THE GERONTOLOGICAL SOCIETY OF AMERICA®

Journals of Gerontology: Medical Sciences
cite as: *J Gerontol A Biol Sci Med Sci*, 2015, Vol. 00, No. 00, 1–8
doi:10.1093/gerona/glv125
Advance Access publication August 22, 2015

OXFORD

Research Article

Patterns of Alcohol Consumption and Risk of Frailty in Community-dwelling Older Adults

Rosario Ortolá,[1] Esther García-Esquinas,[1,2] Luz M. León-Muñoz,[1] Pilar Guallar-Castillón,[1,2] José Lorenzo Valencia-Martín,[1,2,3] Iñaki Galán,[1,4] and Fernando Rodríguez-Artalejo[1,2]

[1]Department of Preventive Medicine and Public Health, Universidad Autónoma de Madrid/Idipaz, Madrid, Spain. [2]CIBER of Epidemioloy and Public Health (CIBERESP), Madrid, Spain. [3]Department of Preventive Medicine, Móstoles University Hospital, Móstoles, Spain. [4]National Centre for Epidemiology, Instituto de Salud Carlos III, Madrid, Spain.

Address correspondence to Rosario Ortolá, MD, Department of Preventive Medicine and Public Health, School of Medicine, Universidad Autónoma de Madrid, Calle del Arzobispo Morcillo 4, 28029 Madrid, Spain. Email: ortolarosario@gmail.com

Received February 19 2015; Accepted July 2 2015

Decision Editor: Stephen Kritchevsky, PhD

Abstract

Background. Consumption of moderate-to-heavy amounts of alcohol has been associated with lower risk of cardiovascular disease and diabetes. Although both diseases are main causes of the frailty syndrome, no previous study has assessed the association between alcohol-drinking patterns and risk of frailty in older adults.

Methods. A prospective cohort study of 2,086 community-dwelling individuals aged 60 and older, recruited in 2008–2010, and followed through 2012, was carried out. Drinking patterns were self-reported at baseline. Moderate drinking was defined as alcohol intake less than 40 g/day for men and less than 24 g/day for women. A Mediterranean drinking pattern was defined as moderate alcohol intake, with wine preference (≥80% of alcohol proceeds from wine) and drinking only with meals. Study participants were followed through 2012 to ascertain incident frailty, defined as ≥2 of the following 4 Fried criteria: exhaustion, muscle weakness, low physical activity, and slow walking speed. Analyses were performed with logistic regression and adjusted for the main confounders.

Results. After a mean follow-up of 3.3 (*SD* = 0.6) years, 292 participants with incident frailty were identified. Compared with nondrinkers, the odds ratio and its 95% confidence interval of frailty was 0.90 (0.65–1.25) for moderate drinkers. The corresponding results were 0.74 (0.48–1.16) for wine versus other beverage preference and 0.53 (0.31–0.92) for drinking only with meals versus only outside meals. Finally, compared with nondrinkers, the odds ratio (95% confidence interval) of frailty was 0.68 (0.47–0.99) for those adhering to the Mediterranean drinking pattern.

Conclusions. Certain drinking patterns, in particular drinking only with meals and the Mediterranean drinking pattern, are associated with a lower risk of frailty in older adults.

Key Words: Alcohol—Frailty—Elderly—Cohort study

Frailty is a clinical syndrome characterized by an age-related decline in multiple physiological functions, leading to a higher vulnerability to even minimal stressors (1,2). As a consequence, frail individuals are at increased short-term risk of hospitalization, fall, disability, and death (3). According to a recent systematic review of studies in developed countries, the prevalence of frailty is around 10% for those

aged 65 and older and reaches 25% in those aged 80 and older (4). Due to the progressive ageing of the population, with projections showing that people aged 65 and older will account for 30% of the European population in 2060 (5), the number of people with frailty is expected to increase rapidly. Thus, the reduction of frailty and its serious consequences is a health and social priority, which requires the appropriate identification and control of its risk factors (6).

Alcohol consumption is one of the leading causes of burden of disease (7). Notwithstanding this, it has also shown some beneficial effects on health, such as the lower morbidity and mortality from cardiovascular disease (CVD) and diabetes observed in individuals with moderate-to-heavy alcohol consumption (8–11). It is well known that CVD and diabetes are main causes of frailty (12,13). To our knowledge, however, only two studies have investigated the association between alcohol and incident frailty and found that consumption of small amounts of alcohol is associated with a lower risk of frailty in older adults (14,15). Moreover, no previous research has evaluated the effect of different drinking patterns on frailty. This is important because, in addition to total alcohol intake, the type of alcohol beverage, as well as the context of drinking (eg, with or without meals), may influence health outcomes. Specifically, a Mediterranean drinking pattern (MDP), characterized by moderate consumption of alcoholic beverages, mainly wine during meals, has been regarded a typical feature of the Mediterranean diet in Southern Europe (16). In this sense, there is recent evidence that adherence to the MDP is associated with reduced mortality in young individuals and that this reduction goes beyond the inverse association usually observed for moderate alcohol consumption (10).

Accordingly, we have assessed the prospective association between patterns of alcohol consumption, including the MDP, and risk of frailty using information from a cohort of community-dwelling older adults in Spain.

Methods

Study Design and Population

Data were taken from the Seniors-ENRICA cohort, whose methods have been reported elsewhere (17,18). The study participants were selected in 2008–2010 by stratified cluster sampling of the noninstitutionalized adult population of Spain. The sample was first stratified by province and size of municipality, then clusters were selected randomly in two stages (municipalities and census sections) and finally, the households within each section were selected by random telephone dialing. Participants in the households were selected proportionally to the age and sex distribution of the population of Spain. At baseline, information was collected in three stages. First, a phone interview was used to obtain data on sociodemographic factors, lifestyle, and morbidity. Then, two home visits were performed. In the first visit, nurses collected blood and urine samples, whereas in the second lay personnel conducted a physical examination, recorded a diet history, and obtained information on prescribed medications and functional limitations (17,18). From the initial sample of 2,614 participants in 2008–2010, 95 (3.6%) individuals died during follow-up. From the remaining 2,519 participants, 115 were lost to follow-up, so information on frailty was obtained only for 2,404 participants in 2012.

All personnel involved in data collection received appropriate training and were certified before starting fieldwork. Study participants provided written informed consent, and the Clinical Research Ethics Committee of 'La Paz' Hospital in Madrid approved both the baseline and the follow-up studies.

Study Variables

Alcohol Consumption

Usual consumption of alcoholic beverages in the previous year was estimated with a validated diet history, developed from the one used in the EPIC cohort study in Spain (19,20). This diet history collected information on 34 alcoholic beverages and used sets of photographs to help quantify portion sizes. Alcohol content was then estimated using food and beverage standard composition tables. In Spain, the estimated alcohol standard unit is 10 g of pure alcohol. Study participants were classified as nondrinkers (including also occasional drinkers, with average alcohol intake close to zero g/day), ex-drinkers (those reporting having quit alcohol either in the previous 12 months or before that), moderate drinkers, and heavy drinkers (the threshold between moderate and heavy drinking set at ≥40 g/day for men and ≥24 g/day for women) (19). A preference for a specific type of alcoholic beverage (wine or other) was considered when such drink accounted for more than 80% of the alcohol intake (21). According to the consumption of alcohol with meals (lunch or dinner), drinkers were also classified into three additional groups: those who drank exclusively during mealtimes, those who drank exclusively outside mealtimes, and those who drank at any time.

Finally, an MDP was defined as moderate average intake of alcohol (and no binge drinking), with wine preference and alcohol consumption only with meals (16). It is noteworthy that the definition of MDP excludes binge drinking, defined as intake of ≥80 g of alcohol for men and ≥60 g for women, during any drinking occasion in the previous month (19).

Frailty

A modification of the operative definition of frailty developed by Fried and colleagues in the Cardiovascular Health Study was used (3). Specifically, as in previous studies on the association between diet and risk of frailty (22,23), we excluded the weight loss criterion from the definition of frailty; the rationale is that energy-rich and nutrient-poor foods and beverages (including alcoholic drinks) may influence body weight through pathways other than malnutrition from low protein intake and sarcopenia, which are key pathogenic components of the frailty cycle. Moreover, in most prospective studies, light-to-moderate drinkers gain less or similar weight than nondrinkers (24). Thus, we defined frailty as having 2 or more of the following 4 Fried criteria: (a) Exhaustion, evaluated as a response of at least "3 to 4 days a week" to any of the two following questions from the Center for Epidemiological Studies Depression Scale (CES-D) (25): "I felt that anything I did was a big effort" and "I felt that I could not keep on doing things"; (b) Muscle weakness, defined as the lowest quintile in the Cardiovascular Health Study on maximum grip strength on the dominant hand, adjusted for sex and BMI (Supplementary Table 1). Grip strength was measured with a Jamar dynamometer, and the highest value of two consecutive measurements was used; (c) Low physical activity, defined as waking ≤2.5 hours/week for men and ≤2 hours/week for women; and (d) Slow walking speed, defined as the lowest quintile in our study sample in the 3-m walking speed test, adjusted for sex and height (Supplementary Table 1).

Potential Confounders of the Study Association

At baseline, information was collected on variables that might be related to both alcohol consumption and frailty. Specifically, we collected data on sex, age, educational level, tobacco smoking, time spent watching TV, and physical activity at leisure time and at the household. Adherence to the Mediterranean diet was summarized

using the Mediterranean Diet Score, also known as the Trichopoulou Index, excluding the alcohol component. The intake of vegetables, legumes, fruits and nuts, grains, and fish is considered beneficial, and thus, a value of 1 is assigned to consumption above the sex-specific median in the study sample; in contrast, intake of red meat and poultry, and dairy products is considered detrimental and a value of 0 is assigned to consumption above the median. Accordingly, the score ranged from 0 [lowest] to 8 [highest adherence] (18,26). Weight and height were measured in standardized conditions (27), and the BMI was calculated as the weight in kilograms divided by the square of height in meters. Participants were also asked whether they had previously suffered from any of the following physician-diagnosed diseases: CVD (myocardial infarction, stroke, or heart failure), diabetes, respiratory disease (asthma or chronic bronchitis), osteomuscular disease (osteoarthritis, arthritis, or hip fracture), and depression requiring treatment. Functional limitations in instrumental activities of daily living were measured with the Lawton and Brody Scale, with summary scores ranging from 0 [no disability] to 5 for men and from 0 to 8 for women (28). Finally, health-related quality of life was assessed with the second version of the 12-item Short-Form Health Survey. A higher score on the physical component summary and on the mental component summary of the 12-item Short-Form Health Survey indicates better health (29).

Statistical Analysis

Among the 2,404 study participants, we excluded 145 who were frail at baseline, 116 who were without complete data on alcohol consumption, 20 who were binge drinkers, 8 who were with unreliable diet history, and 29 who were with missing information on other potential confounders, leading to a final sample of 2,086 participants. Individuals who died during follow-up and who were frail at baseline were more frequently nondrinkers or ex-drinkers, while participants who died during follow-up also showed the lowest adherence to the MDP.

The associations between each pattern of alcohol consumption and risk of frailty were summarized with odds ratios (OR) and their 95% confidence interval (95% CI), obtained from logistic regression. Two regression models were built. The first model adjusted for sex, age, and educational level; the second adjusted additionally for the rest of potential confounders at baseline. The same type of modeling was used to examine the association between patterns of alcohol consumption and the incidence of each frailty criterion in robust participants (not meeting any of the four frailty criteria) at baseline.

Analyses of average alcohol consumption and the MDP were conducted in the total sample, whereas analyses of beverage preference and drinking with meals were performed in the sample of drinkers. We assessed whether the study results varied with sex by testing the statistical significance of interaction terms defined as the product of sex by categories of alcohol-drinking patterns. Because we found no interactions, results are presented for both sexes. Finally, we conducted a number of sensitivity analyses by rerunning the models under different assumptions.

Statistical significance was set at two-sided $p < .05$. All analyses were performed using Stata, version 11.2.

Results

Tables 1 and 2 show the characteristics of study participants according to alcohol consumption patterns.

During a mean (*SD*) follow-up of 3.3 (0.6) years, 292 participants with incident frailty were identified. The median (interquartile range) alcohol intake among those who developed frailty was 11.0 (3.1–21.1) g/day for moderate drinkers and 43.7 (33.0–75.5) g/day for heavy drinkers. Compared with nondrinkers, the fully adjusted OR (95% CI) of frailty was 1.04 (0.64–1.68) in ex-drinkers, 0.90 (0.65–1.25) in moderate drinkers, and 0.24 (0.10–0.56) in heavy drinkers (Table 3).

To assess the robustness of the results, we ran several sensitivity analyses. Although there is no European consensus (30), several guidelines recommend a threshold between moderate and heavy drinking which is lower than that used in this study (31,32). Thus, we repeated the analyses after subdividing the group of moderate drinkers into those consuming ≤20 g/day for men and ≤10 g/day for women and those consuming more than 20 g/day for men and more than 10 g/day for women, with consistent results (Supplementary Table 2). Among the 1,142 drinkers, 124 participants developed frailty during follow-up. In this subgroup of participants, the OR (95% CI) of frailty was 0.74 (0.48–1.16) for wine versus other beverage preference and 0.53 (0.31–0.92) for drinking only with meals versus only outside meals (Table 3). Given that wine preference was more frequent in those who drank only with meals (83.5%) than in those who did not (46.3%), we assessed whether the association between drinking with meals and lower risk of frailty could be explained by the type of alcoholic beverage; to this end, analyses were additionally adjusted for wine preference and the OR (95% CI) of frailty in those drinking exclusively with meals versus without meals was 0.56 (0.31–1.00).

Finally, adherence to the MDP showed an association with reduced risk of frailty. Compared with nondrinkers, the OR (95% CI) of frailty was 0.68 (0.47–0.99) for those adhering to the MDP (Table 3). To assess the robustness of this last result, we conducted a number of sensitivity analyses. Given that alcohol consumption in older adults may simply reflect a better health status at baseline that allows for drinking alcoholic beverages, we repeated the analysis after excluding individuals with limitations in instrumental activities of daily living at baseline, obtaining similar results; the corresponding figure was 0.67 (0.44–1.03) for the MDP versus nondrinkers. For the same reason, we reran the models with exclusion of participants with CVD, diabetes, respiratory disease, or depression at baseline, and the OR (95% CI) of frailty associated with the MDP was now 0.76 (0.47–1.22). We also redefined muscle weakness, by using the lowest quintile of grip strength in our cohort instead of that from the Cardiovascular Health Study, and the corresponding result was 0.64 (0.41–0.99). Finally, we replicated the analyses including unintentional weight loss of ≥4.5 kg in the preceding year as a frailty criterion, so that frailty was redefined as having ≥3 out of the 5 Fried criteria. Compared with nondrinkers, the OR (95% CI) of frailty was 0.82 (0.44–1.53) for the MDP.

Supplementary Table 3 shows the association between patterns of alcohol consumption and incidence of each frailty criterion in robust participants at baseline. Heavy drinking showed a nonstatistically significant tendency to lower risk of exhaustion and muscle weakness. Among drinkers, wine preference was linked to lower risk of slow walking speed (OR: 0.47; 95% CI: 0.31–0.72) and muscle weakness (OR: 0.62; 95% CI: 0.44–0.88). Compared with drinking exclusively outside of meals, consuming alcohol only with meals showed a nonsignificant tendency to reduced incidence of all studied frailty criteria. Finally, compared with nondrinkers, the MDP also showed some tendency to reduced incidence of all studied frailty criteria.

Table 1. Sociodemographic, Lifestyle, and Clinical Characteristics of Study Participants at Baseline, by Alcohol Consumption Patterns, in the Total Sample (n = 2,086)

	Average Alcohol Consumption				MDP[¶]			
	Nondrinker	Ex-drinker	Moderate Drinker	Heavy Drinker	Nondrinker	Ex-drinker	Drinker With no MDP	Drinker With MDP
	n = 770	n = 174	n = 964	n = 178	n = 770	n = 174	n = 658	n = 484
Sex, Men, %	21.6	52.3	63.6	71.4*	21.6	52.3	69.5	58.5*
Age (y)	68.9 ± 6.2	71.2 ± 6.5	67.8 ± 6.1	67.6 ± 6.3*	68.9 ± 6.2	71.2 ± 6.5	67.1 ± 5.7	68.6 ± 6.5*
Educational level, %								
≤Primary	61.7	60.3	48.1	46.1*	61.7	60.3	44.7	52.1*
Secondary	20.5	19.6	28.0	30.9	20.5	19.6	29.8	26.6
University	17.8	20.1	23.9	23.0	17.8	20.1	25.5	21.3
Tobacco smoking, %								
Never smoker	76.5	56.9	49.3	36.0*	76.5	56.9	40.9	55.8*
Former smoker	16.9	31.6	37.3	44.9	16.9	31.6	43.2	32.2
Current smoker	6.6	11.5	13.4	19.1	6.6	11.5	15.9	12.0
Time watching TV (h/wk)	18.7 ± 11.8	19.4 ± 11.9	17.1 ± 10.0	18.7 ± 11.6*	18.7 ± 11.8	19.4 ± 11.9	17.7 ± 10.6	16.9 ± 9.9*
Leisure physical activity (MET-h/wk)	20.4 ± 14.1	24.5 ± 16.8	23.7 ± 16.0	22.6 ± 14.5*	20.4 ± 14.1	24.5 ± 16.8	23.7 ± 15.7	23.2 ± 15.7*
Home physical activity (MET-h/wk)	48.7 ± 33.1	35.4 ± 29.7	32.7 ± 31.5	28.7 ± 27.2*	48.7 ± 33.1	35.4 ± 29.7	29.8 ± 29.0	35.3 ± 33.1*
Trichopoulou Index (excluding alcohol)	4.1 ± 1.6	4.1 ± 1.6	4.0 ± 1.6	3.4 ± 1.5*	4.1 ± 1.6	4.1 ± 1.6	3.9 ± 1.6	4.0 ± 1.6*
BMI (kg/m^2), %								
<25	19.9	19.0	21.0	10.1*	19.9	19.0	16.6	22.9*
25–29.9	46.9	51.1	51.2	54.5	46.9	51.1	55.8	47.5
≥30	33.2	29.9	27.8	35.4	33.2	29.9	28.6	29.6
Diagnosed diseases, %								
Cardiovascular disease[†]	3.9	7.5	5.1	1.7*	3.9	7.5	4.9	4.1
Diabetes	11.6	19.0	10.1	11.2*	11.6	19.0	10.2	10.3*
Respiratory disease[‡]	7.1	5.8	6.4	7.3	7.1	5.8	7.5	5.4
Osteomuscular disease[§]	55.8	54.0	41.0	37.6*	55.8	54.0	38.8	43.0*
Depression requiring treatment	10.4	8.6	5.4	1.7*	10.4	8.6	4.4	5.4*
Disability[‖], %	8.8	21.3	6.5	3.9*	8.8	21.3	4.3	8.7*
SF-12 Physical Component Summary Score	44.7 ± 11.6	45.3 ± 11.3	48.0 ± 9.6	48.3 ± 9.3*	44.7 ± 11.6	45.3 ± 11.3	48.3 ± 9.7	47.7 ± 9.3*
SF-12 Mental Component Summary Score	51.4 ± 10.7	52.5 ± 10.5	53.1 ± 9.5	55.3 ± 7.1*	51.4 ± 10.7	52.5 ± 10.5	54.0 ± 8.6	52.6 ± 10.0*
Walking speed (m/s)	0.69 (0.29)	0.67 (0.28)	0.72 (0.29)	0.75 (9.28)	0.69 (0.29)	0.67 (0.28)	0.74 (0.28)	0.73 (0.29)
Grip strength (kg)	24.7 ± 9.6	25.8 ± 9.0	31.4 ± 10.5	34.0 ± 10.3*	24.7 ± 9.6	25.8 ± 9.0.3	32.3 ± 10.4	31.2 ± 10.7*

Notes: For continuous variables, the mean ± *SD* is provided.
MDP = Mediterranean drinking pattern; *SD* = standard deviation.
*p < .05, based on analysis of variance tests for continuous variables, or chi-square test for qualitative variables.
[†]Ischemic heart disease, stroke, and heart failure.
[‡]Asthma or chronic bronchitis.
[§]Osteoarthritis, arthritis, and hip fracture.
[‖]Score ≥1 on the Lawton–Brody scale on instrumental activities of daily living.
[¶]Moderate alcohol consumption with preference for wine and drinking only with meals.

Discussion

In this study of community-dwelling older adults in Spain, certain alcohol consumption patterns, in particular drinking only with meals and the MDP, were associated with lower risk of frailty over 3.3 years of follow-up. Specifically, wine preference was linked to a reduced incidence of slow walking speed and muscle weakness, and drinking only with meals and the MDP showed a tendency to reduced risk of most frailty criteria.

Published data on the association between alcohol consumption and the risk of frailty are very scarce (14,15). The Women's Health Initiative Observational Study showed that moderate drinkers had a 31% lower 3-year risk of frailty than nondrinkers (14). However, no association was found for heavy drinkers. The discrepancy in the dose–response of alcohol on frailty could be due to differences in the instruments used to assess alcohol consumption as well as in patterns of alcohol consumption between the United States and Spain, where wine drinking during meals is the predominant form of alcohol consumption in older adults (19). The Laussane cohort 65+ study (15) observed a 50% reduced 3-year risk of vulnerability among light-to-moderate drinkers compared with nondrinkers. These findings on a protective effect of alcohol on vulnerability are compatible with ours; of note is that, as in our cohort, in the Laussane cohort

Table 2. Sociodemographic, Lifestyle, and Clinical Characteristics of Study Participants at Baseline, by Alcohol Consumption Patterns, Among Drinkers (n = 1,142)

	Beverage Preference		Drinking With Meals		
	Other	Wine	Only Outside of Meals	With and Outside of Meals	Only With Meals
	n = 369	n = 773	n = 168	n = 318	n = 656
Sex, Men, %	72.6	61.1*	66.7	74.8	59.4*
Age (y)	66.7 ± 5.4	68.3 ± 6.3*	67.7 ± 5.6	66.9 ± 5.7	68.2 ± 6.3*
Educational level, %					
≤Primary	42.5	50.3*	42.2	41.8	52.1*
Secondary	29.3	28.1	31.0	30.2	27.0
University	28.2	21.6	26.8	28.0	20.9
Tobacco smoking, %					
Never smoker	39.6	50.8*	38.1	39.0	53.5*
Former smoker	43.3	36.2	42.9	45.6	34.0
Current smoker	17.1	13.0	19.0	15.4	12.5
Time watching TV (h/wk)	17.5 ± 10.5	17.3 ± 10.2	19.0 ± 11.1	17.1 ± 9.8	17.1 ± 10.3
Leisure physical activity (MET-h/wk)	24.0 ± 16.3	23.3 ± 15.5	22.0 ± 15.3	25.1 ± 16.1	23.1 ± 15.6
Home physical activity (MET-h/wk)	28.5 ± 29.0	33.8 ± 31.7*	27.5 ± 27.2	27.5 ± 27.6	35.5 ± 32.9*
Trichopoulou Index (excluding alcohol)	3.8 ± 1.6	4.0 ± 1.6	4.0 ± 1.7	3.9 ± 1.6	4.0 ± 1.6
BMI (kg/m^2), %					
<25	15.7	21.0	16.7	17.9	20.6
25–29.9	55.6	49.9	51.8	57.2	49.1
≥30	28.7	29.1	31.5	24.9	30.3
Diagnosed diseases, %					
Cardiovascular disease†	4.6	4.5	7.7	4.1	4.0
Diabetes	10.8	10.0	13.1	10.1	9.6
Respiratory disease‡	7.9	6.0	10.7	7.6	5.0*
Osteomuscular disease§	37.7	41.9	39.3	36.8	42.7
Depression requiring treatment	3.5	5.4	6.6	3.5	5.0
Disability‖, %	5.2	6.6	4.2	4.1	7.6
SF-12 Physical Component Summary Score	48.6 ± 9.7	47.7 ± 9.4	47.4 ± 10.7	48.8 ± 9.1	47.8 ± 9.4
SF-12 Mental Component Summary Score	53.3 ± 9.4	53.5 ± 9.1	54.3 ± 7.9	54.2 ± 8.4	52.8 ± 9.9
Walking speed (m/s)	0.73 (0.29)	0.74 (0.28)	0.73 (0.29)	0.75 (0.29)	0.72 (0.26)
Grip strength (kg)	32.0 ± 10.4	31.8 ± 10.6	31.8 ± 10.6	33.4 ± 10.4	31.0 ± 10.5*

Notes: For continuous variables, the mean ± *SD* is provided.

*p < .05, based on analysis of variance tests for continuous variables, or chi-square test for qualitative variables.

†Ischemic heart disease, stroke, and heart failure.

‡Asthma or chronic bronchitis.

§Osteoarthritis, arthritis, and hip fracture.

‖Score ≥1 on the Lawton–Brody scale on instrumental activities of daily living.

65+ study most alcohol intake was from wine. Finally, our results are in line with the emerging evidence on the association between alcohol and disability. In this regard, recent longitudinal studies in older adults have reported a lower incidence of functional limitations associated with alcohol intake versus abstention, particularly in those with better health status (33) or of younger age (34).

Our study is unique in showing that certain drinking patterns, in particular drinking only with meals and the MDP, are associated with lower frailty risk. From the analysis of a pool of studies conducted in Italy, Trevisan and colleagues reported an increased risk of noncardiovascular, cancer, and all-cause mortality among drinkers outside of meals compared with drinkers of alcohol preferentially during meals, independently of the quantity of alcohol consumed (35). However, in the U.S. Health Professionals Follow-up Study, Mukamal and colleagues found that consuming alcohol with meals conferred no additional cardiovascular benefit to that resulting from moderate alcohol intake (8). As regards the MDP, our results are in line with those of a study in young university alumni in Spain, which found that a 2-point increment in a 0–9 score of adherence to the MDP was associated with a 25% reduction in mortality. This MDP score included alcohol intake spread over the week, wine preference, wine consumed preferably during the meals, and absence of binge drinking. Of note is that, within each category of alcohol intake including one with more than 50 g/day for men and more than 25 g/day for women, a higher adherence to the MDP was associated with lower mortality (10). Also, a previous analysis in a Greek population found that moderate alcohol intake (up to 50 g/day for men and 25 g/day for women) was the component of the Mediterranean diet which most contributed to the reduced mortality associated with such dietary pattern; in fact, alcohol intake accounted for 23.5% of the lower mortality among those following the Mediterranean diet (36).

In our study, drinking with meals and the MDP were linked to a tendency to lower risk of most frailty criteria. Given that these criteria tend to cluster, our results suggest that the protective association of alcohol with frailty might derive from synergic benefits on each

Table 3. Association Between Alcohol Consumption Patterns and Risk of Frailty During a 3.3-year Follow-up of Older Adults

	No. of frailty events/total	Model 1 Odds ratio (95% confidence interval)	Model 2 Odds ratio (95% confidence interval)
Average alcohol consumption (n = 2,086)			
Nondrinker	135/770	Ref.	Ref.
Ex-drinker	33/174	0.99 (0.64–1.55)	1.04 (0.64–1.68)
Moderate drinker	117/964	0.82 (0.61–1.11)	0.90 (0.65–1.25)
Heavy drinker	7/178	0.24 (0.11–0.53)***	0.24 (0.10–0.56)**
p trend (excluding ex-drinkers)		<.01	.05
Beverage preference (n = 1,142)			
Other	40/369	Ref.	Ref.
Wine	84/773	0.77 (0.51–1.18)	0.74 (0.48–1.16)
Drinking with meals (n = 1,142)			
Only outside of meals	25/168	Ref.	Ref.
With and outside of meals	31/318	0.66 (0.37–1.17)	0.72 (0.39–1.33)
Only with meals	68/656	0.56 (0.34–0.94)*	0.53 (0.31–0.92)*
MDP† (n = 2,086)			
Nondrinker	135/770	Ref.	Ref.
Ex-drinker	33/174	1.00 (0.64–1.56)	1.04 (0.64–1.68)
Drinker with no MDP	71/658	0.80 (0.57–1.13)	0.93 (0.64–1.35)
Drinker with MDP	53/484	0.66 (0.46–0.94)*	0.68 (0.47–0.99)*

Notes: Model 1: Adjusted for sex, age, and educational level.

Model 2: Adjusted additionally for tobacco smoking, time watching TV (h/wk), leisure-time physical activity (MET-h/wk), household physical activity (MET-h/wk), Trichopoulou Index (excluding alcohol), BMI (kg/m^2), cardiovascular disease, diabetes, respiratory disease, osteomuscular disease, depression requiring treatment, score on the Lawton–Brody IADL Scale, and SF-12 Physical and Mental Component Summary Scores at baseline.

MDP = Mediterranean drinking pattern.

*p < .05. **p < .01. ***p < .001.

†Moderate alcohol consumption with preference for wine and drinking only with meals.

component of frailty, which in some cases might be too small to be detectable when assessed separately. A similar phenomenon has been observed for the Mediterranean diet, in that adherence to this dietary pattern reduces the risk of frailty overall, with nonstatistically significant effects on most frailty criteria (18).

Wine preference showed a tendency to lower risk of frailty and, specifically, it was associated with reduced incidence of slow walking speed and muscle weakness. Whether wine preference has a health effect beyond that of moderate alcohol intake is an unresolved issue. It has been suggested that the high concentration of polyphenols in wine may confer some health benefits (37); also Gea and colleagues found an inverse association for wine preference and mortality which was independent of other aspects of the alcohol-drinking pattern (10). However, a recent meta-analysis has not found a greater benefit of wine versus other beverages on the main cardiovascular risk factors or on CVD incidence (9,38).

Several mechanisms could explain the reduced risk of frailty associated with alcohol consumption. There is consistent evidence that a higher alcohol intake is associated with higher levels of high-density lipoprotein cholesterol and adiponectin, lower levels of fibrinogen, and improved markers of glucose metabolism (reduced leptin, glycated hemoglobin, and insulin resistance) (38,39). As a consequence, alcohol consumption of up to 60 g/day has been linked to lower risk of CVD (9) and diabetes (11).

This study has several strengths and limitations. Among the strengths is the prospective design, which allows for the appropriate time sequence between alcohol and frailty. Also, frailty was defined according to standard criteria, and alcohol consumption was ascertained with a validated diet history; for drinking alcoholic beverages, the Pearson correlation between the diet history and seven 24-hour recalls during 1 year was .65 (20). An important strength was the definition of a MDP, because it allows for investigating dimensions of drinking other than the amount of alcohol intake. In fact, this approach accounts for synergies, and preempts confounding, between the components of the drinking pattern. Also, it gets closer to real-world alcohol consumption and, thus, provides a sound basis for drinking guidelines (40).

Among the main limitations is that alcohol consumption was self-reported, so that there may be recall error and also social desirability bias. Notwithstanding this, the distribution of alcohol consumption in our study is similar to that reported in the European Health Survey in Spain 2009, where 48% of adults aged 65–74 years were not drinkers, according to alcohol consumption in the previous 12 months (41). In our study, 45.2% of participants were either nondrinkers or ex-drinkers. There are two possible explanations of the relatively high frequency of nondrinkers compared with other European countries: (a) nondrinkers include never drinkers and also occasional drinkers (with current average alcohol intake close to zero); (b) Because of cultural reasons in Spain, many older women have never consumed alcohol on a regular basis. Another limitation is that despite the analyses were adjusted for many confounders including diet and health status, certain residual confounding cannot

be ruled out. It may overestimate the protective effect of alcohol on frailty because drinkers were generally healthier than nondrinkers; nevertheless, it is unlikely to entirely explain the observed association between the MDP and frailty because this association was fairly strong. A further limitation is that results for heavy drinkers were based on only seven frailty events. Also, results may reflect a healthy survivor effect, where only those drinkers who are healthier have reached older age. Therefore, our finding on the association between heavy drinking and reduced risk of frailty might not be meaningful and should be interpreted very cautiously; this association should be addressed in larger studies with appropriate account for the healthy survivor bias (eg, age stratification).

In conclusion, in this prospective study of older adults in Spain, drinking only with meals and the MDP were linked to lower risk of frailty. However, these findings should not be used to promote starting or increasing alcohol consumption in older adults, because they have reduced tolerance to the toxic effects of alcohol (31), they may show complex patterns of substance use (eg, alcohol plus inappropriate use of prescribed medications) (32), and they may suffer from morbidity which could be aggravated by alcohol. Moreover, because this is the first study on the association between the MDP and frailty, its results should be confirmed by further research.

Supplementary Material

Supplementary material can be found at: http://biomedgerontology.oxfordjournals.org/

Funding

This work was supported by grant no. 02/2014 from the Plan Nacional sobre Drogas (Ministry of Health of Spain), FIS grant no. 12/1166 (Instituto de Salud Carlos III, State Secretary of R+D+I and FEDER), and the FRAILOMIC Initiative (FP7-HEALTH-2012-Proposal no. 305483-2). The funding agencies had no role in the study design, data analysis, interpretation of results, preparation of manuscript, or decision to submit this manuscript for publication.

References

1. Morley JE, Vellas B, van Kan GA, et al. Frailty consensus: a call to action. *J Am Med Dir Assoc*. 2013;14:392–397. doi:10.1016/j.jamda.2013.03.022
2. Rodríguez-Mañas L, Féart C, Mann G, et al.; FOD-CC group (Appendix 1). Searching for an operational definition of frailty: a Delphi method based consensus statement: the frailty operative definition-consensus conference project. *J Gerontol A Biol Sci Med Sci*. 2013;68:62–67. doi:10.1093/gerona/gls119
3. Fried LP, Tangen CM, Walston J, et al.; Cardiovascular Health Study Collaborative Research Group. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci*. 2001;56:M146–M156.
4. Collard RM, Boter H, Schoevers RA, Oude Voshaar RC. Prevalence of frailty in community-dwelling older persons: a systematic review. *J Am Geriatr Soc*. 2012;60:1487–1492. doi:10.1111/j.1532-5415.2012.04054.x
5. European Commission. Ageing report: economic and budgetary projections for the EU-27 Member States (2008–2060). Luxembourg: Office for Official Publications of the European Communities; 2009. http://ec.europa.eu/economy_finance/publications/publication14992_en.pdf. Accessed December 15, 2014
6. Rodríguez-Artalejo F, Rodríguez-Mañas L. The frailty syndrome in the public health agenda. *J Epidemiol Community Health*. 2014;68:703–704. doi:10.1136/jech-2014-203863
7. Lim SS, Vos T, Flaxman AD, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet*. 2012;380:2224–2260. doi:10.1016/S0140-6736(12)61766-8
8. Mukamal KJ, Chung H, Jenny NS, et al. Alcohol consumption and risk of coronary heart disease in older adults: the Cardiovascular Health Study. *J Am Geriatr Soc*. 2006;54:30–37. doi:10.1111/j.1532-5415.2005.00561.x
9. Ronksley PE, Brien SE, Turner BJ, Mukamal KJ, Ghali WA. Association of alcohol consumption with selected cardiovascular disease outcomes: a systematic review and meta-analysis. *BMJ*. 2011;342:d671. doi:10.1136/bmj.d671
10. Gea A, Bes-Rastrollo M, Toledo E, et al. Mediterranean alcohol-drinking pattern and mortality in the SUN (Seguimiento Universidad de Navarra) Project: a prospective cohort study. *Br J Nutr*. 2014;111:1871–1880. doi:10.1017/S0007114513004376
11. Baliunas DO, Taylor BJ, Irving H, et al. Alcohol as a risk factor for type 2 diabetes: a systematic review and meta-analysis. *Diabetes Care*. 2009;32:2123–2132. doi:10.2337/dc09-0227
12. Newman AB, Gottdiener JS, Mcburnie MA, et al.; Cardiovascular Health Study Research Group. Associations of subclinical cardiovascular disease with frailty. *J Gerontol A Biol Sci Med Sci*. 2001;56:M158–M166.
13. Morley JE, Malmstrom TK, Rodriguez-Mañas L, Sinclair AJ. Frailty, sarcopenia and diabetes. *J Am Med Dir Assoc*. 2014;15:853–859. doi:10.1016/j.jamda.2014.10.001
14. Woods NF, LaCroix AZ, Gray SL, et al.; Women's Health Initiative. Frailty: emergence and consequences in women aged 65 and older in the Women's Health Initiative Observational Study. *J Am Geriatr Soc*. 2005;53:1321–1330. doi:10.1111/j.1532-5415.2005.53405.x
15. Seematter-Bagnoud L, Spagnoli J, Büla C, Santos-Eggimann B. Alcohol use and frailty in community-dwelling older persons aged 65 to 70 years. *J Frailty Aging*. 2014;3:9–14.
16. Willett WC, Sacks F, Trichopoulou A, et al. Mediterranean diet pyramid: a cultural model for healthy eating. *Am J Clin Nutr*. 1995;61(suppl):1402–1406.
17. Rodríguez-Artalejo F, Graciani A, Guallar-Castillón P, et al. [Rationale and methods of the study on nutrition and cardiovascular risk in Spain (ENRICA)]. *Rev Esp Cardiol*. 2011;64:876–882. doi:10.1016/j.recesp.2011.05.019
18. León-Muñoz LM, Guallar-Castillón P, López-García E, Rodríguez-Artalejo F. Mediterranean diet and risk of frailty in community-dwelling older adults. *J Am Med Dir Assoc*. 2014;15:899–903. doi:10.1016/j.jamda.2014.06.013
19. León-Muñoz LM, Galán I, Donado-Campos J, et al. Patterns of alcohol consumption in the older population of Spain, 2008–2010. *J Acad Nutr Diet*. 2015;115:213–224. doi:10.1016/j.jand.2014.08.017
20. Guallar-Castillón P, Sagardui-Villamor J, Balboa-Castillo T, et al. Validity and reproducibility of a Spanish dietary history. *PLoS One*. 2014;9:e86074. doi:10.1371/journal.pone.0086074
21. Valencia-Martín JL, Galán I, Rodríguez-Artalejo F. The association between alcohol consumption patterns and adherence to food consumption guidelines. *Alcohol Clin Exp Res*. 2011;35:2075–2081. doi:10.1111/j.1530-0277.2011.01559.x
22. Bartali B, Frongillo EA, Bandinelli S, et al. Low nutrient intake is an essential component of frailty in older persons. *J Gerontol A Biol Sci Med Sci*. 2006;61:589–593.
23. Talegawkar SA, Bandinelli S, Bandeen-Roche K, et al. A higher adherence to a Mediterranean-style diet is inversely associated with the development of frailty in community-dwelling elderly men and women. *J Nutr*. 2012;142:2161–2166. doi:10.3945/jn.112.165498
24. Harvard School of Public Health. Obesity prevention Source. Food and diet. Alcohol and weight. http://www.harvard.edu/obesity-prevention-source/obesity-causes/diet-and-weight/#references. Accessed December 15, 2014.
25. Ruiz-Grosso P, Loret de Mola C, Vega-Dienstmaier JM, et al. Validation of the Spanish Center for Epidemiological Studies Depression and Zung Self-Rating Depression Scales: a comparative validation study. *PLoS One*. 2012;7:e45413. doi:10.1371/journal.pone.0045413
26. Trichopoulou A, Costacou T, Bamia C, Trichopoulos D. Adherence to a Mediterranean diet and survival in a Greek population. *N Engl J Med*. 2003;348:2599–2608. doi:10.1056/NEJMoa025039
27. Gutiérrez-Fisac JL, Guallar-Castillón P, León-Muñoz LM, Graciani A, Banegas JR, Rodríguez-Artalejo F. Prevalence of general and abdominal

obesity in the adult population of Spain, 2008–2010: the ENRICA study. *Obes Rev*. 2012;13:388–392. doi:10.1111/j.1467-789X.2011.00964.x
28. Lawton MP, Brody EM. Assessment of older people: self-maintaining and instrumental activities of daily living. *Gerontologist*. 1969;9:179–186.
29. Vilagut G, Valderas JM, Ferrer M, Garin O, López-García E, Alonso J. [Interpretation of SF-36 and SF-12 questionnaires in Spain: physical and mental components]. *Med Clin (Barc)*. 2008;130:726–735.
30. Hallgren M, Högberg PI, Andréasson S. Alcohol consumption among elderly European Union citizens. Health effects, consumption trends and related issues. Swedish National Institute of Public Health; 2009. http://www.folkhalsomyndigheten.se/pagefiles/12338/alcohol-consumption-among-elderly-european-union-citizens-2009.pdf. Accessed April 20, 2015.
31. National Institute on Alcohol Abuse and Alcoholism. Alcohol and health. Older adults. http://www.niaaa.nih.gov/alcohol-health/special-populations-co-occurring-disorders/older-adults. Accessed December 15, 2014.
32. Our invisible addicts. First Report of the Older Persons' Substance Misuse Working Group of the Royal College of Psychiatrists College report CR 165. http://www.rcpsych.ac.uk/files/pdfversion/CR165.pdf. Accessed December 15, 2014.
33. Karlamangla AS, Sarkisian CA, Kado DM, et al. Light to moderate alcohol consumption and disability: variable benefits by health status. *Am J Epidemiol*. 2009;169:96–104. doi:10.1093/aje/kwn294
34. Lin JC, Guerrieri JG, Moore AA. Drinking patterns and the development of functional limitations in older adults: longitudinal analyses of the health and retirement survey. *J Aging Health*. 2011;23:806–821. doi:10.1177/0898264310397541
35. Trevisan M, Schisterman E, Mennotti A, Farchi G, Conti S. Drinking pattern and mortality: the Italian Risk Factor and Life Expectancy pooling project. *Ann Epidemiol*. 2001;11:312–319.
36. Trichopoulou A, Bamia C, Trichopoulos D. Anatomy of health effects of Mediterranean diet: Greek EPIC prospective cohort study. *BMJ*. 2009;338:b2337. doi:10.1136/bmj.b2337
37. Arranz S, Chiva-Blanch G, Valderas-Martínez P, Medina-Remón A, Lamuela-Raventós RM, Estruch R. Wine, beer, alcohol and polyphenols on cardiovascular disease and cancer. *Nutrients*. 2012;4:759–781. doi:10.3390/nu4070759
38. Brien SE, Ronksley PE, Turner BJ, Mukamal KJ, Ghali WA. Effect of alcohol consumption on biological markers associated with risk of coronary heart disease: systematic review and meta-analysis of interventional studies. *BMJ*. 2011;342:d636. doi:10.1136/bmj.d636
39. Galán I, Valencia-Martín JL, Guallar-Castillón P, Rodríguez-Artalejo F. Alcohol drinking patterns and biomarkers of coronary risk in the Spanish population. *Nutr Metab Cardiovasc Dis*. 2014;24:189–197. doi:10.1016/j.numecd.2013.07.002
40. Hu FB. Dietary pattern analysis: a new direction in nutritional epidemiology. *Curr Opin Lipidol*. 2002;13:3–9.
41. National Institute of Statistics. European Health Survey in Spain, 2009. http://www.ine.es/jaxi/menu.do?type=pcaxis&path=%2Ft15/p420&file=inebase. Accessed April 20, 2015.