined as an intake of 10–50 g/day for males and 5–25 g/day for females, respectively. Compared with the original score (Trichopoulou et al., 2003), polyunsaturated fatty acids replaced monounsaturated fatty acids when estimating dietary fat quality since in a traditional Swedish diet saturated and monounsaturated fats have similar food origins. In addition, because of their very low intake, nuts and seeds were excluded, and dietary leguminous plants were pooled with vegetables in our score. The reported intake of potatoes was added to cereals, because potato

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