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Switching to a 10-day Mediterranean-style diet improves mood and cardiovascular function in a controlled crossover study

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ABSTRACT

Objectives: Even short-term adherence to a Mediterranean-style diet may benefit aspects of psychological functioning. The aim of the present study was to assess the effects of switching to a 10-d Mediterranean-style diet on mood, cognition, and cardiovascular measures.
Methods: Using a crossover design, 24 women were randomly assigned to either the diet change (where they switched to a Mediterranean-style diet) or no diet change (normal diet) condition for 10 days before switching to the other condition for the same duration. Mood, cognition, and cardiovascular measures of blood pressure, blood flow velocity, and arterial stiffness were assessed at baseline and at the completion of the two diets (days 11 and 22).
Results: Independent of whether the Mediterranean-style diet was undertaken before or after the crossover, it was associated with significantly elevated contentment and alertness, and significantly reduced confusion. Additionally, aspects of cognition, such as memory recall, improved significantly as a result of switching to the Mediterranean-style diet. Regarding cardiovascular measures, there was a significant reduction in augmentation pressure associated with the Mediterranean-style diet intervention, but blood flow velocity through the common carotid artery did not change.
Conclusions: This Mediterranean-style diet has the potential to enhance aspects of mood, cognition, and cardiovascular function in a young, healthy adult sample.

Introduction

A high-level consumption of fresh fruit, vegetables, whole grains, and legumes, as well as moderate consumption of oily fish, olive oil, and dairy products, such as milk and yogurt, have been described as a Mediterranean-style diet (MedDi). The MedDi is considered particularly healthy because it contains higher levels of nutrients, such as ω-3 essential fatty acids, magnesium, and vitamins that are associated with better cardiovascular and neurocognitive health [1–3].

Epidemiologic studies report that greater adherence to the MedDi is associated with reduced risk for developing cardiovascular disease (CVD) [4], type 2 diabetes [5], metabolic syndrome [6], stroke [4], mild cognitive impairment [7], and Alzheimer's disease [8]. In individuals with compromised cardiovascular health, the MedDi has been shown to improve lipid profiles, inflammation, and insulin resistance [5] and to increase levels of cognitive function [9]. These beneficial effects may have the potential to contribute to better management of hypertension, CVD, vascular dementia, Alzheimer's disease, and cognitive decline in clinical samples [10].

Reports of beneficial effects of the MedDi are not restricted to clinical samples, or those with cardiovascular pathology or cognitive deficits. A 24-y longitudinal study found that greater lifetime adherence to the MedDi was associated with lower levels of arterial stiffness at age 36; as well as lower levels of other cardiovascular risk factors, including blood pressure (BP), total cholesterol, and body mass index [11]. These results suggest

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that following a MedDi during childhood through to adulthood may be associated with decreased risk for CVD. This raises the questions of whether switching to a MedDi also may have health benefits in young, healthy cohorts, including prevention of adverse cardiovascular events associated with a substantial increase in arterial stiffness during adulthood [11].

In addition to cardiovascular health, there is some evidence that following MedDi may benefit cognition. In older, dementia-free individuals, adherence to a MedDi has been associated with a slower rate of global cognitive decline over 7 y [12]. Similarly, antioxidant- and flavanol-rich foods, which are integral components of the MedDi, have been correlated with better performance on individual measures of memory in people aged 55 to 80 y [9]. With regard to younger cohorts, a recent pilot (N = 25) study investigated the effects of a 10-d MedDi intervention on mood and cognitive performance in healthy, young women. In comparison to participants who did not change their diet, those on the MedDi had significantly improved self-reported vigor, contentment, and alertness with decreased levels of depression, anxiety, and confusion. The cognitive effects were mixed with the MedDi condition being associated with faster spatial working memory, but with slower numeric working memory and word recognition [13].

The present study was a partial replication of the previous trial [13]. We adopted a crossover design to limit intrasubject variability and also to allow examination of the effects of a transient diet change. Additionally, we investigated cardiovascular functioning over the same period. Based on previous findings [13], it was hypothesized that switching to a 10-d MedDi would cause improvements in mood, particularly alertness, contentment, and vigor. We were also interested in the extent to which the cognitive effects were consistent from study to study. On the basis of recent observational studies [11,14], it was also predicted that the MedDi would reduce systolic BP and measures of aortic stiffness, including central aortic pressure.

Materials and methods

Design

In partial replication of the earlier study [13], the present study examined the effects of a 10-d diet change intervention on mood, cognition, and cardiovascular functioning utilizing a randomized, balanced, crossover design. The study was approved by the Swinburne University Human Research Ethics Committee, and carried out in accordance with the Declaration of Helsinki.

Participants

Twenty-four healthy women aged 20 to 38 y (mean = 25.6, SD = 5.1) were recruited via social media using the snowball technique. Face-to-face screening interviews were conducted to exclude individuals with medical conditions, such as food allergies, diabetes, heart disease, as well as neurologic and psychiatric disorders. Individuals who were pregnant, breastfeeding, smoked, or had a history of substance abuse also were excluded. Participants received supermarket vouchers valued at AU$150 for their participation and were encouraged to use them to cover grocery expenses.

Diets

At the first testing session, participants were randomly allocated to follow either a Mediterranean-style eating plan (MedDi condition), or to continue with their normal diet (no diet change, NC condition) for 10 d. After the first 10 d, participants were assigned to the alternate condition in a counterbalanced fashion. Participants were provided with an eating plan when undertaking the MedDi condition and daily food diaries to record their food intake over the course of the study. The requirements of the MedDi included increasing consumption of fruits, vegetables, oily fish, low-fat dairy, and nuts over the 10-d period, focusing on foods that provided a source of carbohydrates, protein, and healthy fats. When possible, participants were instructed to ensure all foods were freshly prepared, and to exclude all preprepared, packaged, and processed foods. Participants were instructed to abstain from consuming meat, butter and margarine, caffeinated/energy drinks, added sugars and salts, alcohol, and the use of tobacco or illicit drugs throughout the diet-change period. In the normal diet condition, participants were instructed to continue their diet as per usual, but still document their eating habits in the food diary.

Morphometric data

Height and weight were measured for each participant and used to calculate body mass index (BMI).

Mood

Participants completed the Profile of Mood States (POMS) questionnaire [15], which measures six dimensions of mood corresponding to anger, anxiety, confusion, vigor, fatigue and depression. A total mood disturbance score also was derived from the sum of anger, anxiety, confusion, fatigue, and depression minus vigor factors. Participants also completed an electronic version of the Bond and Lader [16] visual analog scale (VAS) by indicating their subjective state on 16 VAS lines anchored by paired antonyms. Scores derived according to the original developers' instructions indicated participants' levels of alertness, calmness, and contentment.

Cognition

The Computerized Mental Performance Assessment System [17] battery was used to measure various cognitive domains including attention, working memory, long-term memory, and executive functioning. The battery was designed to include tasks that have been shown to be sensitive to nutritional manipulations as described previously [17]. Tasks were presented in the following order: simple reaction time, choice reaction time, word presentation with immediate word recall, picture presentation, rapid visual information processing, numeric working memory, 3-back, Corsi blocks, serial three subtraction, serial seven subtraction, delayed word recall, delayed word recognition, and delayed picture recognition. Participant outcomes for all tasks included measures of accuracy and reaction time, with the exception of word recall tasks, where the number of correct and incorrect words was recorded.

Cardiovascular functioning

Participants underwent assessments of brachial BP, central (aortic) BP, and blood flow velocity. All measurements were taken with the participant seated, after a 5-min rest period. Brachial BP was measured using an automatic BP monitor. The average of three BP measurements, each separated by a 30-sec delay, was used in the statistical analyses. Pulse wave analysis (SphygmoCor; AtCor Medical, Sydney, Australia) was used to measure central BPs. Central pressures were measured because they provide information relating to the risk for CVD and cognitive impairment beyond the use of brachial BPs [18,19], especially in younger cohorts [20]. Through applanation of the radial artery (using a noninvasive pressure sensor), SphygmoCor automatically derived the ascending aortic waveform through a validated mathematical transfer function [21]. Quality control was ensured, where only recordings with an operator index >75% were accepted. Measures of central systolic pressure, diastolic pressure, pulse pressure, augmentation pressure, and augmentation index were automatically derived. Augmentation pressure represents the amount the aortic systolic pressure that has been augmented by wave reflections and aortic stiffness. Similarly, augmentation index (augmentation pressure/pulse pressure by 100) is a surrogate marker for aortic stiffness and wave reflection. Transcranial Doppler ultrasonography (Compumedics, Australia) was used to calculate blood flow velocity in the left common carotid artery using a 4-MHz probe. A trained research assistant recorded and saved a continual trace of blood flow velocity such that the software could automatically calculate the mean blood flow velocity for each participant. The purpose of measuring blood flow velocity was to examine whether any changes in cognition, following the MedDi, were underpinned by changes in blood flow to the brain.

Sample size calculation

A previous study found large effects on aspects of both mood and cognition with a MedDi condition compared with a no diet condition [13]. Power analysis revealed that 20 participants were required in order to reach 90% chance of detecting an effect size of 0.4. We thus recruited 24 participants to account for dropouts.

Procedure

Information regarding the study and consent forms were provided to participants before attending the first testing session. To minimize confounding factors, each testing session followed the same sequence. Eligibility was confirmed before the completion of the POMS questionnaire, food diary distribution, and a discussion regarding the diet if applicable, and then height, weight,