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Adherence to a Mediterranean diet is associated with lower incidence of frailty: A longitudinal cohort study

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SUMMARY

Background & aims: There is a paucity of data investigating the relationship between the Mediterranean diet and frailty, with no data among North American people. We aimed to investigate if adherence to a Mediterranean diet is associated with a lower incidence of frailty in a large cohort of North American people.

Methods: This study included subjects at higher risk or having knee osteoarthritis. Adherence to the Mediterranean diet was evaluated using a validated Mediterranean diet score (aMED) as proposed by Panagiotakos and classified into five categories. Frailty was defined using the Study of Osteoporotic Fracture (SOF) index as the presence of ≥ 2 out of: (i) weight loss $\geq 5\%$ between baseline and the subsequent follow-up visit; (ii) inability to do five chair stands; (iii) low energy level.

Results: During the 8 years follow-up, of the 4421 participants initially included (mean age: 61.2 years, % of females = 58.0), the incidence of frailty was approximately half in those with a higher adherence to the Mediterranean diet (8 for 1000 person years) vs. those with a lower adherence (15 for 1000 persons-years). After adjusting for 10 potential confounders (age, sex, race, body mass index, education, smoking habits, yearly income, physical activity level, Charlson co-morbidity index and daily energy intake), participants with the highest aMED scores were found to have a significant reduction in incident frailty (hazard ratio = 0.71; 95% CIs: 0.50–0.99, $p = 0.047$) with respect to those in a lower category. Regarding individual components of the Mediterranean diet, low consumption of poultry was found to be associated with higher risk of frailty.

Conclusions: A higher adherence to a Mediterranean diet was associated with a lower incidence of frailty over an 8-year follow-up period, even after adjusting for potential confounders.

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1. Introduction

Defined as “a state of increased vulnerability to stressors resulting from a decrease in physiologic reserves in multiple organ

systems causing limited capacity to maintain homeostasis” [1], frailty is a common condition in older people. It has been associated with an increased risk of several deleterious outcomes in that population, including disability, hospitalization and institutionalization [2]. Recent studies have also suggested that frailty could be considered an independent risk factor for cardiovascular [3,4] and metabolic [5] diseases that could further hasten the typical transition from frailty to disability.

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Although the risk factors for frailty are numerous, diet could play its own relevant role in its development. Some observational studies have suggested that a deficiency of single nutrients, such as carotenoids, vitamins D, E, and C, folates, proteins, and whole grains [6–12] might play a putative role in the development of frailty. But as the deficiency of some nutrients is often associated with the paucity of others, assessment of whole dietary patterns seems more appropriate for epidemiological purposes [13]. Interestingly, a higher consumption of fruits and vegetables was associated with a reduced risk of frailty in a large cohort of older European subjects [14]. The Mediterranean diet is one of the most important dietary patterns that has been investigated in view of its beneficial effects on several diseases. The term 'Mediterranean diet,' which describes traditional dietary habits of peoples from Mediterranean countries, is frequently depicted as a food pyramid [15]. For epidemiological purposes, adherence to the Mediterranean diet is usually evaluated using standardized questionnaires that take into consideration foods that are commonly eaten by Mediterranean populations. The Mediterranean-style diet is an established healthy-eating behavior that has consistently been shown to have beneficial effects on quality of life [16] and on musculoskeletal [17], cardiovascular [18], metabolic [19], and cognitive [20,21] diseases.

Until now, to the best of our knowledge, only four studies have investigated the effect of the Mediterranean diet on incident frailty [22–25]. While all of these advanced the field and suggested that the Mediterranean diet may play a role in delaying the onset of frailty, three were nevertheless limited because of their short follow-up period [22,23,25] (less than 4 years). No study has, moreover, investigated the possible role of higher adherence to Mediterranean diet on frailty in a North American population a population in which the higher presence of some medical conditions (such as obesity) [26] that predicts frailty, could alter the association between Mediterranean diet and frailty.

Given the potential benefits of the Mediterranean diet on several diseases and the absence of data on North American subjects, the current study aimed to investigate whether adherence to a Mediterranean diet is associated with a lower incidence of frailty in a large cohort of North Americans participating in the Osteoarthritis Initiative. We hypothesized that higher adherence to the Mediterranean diet is associated with a lower incidence of frailty.

2. Methods

2.1. Data source and subjects

Data were gathered from the Osteoarthritis Initiative (OAI) [27], available for public access at <http://www.oai.ucsf.edu/>. The specific datasets utilized for this research were registered during the baseline and screening evaluations (V00) and each database reporting data on frailty until 96 months from baseline (V10). Patients at high risk or having knee OA were recruited at four clinical centers in the USA (Baltimore, MD; Pittsburgh, PA; Pawtucket, RI; and Columbus, OH) between February 2004 and May 2006.

All the participants provided written informed consent. The OAI study protocol was approved by the institutional review board of the OAI Coordinating Center, University of California at San Francisco.

2.2. Adherence to Mediterranean diet (exposure)

Participants' diet patterns were analyzed using the Block Brief 2000 food frequency (FFQ) questionnaire during the baseline appointment [28]. The validated tool, containing a food list of 70 items, was designed to assess the individual's food and beverage consumption over the past year. Frequency of food consumption of

the items included was reported at nine levels of intake from "never" to "every day". There were also seven dietary behavior questions on food preparation methods and fat intake, one question on fiber intake, and 13 questions on vitamin and mineral intakes.

Adherence to a Mediterranean diet was evaluated using the Mediterranean diet score (aMED) proposed by Panagiotakos et al. [29]. The score was calculated based on a food frequency questionnaire completed during the baseline OAI visit. The aMED takes into consideration foods commonly consumed by individuals living in Mediterranean area. Participants were asked to rate their consumption of each single food item using a score ranging from 0 (less adherence) to 5 (better adherence); the total possible score ranges from 0 to 55, with higher values indicating higher adherence to a Mediterranean diet. Cereals (e.g. bread, pasta, rice), potatoes, fruits, vegetables, legumes (e.g. peas, beans), fish were categorized on the basis of servings/month and specifically as: 0 = never; 1 = 1–4 servings for month; 2 = 5–8; 3 = 9–12; 4 = 13–18; 5 = more than 18 servings/month. As no distinction was made with reference to whole vs. refined cereals, all types of grains were considered under the same heading. Consumption of red meat, poultry, and full fat dairy products (e.g. milk cheese, yogurt) was categorized as: 0 = more than 18 servings/month; 1 = 13–17 servings/month; 2 = 9–12; 3 = 5–8; 4 = 1–4; 5 = never. Consumption of olive oil was categorized as the times it was used in a week's time and specifically as: 0 = never; 1 = rare; 2 = ≤ 1 /weekly; 3 = 2 times/weekly; 4 = 3–6; 5 = daily. Alcoholic beverages were categorized as: 0 = ≥ 700 ml/day or 0; 1 = 600–699 ml/day; 2 = 500–599 ml/day; 3 = 400–499 ml/day; 4 = 300–399 ml/day; 5 = < 300 ml/day.

We arbitrarily divided the population into 5 categories depending on their total scores as follows: aMED score $< 24 = Q_1$, $25–27 = Q_2$, $28–30 = Q_3$, $31–32 = Q_4$ and $> 32 = Q_5$.

2.3. Outcome

The study's outcome of interest was incident frailty. In agreement with the Study of Osteoporotic Fracture (SOF) index [30,31] frailty was defined as the presence of at least ≥ 2 out of three of the following criteria: (i) weight loss $\geq 5\%$ taking place between baseline and the follow-up examinations (at the baseline examination a body mass index, BMI, of less than 20 kg/m^2 , a common cut-off for identifying underweight people the elderly [32,33], was used, since no information regarding weight changes was recorded). Weight and height were measured at baseline and during follow-up examinations by a trained nurse; (ii) the inability to rise from a chair five times without arm support (hereafter referred to as inability to carry out chair stands); and (iii) poor energy based on the SF12 questionnaire response of "little at a time" or "none at a time" to the question "in the past 4 weeks, did you have a lot of energy?"

The assessment of the outcome was made at the baseline and during the V01 (12 months), V03 (24 months), V05 (36 months), V06 (48 months), V08 (72 months) until the V10 (96 months).

2.4. Covariates

We identified 10 potential self-reported confounders including BMI; physical activity evaluated using the Physical Activity Scale for the Elderly (PASE) [34]; race; smoking habit, educational level and yearly income ($<$ or $\geq \$50,000$ and missing data) to assess the relationship between aMED and incident frailty.

Validated general health measures of self-reported comorbidities were assessed using the modified Charlson comorbidity score [35]. The medical morbidities that were assessed using that score regarded diseases/disorders that were common in North Americans such as fractures, heart attack and failure, stroke, chronic obstructive pulmonary disease, diabetes and cancer [36].

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