RESEARCH

Dietary Fat Composition and Frailty in Oldest-Old Men

Several nutrition-related components, such as higher overall diet quality, protein intake, and diet's antioxidant capacity, have been inversely associated with frailty.[1] However, an important macronutrient, fat, has been less studied, especially in the oldest old. The results have also been conflicting: total fat intake has or has not been associated with increased frailty risk,[2,3] whereas monounsaturated fatty acid (MUFA) intake was reported to be inversely associated with frailty.[4] Our hypothesis was that individual fatty acids and fatty acids ratios may be linked with frailty because cardiovascular disease is associated with increased risk of frailty. Therefore, we explored relationships between frailty and variables related to fat intake in oldest-old community-living men.

METHODS

The Helsinki Businessmen Study (HBS) involves a socioeconomically homogeneous cohort of men, born between 1919 and 1934, who have been followed since the 1960s.[5] In the present cross-sectional analysis, we report findings from the most recent clinic visit including a random subcohort of home-living survivors of HBS in 2017-2018. At the visit, frailty status was determined according to modified Fried criteria as follows: (1) weight loss more than 5% of body weight during the last year; (2) low physical activity/exercise, explored with the question "Do you exercise regularly?" (3) walking speed of .8 m/s or slower, (4) handgrip strength less than 27 kg, and (5) self-reported exhaustion, explored with the question "Have you felt unusually tired or exhausted most of the time or all the time during the last month?" Accordingly, participants were classified as robust (zero criteria fulfilled), pre-frail (one to two criteria), and frail (at least three criteria).

Body mass index (BMI) (in kg/m^2) was calculated, and the short form of the Mini Nutritional Assessment (MNA-SF) performed as instructed.[6] Plasma lipid levels (total, low-density lipoprotein [LDL]-cholesterol, and high-density lipoprotein [HDL]-cholesterol; triglycerides), albumin, pre-albumin, and high-sensitive C-reactive protein (hs-CRP) were analyzed after a 12-hour fast, and the use of cholesterol-lowering medication was recorded.

Dietary data including total fat intake and fat composition of diet including saturated fatty acids (SFAs), MUFAs, and polyunsaturated fatty acids (PUFAs), and vitamin E intakes were analyzed from 3-day food diaries, and fat quality indicators MUFA:SFA and PUFA:SFA ratios were calculated. Because the food records are subject to misreporting, the participants received both oral and written advice beforehand on how to fill out the food records. After returning the food records, the study nutritionist called the participants to confirm the dietary information and eaten amounts as accurately as possible. Statistical significance of linearity was evaluated for trend using analysis of variance for continuous variables and the Cochran-Armitage test of categorical variables. Age adjustment was not performed because frailty status was not associated with age. Analyses were performed using the SPSS statistical program, v.24 (IBM Corp, Armonk, NY, USA).

Ethics

The study protocol was approved by the ethics committee of the Department of Medicine at Helsinki University Hospital.

RESULTS

A random subsample of 180 survivors was invited to participate in the clinic visit. Of them, 130 participated in the visit and 126 returned food diaries. The main reasons for refusal to take part in the clinical examinations were poor health, Alzheimer's disease, or hospitalization.

Of the participants, 31% (n = 40) we classified as robust, 54% (n = 70) as pre-frail, and 15% (n = 20) as frail. Age, BMI, MNA-SF, or use of cholesterol-lowering statins did not differ between frailty groups. Levels of total (P = .013), LDL-cholesterol (P = .036), and HDL-cholesterol (P = .012), albumin (P = .017), and pre-albumin (P = .044) were inversely associated, whereas hs-CRP (P = .012) was linearly associated with frailty status (Table 1). Although total fat and SFA intakes were not associated, there were inverse trends between frailty and MUFA (P = .047) and PUFA (P = .044) intakes (Supplementary Figure S1). Of fat quality indicators, the MUFA:SFA ratio (P = .038) but not the PUFA:SFA ratio (P = .215) was inversely associated with frailty. In addition, fat-soluble vitamin E intake was inversely associated with frailty (P = .017).

DISCUSSION

Our study is one of the very few studies to explore detailed dietary fat composition and quality in relation to frailty phenotype, and significant associations were found in oldest-old home-living men. Fatty acids participate in multiple functions and interact with other dietary components as well as microbiome in the body, and thus dietary fat composition may be either pro- or anti-inflammatory.[7,8] Higher PUFA-containing fats are a rich source of fat-soluble antioxidant vitamin E, whose intake was previously associated with less frailty,[9] as

DOI: 10.1111/jgs.16402

0002-8614/20/$15.00

Table 1. Macronutrient and Fat-Soluble Vitamin Intakes According to Frailty Status

Baseline characteristics and energy and nutrient intakes	Frailty status			
	Robust n = 40	Pre-frail n = 70	Frail n = 20	*P* value[a]
Age, y (SD)	86.3 (2.6)	87.9 (3.0)	87.3 (2.9)	.072
BMI, kg/m^2 (SD)	25.6 (2.5)	26.0 (2.7)	25.6 (3.3)	.842
MNA-SF (SD)	13.2 (1.0)	13.1 (1.3)	12.7 (1.5)	.202
Use of statins, %	62.5	54.3	65.0	.934
Cholesterol, mmol/L (SD)	4.7 (1.0)	4.4 (.9)	4.0 (1.3)	.013
LDL-cholesterol, mmol/L (SD)	2.7 (.9)	2.5 (.8)	2.2 (1.1)	.036
HDL-cholesterol, mmol/L (SD)	1.6 (.3)	1.4 (.3)	1.4 (.4)	.012
Triglycerides, mmol/L (SD)	1.1 (.3)	1.2 (.4)	1.0 (.5)	.807
hs-CRP (SD)	1.8 (2.2)	2.6 (3.0)	3.9 (4.4)	.012
Albumin	38.7 (2.3)	37.6 (3.5)	36.8 (2.4)	.017
Pre-albumin	250 (41)	247 (44)	222 (56)	.044
Energy, kcal	1619 (352)	1574 (354)	1573 (402)	.576
Fat, g	68 (23)	64 (20)	61 (21)	.227
SFAs	22 (6)	22 (8)	23 (11)	.515
MUFAs	27 (13)	24 (11)	21 (7)	.047
PUFAs	13 (5)	12 (5)	11 (4)	.044
PUFA:SFA ratio	.64 (.2)	.62 (.3)	.53 (.2)	.215
MUFA:SFA ratio	1.26 (.5)	1.15 (.4)	1.00 (.3)	.038
Vitamin E, mg	12 (6)	10 (4)	9 (3)	.017

Abbreviations: BMI, body mass index; HDL, high-density lipoprotein; hs-CRP, high-sensitive C-reactive protein; LDL, low-density lipoprotein; MNA, Mini Nutritional Assessment; MUFAs, monounsaturated fatty acids; PUFAs, polyunsaturated fatty acids; SD, standard deviation; SFAs, saturated fatty acids.

[a]The statistical significance of the hypotheses of linearity was evaluated for a trend using analysis of variance for continuous variables and the Cochran-Armitage test for categorical variables; *P* value <.05 was considered statistically significant.

was also the case in our study. Frailty phenotype was associated with increased chronic inflammation,[8] and in line with this, hs-CRP was associated linearly with frailty status in our study. Lowering of cholesterol, albumin, and pre-albumin levels are further well-known associates with frailty, probably reflecting both impaired liver function and inflammation.

The strengths of our study are the robust findings, although the study sample was relatively small, and the fact that to the best of our knowledge, this is the first study to explore the relationship between fat quality and frailty. An obvious limitation is that the surviving participants of HBS differ in many ways from the general population by being the oldest-old men from the upper socioeconomic class. The cross-sectional design of the study is a further limitation and prevents drawing conclusions about causal relationships.

In conclusion, our study also supports prevailing dietary guidelines[10] about healthy dietary fat composition in the oldest old. These findings should be corroborated in larger longitudinal studies with different populations of older adults.

Satu K. Jyväkorpi, PhD, Annele Urtamo, MSc and Timo E. Strandberg, MD, PhD
Department of General Practice and Primary Health Care, and Helsinki University Central Hospital, Unit of Primary Health Care, University of Helsinki, Helsinki, Finland
Clinicum, and Helsinki University Hospital, University of Helsinki, Helsinki, Finland
Center for Life Course Health Research, University of Oulu, Oulu, Finland

ACKNOWLEDGMENTS

Financial Disclosure: This work was supported by the Foundation of Nutrition Research, VTR funding of the Helsinki University Hospital (EVO), Helsinki University Hospital Internal Medicine and Rehabilitation, and the Academy of Finland (grant no. 311492).

Conflict of Interest: Satu K. Jyväkorpi and Annele Urtamo report no conflict of interest. Timo E. Strandberg reports various educational and consultative relationships with Nutricia, Abbott, Amgen, Merck, Pfizer, Novartis, and Novo-Nordisk; a minor amount of stock in Orion Pharma; and he is a board member and former president of the executive board of the European Union Geriatric Medicine Society that also cooperates with the nutrition industry.

Author Contributions: *Designed and performed the data analysis*: Jyväkorpi. *Conducted the clinic visits*: Urtamo. *Contributed to writing of the manuscript and approved the final version*: All authors.

Sponsor's Role: The sponsors did not have any role in the study design, analysis, or interpretation of data, nor in writing the report or the decision to submit this article. The authors are independent researchers and not associated with the funders.

REFERENCES

1. Lorenzo-Lopez L, Maseda A, de Labra C, Regueiro-Folgueira JL, Rodriguez-Villamil JL, Millan-Calenti JC. Nutritional determinants of frailty in older adults: a systematic review. BMC Geriatr. 2017;108:1-13.

2. Shikany JM, Barrett-Connor E, Ensrud KE, Cawthon PM, Lewis CE, Dam TTL, Shannon J, Redden DT; Osteoporotic Fractures in Men (MrOS) Research Group Macronutrients, diet quality, and frailty in older men. J Gerontol A Biol Sci Med Sci. 2014;69(6):695-701.
3. Verspoor E, Voortman T, van Rooij FJA, et al. Macronutrient intake and frailty: the Rotterdam Study. Eur J Nutr. 2019. https://doi.org/10.1007/s00394-019-02131-0.
4. Sandoval-Insausti H, Pérez-Tasigchana RF, López-García E, García-Esquinas E, Rodríguez-Artalejo F, Guallar-Castillón P. Macronutrients intake and incident frailty in older adults: a prospective cohort study. J Gerontol A Biol Sci Med Sci. 2016;7:1329-1334. https://doi.org/10.1093/gerona/glw033.
5. Strandberg TE, Salomaa V, Strandberg AY, et al. Cohort profile: the Helsinki businessmen study (HBS). Int J Epidemiol. 2016;45:1074-1074h.
6. Vellas B, Guigoz Y, Garry PJ, et al. The Mini Nutritional Assessment (MNA) and its use in grading the nutritional state of elderly patients. Nutrition. 1999;15(2):116-122.
7. Fritsche KL. The science of fatty acids and inflammation. Adv Nutr. 2015;6:293S-301S. https://doi.org/10.3945/an.114.006940.
8. Soysal P, Stubbs B, Lucato P, et al. Inflammation and frailty in the elderly: a systematic review and meta-analysis. Ageing Res Rev. 2016;31:1-8.
9. Das A, Cumming RG, Naganathan V, et al. Prospective associations between dietary antioxidant intake and frailty in older Australian men: the Concord Health and Ageing in Men Project. J Gerontol A Biol Sci Med Sci. 2020;75(2):348-356. https://doi.org/10.1093/gerona/glz054.
10. Nordic Nutrition Recommendations. Integrating Nutrition and Physical Activity. Copenhagen, Denmark: Nordic Council Ministers; 2014. https://doi.org/10.6027/Nord2014-002. Accessed December 5, 2019.

SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article.

Supplementary Figure S1: Intake of saturated fatty acids (SFAs), monounsaturated fatty acids (MUFAs), and polyunsaturated fatty acids (PUFAs) according to frailty status.

COMMENT

Comment on: Objectively Measured Physical Activity Reduces the Risk of Mortality Among Brazilian Older Adults

To the Editor: In a recent issue of the journal, Bielemann et al reported physical activity (PA) of any intensity, measured by accelerometry and questionnaire, was observed to be a significant predictor of survival in community-dwelling older individuals from southern Brazil.[1] The use of an accelerometer has been recommended to more objectively rate the intensity of PA, but it had not been effectively tested in a longitudinal study in the same population. Thus, even though some differences across sexes were observed, the results are considered significant, given the previous scarce evidence of improvement in survival with light-intensity PA in older people. However, we would be cautious about reaching definite conclusions based on insufficiently adjusted comparisons.

Among many predictors of risk of mortality, body mass index (BMI) is strongly associated with life expectancy in older adults.[2] Either a lower (<22.5 kg/m^2)[3] or increased BMI[4,5] was shown to be associated with the risk of increased mortality in these people. Besides, further weight gain can result in excess mortality in obese individuals.[6]

The authors collected data of self-reported comorbidities at enrollment, which included high blood pressure, diabetes, heart problems, heart failure, Parkinson's disease, kidney failure, hypercholesterolemia, depression, stroke, and cancer. While people with such comorbidities have varying degrees of limitations in PA, each of these comorbidities influences survival rates differently in older adults.[7-10] Instead of focusing on diseases particularly related to mortality, the authors chose to include a single parameter as the total number of comorbidities in their study. However, those who died during follow-up had almost two-fold higher frequency of four or more morbidities at baseline, suggesting some potential confounders remained unnoticed in the analysis. Besides, effective treatment of chronic conditions, such as hypertension, diabetes, coronary heart disease, and hypercholesterolemia, as well as the use of certain classes of drugs independently improve survival, even in advanced ages. Finally, the residual impact of some chronically used drugs, such as statins, in coronary heart disease or certain antihyperglycemics in diabetes on mortality outcome should not be disregarded in multivariable analyses.

Collectively, the results by Bielemann et al[1] suggest some evidence of improved overall survival by any intensity of PA. However, to avoid significant confounding and provide more robust conclusions, future confirmatory studies should include as many variables as possible that alter mortality events in older populations.

Bilal Katipoglu, MD and Mehmet Ilkin Naharci, PhD
Division of Geriatrics, University of Health Sciences, Gulhane Faculty of Medicine and Gulhane Training and Research Hospital, Ankara, Turkey

Ilker Tasci, PhD
Department of Internal Medicine, University of Health Sciences, Gulhane Faculty of Medicine and Gulhane Training and Research Hospital, Ankara, Turkey

ACKNOWLEDGMENTS

Conflict of Interest: All authors declare that they have no conflict of interest.

Author Contributions: All authors contributed to the response design and preparation of the letter to the editor.

Sponsor's Role: No sponsor for this letter.

REFERENCES

1. Bielemann RM, LaCroix AZ, Bertoldi AD, et al. Objectively measured physical activity reduces the risk of mortality among Brazilian older adults. J Am Geriatr Soc. 2020;68:137-146.

See the Reply by Bielemann et al.

DOI: 10.1111/jgs.16460