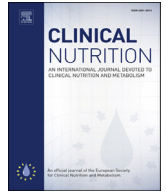




Contents lists available at ScienceDirect

Clinical Nutrition

journal homepage: <http://www.elsevier.com/locate/clnu>

Original article

High adherence to a Mediterranean diet and lower risk of frailty among French older adults community-dwellers: Results from the Three-City-Bordeaux Study

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ARTICLE INFO

Article history:

Received 30 March 2016

Accepted 18 May 2017

Keywords:

Mediterranean-type Diet

Frailty risk

Late life

SUMMARY

Background & aims: Mediterranean diet (MeDi) is considered as a key component for healthy aging, including prevention of age-related disability, while its association with frailty, independent of disability has never been assessed. Our objective was to investigate the relation between MeDi adherence and frailty incidence among persons aged ≥ 75 years participating at the prospective population-based French Three-City Study.

Methods: The study sample consisted of 560 initially non-frail participants of the Three-City-Bordeaux center, seen at the 2009–2010 follow-up, and re-examined two years later. Adherence to MeDi was computed from a food frequency questionnaire (scored as 0–9). Frailty was defined as having at least three out of the following five slightly modified Fried frailty criteria: involuntary weight loss, exhaustion, slowness, weakness and low physical activity. Logistic regression models adjusted for sociodemographic and clinical covariates, including cognitive performance and depressive symptomatology, were used to assess the association between MeDi score and subsequent frailty risk.

Results: Over the 2-year follow-up, 79 participants (14%) became frail. Older adults with the highest MeDi adherence (score 6–9) had a significantly 68% frailty risk reduction (95% CI: 28–86%, $p = 0.006$) compared to those in the lowest MeDi category (score 0–3). Regarding the frailty criterion separately, the highest MeDi adherence was associated with a significantly reduced risk of incident slowness (OR = 0.45; 95% CI: 0.20–0.99, $p = 0.04$), poor muscle strength (OR = 0.44; 95% CI: 0.20–0.98, $p = 0.04$) and low physical activity (OR = 0.39; 95% CI: 0.18–0.82, $p = 0.01$), compared to the lowest MeDi adherence.

Conclusion: In addition to its well-documented beneficial effects on health, adherence to MeDi might contribute to prevent the onset of frailty, even at late stages of life.

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1. Introduction

Frailty, a clinically relevant geriatric syndrome, is defined as a state of a higher individual's risk of developing many adverse

outcomes, especially disability, hospitalization and mortality [1]. It is characterized by an age-related decreased functioning of multiple physiological systems and reduced resistance to stress [1].

Few studies have suggested that poor nutrition is related to frailty and that healthy dietary patterns could play a major role in frailty prevention [2]. In fact, nutrients such as proteins [3], and food groups, either isolated or combined in dietary patterns were observed to be associated with frailty [3–6]. Specifically, a high adherence to a Mediterranean-type Diet (MeDi) was significantly associated to lower frailty prevalence [6] or risk [7,8]. Nevertheless, to date, there are only two longitudinal studies assessing this relationship [7,8]. First, Leòn-Muñez et al. observed that a better MeDi

Abbreviations: MeDi, Mediterranean type diet; OA, Older adults; PA, Physical activity.

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<http://dx.doi.org/10.1016/j.clnu.2017.05.020>

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Please cite this article in press as: Rahi B, et al., High adherence to a Mediterranean diet and lower risk of frailty among French older adults community-dwellers: Results from the Three-City-Bordeaux Study, Clinical Nutrition (2017), <http://dx.doi.org/10.1016/j.clnu.2017.05.020>

adherence was associated with a 52% risk reduction of frailty among Spanish older adults (OA) aged ≥ 60 years followed for 3.5 years in the study Seniors Enrica [7]. However, major confounders were not considered in this study, such as cognitive status known as a risk factor for frailty [9]. The second longitudinal study, done in a sample of OA aged 73 or more from the InCHIANTI cohort, showed a 70% risk reduction of frailty among those having high MeDi adherence over six years of follow-up [8]. Regarding these previous results, major limits must be stressed. Indeed, it is worthy to mention that both studies did not differentiate between frail and disabled participants despite increasing consensus that frailty and disability are distinct entities [10] and that frailty is usually considered as a pre-disability state [11]. This is of particular interest especially knowing that a high MeDi adherence has already been associated with risk reduction of incident disability [12]. Moreover, disability and the associated functional limitations strongly affect both the quality and quantity of dietary intake [13]. Second, the maximum mean age in both studies was 73-yr old. Hence, we questioned whether following a MeDi later in life would confer the same beneficial effects on frailty. Therefore, our objective was to determine if a high MeDi adherence is associated with a lower frailty risk among elderly community French dwellers followed for two years while taking into account several confounders including cognitive status and excluding all participants disabled on Activities of Daily Living (ADL).

2. Methods

2.1. Study overview

Three-City (3C) Study is a population-based prospective cohort study of vascular risk factors of dementia [14]. Its protocol was approved by the Consultative Committee for the Protection of Persons participating in Biomedical Research at Kremlin-Bicêtre University Hospital and all participants gave written informed consent (Supplementary methods). Eligible participants were randomly sampled from electoral rolls. Eligible participants were persons 65 years or older at the time of recruitment, not institutionalized and expecting to remain in the area for the next four years. The present sample included subjects seen at the 10-year follow-up (2009–2010) and re-examined two years later (2011–2012) at the Bordeaux center, the only center of the 3C study where the standard data collection was completed with a comprehensive dietary survey. These two data collection dates will be considered our baseline and 2-year follow-up, respectively.

2.2. Dietary assessment and computation of the Mediterranean diet score

Dietary habits were evaluated by a trained research assistant using a semi-quantitative food frequency questionnaire (FFQ) assessing the weekly consumption of 12 foods and food groups, including fats. Food groups constituting the MeDi are the following: fruits, vegetables, legumes, cereals, including bread, pasta and rice (whole and refined grains), fish and seafood, meat and dairy products. The number of servings/week for each food group was determined and the MeDi score was generated as follows: a value of 0 or 1 was assigned to each food group using sex-specific medians of the population as cut-offs, as previously described [15]. Briefly, participants received one point if their intake was higher than the sex-specific median for a presumed protective component (fruits, vegetables, legumes, cereals, fish and seafood) and lower than the sex-specific median for a presumed deleterious component (meat and dairy products). The monounsaturated -to-saturated fatty acids ratio used in the original scale assessing MeDi adherence [15] cannot be obtained from the FFQ. Therefore, olive oil consumption was used

as a proxy. Participants who reported an olive oil consumption as “frequent” and “all the time” were given one point; 0 otherwise. For alcohol, one point was given to mild-to-moderate consumers. Cut-offs, chosen to be close to the second quartile of distribution of total alcohol consumption, were defined in men and women separately [12]. One point was attributed for men if consumption was within 4–8 glasses per week and for women if consumption was within 1–2 glasses per week. Then, the MeDi score was calculated by adding the scores for each food category for each participant, ranging from 0 to 9, with higher scores indicating greater MeDi adherence. Three MeDi categories (low MeDi adherence, score 0–3; Middle, score 4–5; or High, score 6–9) were defined so as to be nutritionally relevant, and consistent to those used in previous studies [12,16,17] (Supplementary methods).

2.3. Definition of frailty

At baseline and the 2-year follow-up, frailty was defined following the Cardiovascular Health Study frailty index [18] with a slight modification of some of the five criteria since there is no consensus to date about the tools that should be used to define frailty among older adults [10]. Therefore, we have chosen the more relevant proxies among available variables in the 3C database: 1) Weight loss was defined as self-reported unintentional loss of 3 kg or more or as a body mass index (BMI) $< 21 \text{ kg/m}^2$ when weight loss was missing (2% at baseline); 2) Exhaustion was evaluated as any of the following responses to two questions from the Center for Epidemiologic Studies-Depression scale (CES-D): “I felt that anything I did was a big effort” and “I felt that I could not keep on doing things” at least 3–4 days a week [19]; 3) Walking speed was only available at baseline, therefore slowness was determined using the Rosow–Breslau Test recorded at each visit [20]. This proxy has been shown to be strongly associated with walking [21]. Participants were considered frail for this criterion when they answered no to one of the following two questions about their ability to walk between 500 m and 1 km and their capacity to walk up and down a flight of stairs; 4) Weakness was identified using the handgrip strength quartiles stratified by sex and BMI at baseline. However, this variable was not available at the 2-year follow-up. Weakness was identified using the chair standing method, which was shown to be a good proxy for handgrip strength [22]; 5) Physical activity (PA) was assessed in a face-to-face interview via an open-ended questionnaire. Older adults were asked if they practice PA or any leisure activities and, if they answered yes, they were asked to name the type of each activity in addition to the number of hours practiced per week and the number of month of practice per year. Low PA was defined as less than 1 h of sports activities or less than 3.5 h of leisure activities per week. Older people having three or more criteria out of five were considered as frail, otherwise they were considered as non-frail. Prevalent frail participants at baseline were excluded from the analyses.

2.4. Covariates

The covariates included age, sex, education, marital status, presence of diabetes, hypertension, history of cardio- and cerebrovascular diseases, BMI (3 categories: < 23 ; 23–27 (reference category) and $> 27 \text{ kg/m}^2$), medication intake (dichotomous variable with 5 drugs/day as a cut-off), cognitive status and depressive symptomatology (dichotomous variable: Depressed (≥ 23 for women and ≥ 17 for men)) (Supplementary methods).

2.5. Definition of disability

Disability in basic ADL was assessed using the five following items of the Katz scale: bathing, dressing, toileting, transferring

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