Macronutrient composition and sarcopenia in the oldest-old men

The Helsinki Businessmen Study (HBS)

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Abstract

Background and aim: Sarcopenia is associated with increased risk for several adverse health outcomes including frailty, disability, loss of independence, and mortality. We examined cross-sectional associations between sarcopenia and detailed dietary macronutrient composition in community-living oldest-old men (mean age 87).

Methods: Participants were invited to a clinic visit in 2017/2018 including assessments of sarcopenia status using European Working Group on Sarcopenia in Older People's 2 (EWGSOP2) criteria and detailed macronutrient, vitamin D and food intakes retrieved from 3-day food diaries.

Results: Of the 126 participants, 48 had probable sarcopenia and 27 sarcopenia. Sarcopenia was associated with lower energy ($p = 0.020$), total protein ($p = 0.019$), plant ($p = 0.008$) and fish proteins ($p = 0.041$), total fat ($p = 0.015$), monounsaturated fatty acids (MUFA) ($p = 0.011$), polyunsaturated fatty acids ($p = 0.002$), vitamin D intakes ($p = 0.005$) and, of fat quality indicators, MUFA: saturated fatty acid-ratio ($p = 0.042$).

Conclusion: These findings suggest that sufficient energy and protein intakes, but also fat quality may be important along with healthy dietary patterns for prevention of sarcopenia in the oldest-old.

Introduction

Sarcopenia, defined as low muscle strength, loss of skeletal muscle mass, and poor physical performance, is associated with increased risk for several adverse health outcomes including frailty, disability, loss of independence, and mortality (1). In recent years, diet as a modifiable risk factor has been extensively studied in relation to sarcopenia. Sufficient energy, protein, amino acids, n-3 fatty acids, vitamin D intakes, and Mediterranean dietary pattern have been linked to lower prevalence of sarcopenia (2, 3). Less is known about detailed macronutrient content of diet in relation to sarcopenia, particularly in the oldest-old people. Therefore, we explored relationships between sarcopenia and macronutrient composition of the diet as well as food and vitamin D intakes in oldest-old community-living men.

Methods

In the Helsinki Businessmen Study (HBS) socioeconomically homogenous cohort of men, born between 1919 and 1934 has been followed-up since the 1960s (4). In the present cross-sectional analysis, we report findings from the most recent clinic visit including a random sub-cohort of home-living survivors of HBS in 2017/2018. At the clinic visit sarcopenia status was determined according to the European Working Group on Sarcopenia in Older People 2 (EWGSOP2)'s criteria (1) as follows: 1) Low muscle strength < 27 kg, 2) low appendicular muscle mass < 20 kg, 3) low physical performance measured with Short Physical Performance Battery ≤ 8 points (5). Accordingly, participants were classified into robust, (zero criteria fulfilled), probable sarcopenia (1 criterium) and being sarcopenic (at least 2 criteria). Body mass index (BMI) was calculated as weight (kg/height (m) squared, and Mini Nutritional Assessment (MNA) performed as instructed (6). Total food intakes, energy, and detailed macronutrient intake -- including intakes of monounsaturated (MUFA), polyunsaturated (PUFA), and saturated fatty acids (SFA), starch, sugar, fiber, as well as detailed protein composition (plant and animal protein from meat, milk, fish, and eggs), and vitamin D intakes -- were analyzed from 3-day food diaries. Ratios MUFA: SFA and PUFA: SFA were calculated to indicate fat quality. Statistical significance for group differences was evaluated using ANOVA trend test (continuous variables) and Cochran Armitage test (categorical variables). P-value < 0.05 was taken as statistically significant. Analyses were performed using the SPSS statistical program, version 24 (SPSS IBM, Armonk, NY, USA).

Ethics

All participants signed an informed consent and the study protocol was approved by the Ethics Committee of the Helsinki University Hospital, Department of Medicine.

Results

In total, 130 men (mean age 87) attended, and 126 additionally returned 3-day food records. Twenty-seven had sarcopenia and 48 probable sarcopenia, whereas 51 were classified as robust. Sarcopenia status was not associated with age, BMI, MNA-SF, or marital status (Table 1). An inverse association was observed with total energy ($p = 0.020$), total protein ($p = 0.019$), plant protein ($p = 0.008$), and fish protein ($p = 0.041$) intakes. Total fat ($p = 0.015$), monounsaturated fatty acids (MUFA) ($p = 0.011$), and polyunsaturated fatty acid (PUFA) ($p = 0.002$) intakes. Saturated fatty acids (SFA) intake was not associated with sarcopenia status. Of fat quality indicators, MUFA: SFA-ratio ($p = 0.042$) was inversely associated with sarcopenia, whereas the association with PUFA: SFA-ratio was nonsignificant ($p = 0.077$). Of carbohydrates, only fiber intake ($p = 0.026$) was inversely associated with sarcopenia. Vitamin D ($p = 0.005$) and poultry intake among various foods were inversely associated with sarcopenia, whereas a nonsignificant trend was observed with berry, whole grain, and fish intakes (Table 2).

Discussion

The inverse association between sarcopenia and the amount of energy, protein, and vitamin D in the diets of older men is expected, but somewhat surprisingly we also observed an association between sarcopenia and the quality of fat intake in this cohort of oldest-old , community-dwelling men.

Energy intake tends to decline with age and poor energy and protein intakes have been reported in older people with sarcopenia (2). Protein is known to be the key nutrient in old age with low intakes being associated with greater losses of lean mass (7). Fat is a macronutrient with high energy content, and accordingly, energy and total fat intakes were related to sarcopenia in our study. In addition, unsaturated fat intake (MUFA and PUFA) and fat quality were also inversely associated with sarcopenia.

Fatty acids take part in many functions in the body, and membrane phospholipid fatty acid composition in skeletal muscle may contain larger amounts of PUFAs reflecting fatty acid content of the diet (8). Previous studies suggest serum PUFAs -- especially n-3 PUFAs -- may protect against accelerated decline of physical performance in older people (9). In our study, higher MUFA intake and MUFA: SFA-ratio were additionally associated with lower sarcopenia risk. Olive and canola oils, which are recommended in healthy dietary patterns, are high in MUFAs (3,10). Olive oil is also an integral part of the traditional Mediterranean diet, which has been found to support muscle health in old age (3). Furthermore, sufficient plant and fish protein and fiber intakes are part of healthy diet. In our study of oldest-old men, food intakes showed similar patterns, although only a nonsignificant inverse trend with berry, whole grain, and fish intakes was observed, possibly due to limited statistical power.

The strengths of our study are the robustness of main findings, despite the relatively small sample size, and the fact that to the best of our knowledge, this is the first study to explore the relationship between very detailed macronutrient composition of diet and sarcopenia in the oldest-old. As a limitation, the dietary analysis software used did not allow more detailed analysis of fat composition as to n-3 and n-6 PUFAs of the diet. Furthermore, the surviving participants of the Helsinki Businessmen Study differ in many ways from the general population by being oldest-old men from upper socioeconomic class. The cross-sectional design of the study is also a limitation and prevents drawing conclusions about temporal relationships.

In conclusion, our study suggests that current knowledge of healthy dietary patterns, including the importance of good fat quality of the diet, also applies to the muscle health of oldest-old individuals.

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Conflict of interest statement

SKJ: reports no conflict of interest.

AU: reports no conflict of interest.

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TES: reports having various educational and consultative cooperation with several companies, including Nutricia, Abbott, Amgen, Merck, Pfizer, Novartis, and Novo-Nordisk; a minor amount of stock in Orion Pharma; and is a board member and former president of executive board of European Union Geriatric Medicine Society which has cooperation also with the nutrition industry.

Authors' contributions

SKJ designed and performed out the data-analysis, AU carried out the clinic visits and all of the authors contributed to writing of the manuscript and approved the final version.

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Table 1. Macronutrient and fat soluble vitamins intakes according to sarcopenia status

Sarcopenia status Baseline characteristics, energy and nutrient intakes	Robust n = 51	Probable sarcopenia n = 48	Sarcopenia n = 27	p- value[1]
Age, years (SD)	87.1 (2.9)	87.2 (2.9)	88.0 (3.0)	0.247
Marital status, %				
Married	69	79	52	0.247
Not married or living alone	31	21	48	
BMI (SD)	26.0 (2.6)	25.6 (2.6)	25.9 (3.1)	0.166
MNA (SD)	13.0 (1.2)	13.2 (1.2)	12.9 (1.4)	0.205
Energy, kcal (SD)	1682 (353)	1529 (372)	1510 (313)	**0.020**
Carbohydrates, g (SD)	176 (48)	161 (41)	166 (37)	0.212
Starch, g	91 (29)	81 (21)	82 (22)	0.070
Sugar, g	25 (15)	23 (10)	27 (9)	0.630
Fiber, g	24 (9)	20 (7)	21 (8)	**0.026**
Protein, g (SD)	78 (21)	72 (25)	66 (15)	**0.019**
Protein, g/kg BW/d	0.99 (0.27)	0.96 (0.32)	0.86 (0.23)	0.077
Vegetable protein, g	24 (7)	19 (6)	20 (5)	**0.008**
Animal protein, g	54 (20)	53 (21)	46 (15)	0.099
Meat protein, g	23 (14)	20 (13)	18 (10)	0.101
Milk protein, g	16 (8)	18 (13)	18 (10)	0.408
Fish protein, g	13 (12)	12 (10)	10 (8)	**0.041**
Egg protein, g	2 (3)	2 (4)	3 (4)	0.603
Fat, g (SD)	71 (20)	60 (19)	60 (23)	**0.015**
SFA	22 (7)	22 (9)	21 (8)	0.438
MUFA	28 (11)	22 (8)	22 (12)	**0.011**
PUFA	14 (5)	11 (4)	11 (4)	**0.002**
PUFA:SFA-ratio	0.67 (0.28)	0.57 (0.31)	0.56 (0.24)	0.077
MUFA:SFA-ratio	1.3 (0.52)	1.1 (0.35)	1.1 (0.43)	**0.042**
Vitamin D, µg (SD)	11 (9)	9 (7)	6 (5)	**0.005**

Numbers are means unless otherwise stated.

[1] The statistical significance of the hypotheses of linearity was evaluated for a trend using ANOVA; Cochran Armitage test of categorical variables;

Abbreviations: SD = standard deviation, BW = body weight, SFA = saturated fatty acids, MNA = Mini Nutritional Assessment, MUFA = Mono unsaturated fatty acids, PUFA = polyunsaturated fatty acids

Table 2. Food intakes according to sarcopenia status

Sarcopenia status / Food intakes, g/d	Robust n = 51	Probable sarcopenia n = 48	Sarcopenia n = 27	p- value[1]
Fruits (SD)	147 (160)	90 (132)	142 (177)	0.602
Berries, g (SD)	25 (35)	18 (25)	13 (26)	0.093
Vegetables (SD)	160 (159)	153 (132)	154 (96)	0.816
Total fruits and vegetables (SD)	320 (251)	262 (179)	304 (222)	0.585
Fruit juices 100% (SD)	48 (90)	46 (102)	31 (71)	0.471
Cereal products (SD)				
Whole grain	113 (65)	86 (51)	91 (57)	0.058
Other cereal products	247 (155)	228 (131)	238 (137)	0.705
Milk products (SD)	312 (203)	337 (295)	298 (191)	0.924
Fish (SD)	68 (59)	70 (60)	40 (49)	0.073
Red meat (SD)	40 (43)	52 (54)	51 (48)	0.269
Processed meat (SD)	37 (44)	31 (24)	24 (21)	0.129
Poultry (SD)	36 (51)	16 (31)	19 (32)	**0.039**
Egg (SD)	16 (26)	16 (31)	19 (28)	0.617
Pulses (SD)	7 (19)	9 (24)	3 (9)	0.599
Nuts (SD)	8 (20)	2 (5)	4 (13)	0.150
Alcohol (SD)	4 (7)	6 (9)	4 (8)	0.468
Tea (SD)	114 (160)	97 (153)	126 (166)	0.868
Coffee (SD)	287 (228)	253 (160)	230 (158)	0.191

Numbers are means unless otherwise stated.

[1] The statistical significance of group differences was evaluated using ANOVA; SD = standard deviation.