Research Article

Prospective Association Between Nut Consumption and Physical Function in Older Men and Women

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Abstract

Background: The beneficial effect of nut consumption preventing cardio-metabolic diseases and cancer suggests that nuts might also protect from physical function impairment in older people since aging-related functional decline shares biological pathways with these chronic diseases. The objective was to examine the association between nut consumption and impairment of physical function in older adults.

Methods: Prospective study with 3,289 individuals aged ≥60 years from the Seniors-ENRICA cohort. In 2008–2010 and 2012 nut consumption was measured with a validated diet history. Participants were followed-up until 2015 to ascertain incident impaired physical function, specifically impaired agility, mobility, grip strength, gait speed, and overall physical function. Statistical analyses were performed with Cox regression and adjusted for the main confounders, including a wide set of socioeconomic, lifestyle, dietary, and morbidity variables.

Results: Overall, 65.7% of participants consumed any type of nuts. The mean intake among nut consumers was 15.1 g/d in men and 14.6 g/d in women. Median consumption of nuts was 11.5 g/d in both sexes. Men consuming ≥11.5 g/d of nuts had a lower risk of impaired agility and mobility than those who did not consume nuts; the hazard ratios (95% confidence interval (CI); p for linear trend) were 0.59 (0.39–0.90; p = .01) and 0.50 (0.29–0.90; p = .02), respectively. In women, compared with nonconsumers, the hazard ratio (95% CI; p for linear trend) of impaired overall physical function for nut intake ≥11.5 g/d was 0.65 (0.48–0.87; p = .004). No association was observed between nut consumption and low grip strength and slow gait speed.

Conclusions: Nut consumption was associated with half the risk of impaired agility and mobility in men and with a lower risk of overall physical function impairment in women. The suggested protective effect of nut consumption on physical functioning merits further examination.

Keywords: Frailty, Nuts, Nutrition, Physical performance

Nuts have been part of most human dietary patterns throughout history. In addition to their worldwide distribution and appreciated culinary use, nuts are energy- and nutrient-dense foods. Specifically, they are substantial sources of proteins, monounsaturated and poly-unsaturated fatty acids including long-chain n-3, fiber, antioxidants, and several other bioactive compounds, all of them with beneficial health effects (1,2).

The evidence linking nut consumption with reduced risk of major health outcomes has increased in the last few years (3,4). The most recent meta-analysis of prospective studies found that an increase of 28 g/d in nut intake was associated with a risk reduction of 21% for cardiovascular diseases, 15% for all-cancer sites, and 22% for all-cause mortality (4). These associations were mediated by a beneficial effect of nuts on biological risk factors of chronic diseases, such
as blood lipid concentration, inflammation, insulin resistance, blood pressure, body fat distribution, oxidative stress, and several cancer pathways (5–9).

Aging is associated with a decline in many biological systems, including the musculoskeletal system, which may result in impaired physical functioning (10). Since aging-related functional decline shares many biological pathways with cardio-metabolic diseases and cancer progression (11), it is plausible that nut consumption might also have a beneficial effect on physical functioning.

Moreover, nuts are core components of the Mediterranean diet pattern, which has been robustly linked with overall healthy aging (12,13). Our research group has found a specific inverse association between adherence to Mediterranean diet and physical function impairment (14). However, Tosti and colleagues (15) recently claimed that the better understanding of single nutrients and foods from the Mediterranean diet is still needed. Thereby, the aim of this study was to examine the association between nut consumption and risk of impaired physical function, specifically of some important components such as agility, mobility, grip strength, gait speed, and overall physical function in older adults.

Materials and Methods

Study Design and Participants

This was a prospective analysis of the Seniors-ENRICA cohort, whose methods have already been described in detail elsewhere (16). Briefly, this cohort was established in 2008–2010 with 3,289 individuals representative of the noninstitutionalized Spanish population aged 60 years and older. At baseline, information on lifestyle, health status, morbidity, and use of health services was collected through a standardized phone interview. This was followed by two home visits to perform a physical examination and to obtain information on habitual diet. Interviewers and nurses in charge of the home visits received specific training. Then, two waves of data collection were performed using the same procedures to update all the information from baseline and to re-evaluate physical function, the first one in 2012 and the second one in 2015. Study participants gave written informed consent. The study protocol was approved by the Ethical Committee of Clinical Research of the University Hospital “La Paz” in Madrid (Spain).

Study Variables

Nut consumption

A validated computerized diet history was developed from the one used in the EPIC study in Spain, and included 880 different foods and recipes, with sets of photographs to help participants in estimating the habitual amount of intake (17). Subjects were requested to indicate all the foods usually consumed within the last year, considering the variations between work and weekend days, and between annual seasons. Then, the average g/d for each food was calculated. The diet history included 20 types of nuts, which were later grouped as follows: almonds, hazelnuts, peanuts, chestnuts, walnuts, pine nuts, sunflower seeds, pistachios, sesame seeds, cashews, macadamia nuts, and other types of nuts. The average nut consumption at baseline (2008–2010) and in the first follow-up wave of data collection (2012) was calculated to represent cumulative intake over follow-up. Furthermore, we estimated the intake of total energy, n-3 polyunsaturated fatty acids (PUFA) and monounsaturated fatty acids (MUFA) using Spanish food composition tables. The validity of the diet history has been assessed against seven 24-h recalls over 1 year; energy-adjusted Pearson correlations were moderate-to-good for nut consumption (r = .43) and for the studied fatty acids [coefficients ranged from 0.44 to 0.63 (17)].

Physical function impairment

Five domains were considered to characterize subjects’ physical function. Three of them were self-reported (agility, mobility, and overall physical function), and the other two were objective measures of muscle strength and physical performance (grip strength and gait speed). A subject was deemed to have “impaired agility” when answering “a lot” to the following question from the Rosow and Breslau scale: “On a normal day, does your current health limit you to bend down or kneel?” (18). In the same way, “impaired mobility” was defined by answering “a lot” to any of the next three questions from the Rosow and Breslau scale: “On an average day with your current health, would you be limited in the following activities: 1) picking up or carrying a shopping bag? 2) climbing one flight of stairs? 3) walking several city blocks (a few hundred meters)?” (18). These responses reflect the highest possible level of impairment in a scale of three values (“yes, a lot” “yes, a little” and “not at all”) (18). Grip strength was assessed as the highest value in two consecutive measures on the dominant hand using a Jamar dynamometer; “low grip strength” was defined as the lowest quintile of the maximum strength in our study sample, adjusted for sex, and body mass index (BMI). In addition, “low gait speed” was defined as the lowest quintile for the 3-m walking speed test in our study sample, adjusted for sex and height. Finally, a 10-point decrease in the physical component summary (PCS) score of the 12-Item Short-Form Health Survey (SF-12) from baseline to follow-up was used as a measure of “impaired overall physical function” (19).

Other study variables

We also collected data on several variables which could be associated with both nut consumption and physical function. Specifically, we asked about sociodemographic characteristics (sex, age, education level) and lifestyle behaviors, including smoking, alcohol consumption, time spent watching television, and physical activity at leisure time, which was assessed using the validated questionnaire from the EPIC study (20). Regarding diet, we used the Trichopoulou’s Mediterranean diet score as a proxy of a healthy diet; a higher score indicates better diet (21). BMI was calculated as weight in kg divided by squared height in m. Lastly, we obtained information on morbidity. Blood pressure was measured under standard conditions, and hypertension was considered as systolic blood pressure ≥140 mm Hg, diastolic blood pressure ≥90 mm Hg or being under hypertensive drug treatment. Diabetes was defined as baseline glucose levels ≥126 mg/dL or undergoing hypoglycemic or taking antidiabetic therapy. Participants also reported if they had a physician-diagnosis of cardiovascular disease, cancer, musculoskeletal conditions, chronic lung disease, or depression requiring treatment. Furthermore, cognitive function was measured using the Mini-Mental State Examination (MMSE); cognitive impairment was defined as a score <23 (22). Finally, participants were also asked to report whether they suffered any episode of fall or hospitalization within the 12 months before each wave of follow-up.

Data Analyses

From the 3,289 initial participants, 1,291 were lost, and 157 died during follow-up. Then, we excluded participants lacking data on nut consumption or physical function, either at baseline or during
follow-up: 167 on agility, 174 on mobility, 361 on grip strength, 308 on gait speed, and 176 on overall physical function. Additionally, prevalent cases of impaired physical function at baseline were excluded. Therefore, five subsamples were constituted according to each one of the study endpoints: impaired agility \((n = 1,502)\), impaired mobility \((n = 1,502)\), low grip strength \((n = 1,236)\), slow gait speed \((n = 1,232)\), and impaired overall physical function \((n = 1,665)\). Participants were classified into three categories according to the median of nuts intake of consumers in our sample \((11.5 \text{ g/d})\): nonconsumers, medium, and medium.

We estimated hazard ratios (HR) and 95% confidence intervals \((CI)\) for the association between categories of nut consumption and the incidence of the specified endpoints using Cox regression, with person-years as the underlying time metric. Person-years for each participant were calculated from the date of recruitment to the date of loss to follow-up, death, occurrence of the event or the last examination, whichever came first. Three recruitment models were conducted. The first model was adjusted for age. The second model was additionally adjusted for education level \((primary, secondary, or university)\), smoking \((never, former, or current)\), time spent watching television \((quintiles of h/wk)\), energy intake \((quintiles of kcal/d)\), alcohol consumption \((never, former, moderate, or heavy drinker)\), with the threshold between moderate and heavy drinking established as 20 g/d in men and 10 g/d in women, BMI \((\text{kg/m}^2)\), Mediterranean diet \((quintiles of the Trichopoulou score)\), and hypertension, diabetes, cardiovascular disease, musculoskeletal disease, cancer, chronic lung disease, and depression. The third model was additionally adjusted for leisure time physical activity \((\text{MET-h/wk})\), cognitive impairment, and any episode of fall or hospitalization during follow-up, since these variables are highly related to the study outcomes. To test for a linear dose–response relationship, we modeled nut consumption categories as a continuous variable.

We assessed if the study associations varied with sex by building interaction terms as the product of nut consumption categories by sex, and then using likelihood ratio tests to compare models with and without interaction terms. Since we found a significant interaction for impaired agility \((p = 0.05)\), impaired mobility \((p = 0.03)\) and for a 10-point decrease in PCS \((p = 0.02)\), we performed sex-specific analyses.

Several additional analyses were run to assess the robustness of the results, using the above mentioned fully adjusted Cox regression (Model 3). First, given that nut consumption might reflect an overall diet pattern, we run stratified analyses to see if the association was consistent between low and high PUFA and MUFA consumers \((cut-off: median of intake)\), and between participants with low and high Mediterranean diet score \((cut-off: median of intake)\). Second, to improve comparison of findings, we repeated the main analyses by categorizing nut consumption according to U.S. serving sizes \((23)\): nonconsumers of nuts, consumers of <1 oz/d \((28.3 \text{ g/d})\) and consumers of ≥1 oz/d. Third, as micronutrient content might be influenced by the type of nut processing, we ran a sensitivity analysis using only raw nuts \((with exclusion of roasted and salted nuts)\) \((24)\).

Statistical significance was set at two-tailed \(p\)-value <.05. Analyses were performed using Stata version 13.0 \((\text{Stata Corp, College Station, TX})\).

### Results

The mean \((\text{SD})\) nut consumption in the whole sample was 9.47 \((12.8)\) g/d. Of this amount, 31.4% was due to walnuts \((2.97 \text{ g/d})\) and 10% to almonds \((0.95 \text{ g/d})\), which were the two most consumed subtypes \((\text{Supplementary Table 1})\). Among participants with some amount of nuts intake \((65.7\% of the total sample)\), the mean consumption was 14.8 \((13.3)\) g/d; this amount was slightly higher in men \((15.1 \text{ g/d}; SD: 13.3)\) compared with women \((14.6 \text{ g/d}; SD: 12.9)\)

The median of nut intake among consumers was 11.5 g/d in both sexes. This amount corresponds approximately to 2.3 walnuts/d or 6 almonds/d. Using the median as cut-off point, mean intake of nuts was 5.6 g/d \((0.13)\) among participants with low consumption and 24.2 g/d \((0.60)\) among high consumers.

Table 1 and Supplementary Tables 2 and 3 present the sociodemographic, lifestyle, and morbidity characteristics of the study participants according to incident functional impairments, for men and women separately. Those who developed any of the studied impairments were older, with lower education, had less alcohol intake, did less physical activity and spent more time watching television. They also showed higher BMI and more comorbidity, particularly musculoskeletal disorders. Moreover, impaired women had significantly lower energy intake than nonimpaired ones \((\text{Supplementary Table 3})\)

During 7.2 years of follow-up, we identified 484 incident cases of impaired agility \((165 \text{ in men}, 319 \text{ in women})\), 351 of impaired mobility \((94 \text{ in men}, 257 \text{ in women})\), 343 of low gait speed \((169 \text{ in men}, 174 \text{ in women})\), 382 of slow gait speed \((192 \text{ in men}, 190 \text{ in women})\), and 559 of impaired overall physical function \((250 \text{ in men}, 309 \text{ in women})\). The association between nut consumption and these outcomes is shown in Tables 2 and 3. In fully adjusted analyses, compared with no consumption, an intake of nuts equal or greater than the median in nut consumers \((11.5 \text{ g/d})\) was associated with lower
risk of self-reported impaired agility and mobility; the full-adjusted HRs (95% CI) were 0.59 (0.39–0.90) and 0.50 (0.28–0.90), respectively. In addition, there was a dose–response relationship between nut consumption and impaired agility and mobility (Table 2). In women, compared with no consumption, the fully-adjusted HR (95% CI) of impaired self-reported overall physical function was 0.79 (0.60–1.04) for nut intake <11.5 g/d and 0.65 (0.48–0.87) for intake ≥11.5 g/d (\(p\) linear trend = .004; Table 3). No association was found between nuts and grip strength and gait speed: among men, the fully-adjusted HRs (95% CI) of low grip strength and slow gait speed were 0.92 (0.61–1.40) and 0.99 (0.68–1.51) for nut consumers of ≥11.5 g/d, respectively; the corresponding figures for women were 0.71 (0.47–1.09) and 1.32 (0.89–1.95), Tables 2 and 3.

In stratified analyses, the association between nut consumption and physical function impairment was similar, although of less magnitude, in men and women with low or high PUFA and MUFA intake, and among those with worse or better diet quality (Supplementary Tables 4 and 5). The study association did not significantly vary across the strata (\(p\) for interaction ≥ .05 in all cases).

Moreover, results were in the same direction when the analyses were repeated using the distribution of nut intake according to oz/d and in analyses limited to raw nuts (data not shown).

### Discussion

In this prospective study among community-dwelling older adults, nut consumption was associated with lower risk of physical function impairment. The association was observed for self-reported impaired agility and mobility in men and for self-reported overall physical function in women, suggesting a possible differential effect between sexes. No association was observed for low grip strength and slow gait speed.

Several biological mechanisms could explain a protective role of nuts on physical function. The most obvious is the role of nuts preventing cardio-metabolic diseases and cancer (3–5), which have been shown to produce frailty and disability among older adults (25,26). Additionally, it has also been suggested that nuts intake protects from cognitive impairment (27,28), which can be another
important trigger of frailty and disability (29). However, given that our results held after adjustment for several intermediate factors, such as BMI, hypertension, hospitalization, depression, and cognitive impairment, it is plausible that other biological mechanisms may act. Moreover, given that our findings were independent of healthy fatty acids intake and adherence to a Mediterranean diet score, nut consumption might have a beneficial effect on health beyond of being a marker of a healthy diet pattern.

Among older people, physical function impairment usually appears in the context of age-related sarcopenia (30) and bone loss that overlap with the frailty phenotype (31). Thereby, impaired physical function, sarcopenia, and frailty could share some underlying mechanisms. It has been suggested that oxidative stress could be an important determinant of muscle quality and quantity (32). However, antioxidants contribute to maintain normal redox reactions in the muscle and delay or prevent the alteration caused by oxidative stress. Since nuts are good exogenous sources of nutrient and non-nutrient antioxidants, such as vitamin E, zinc, or selenium, their consumption might help preserve muscle function (2). Also, nuts contain phytochemicals with strong antioxidant activity, such as catechin, tannins, or ellagic acid (2). The above hypothesis regarding the preventive effect of antioxidants on oxidative stress has been examined in several in vitro and in vivo studies (33–35).

A substantial part of the abovementioned positive effects of nuts is linked to their content of antioxidants and phenolic compounds. But most of these compounds are concentrated in the pellicle of outer soft shell, as it has been shown in almonds and peanuts (36,37); this pellicle is usually removed before consumption, thus around a half of the antioxidant load may be lost (38). Moreover, cracking nuts, as it occurs naturally in pistachios, also results in the depletion of most of the antioxidants (39). Since the standardization of consumption that usually occurs in clinical trials might not reflect all factors influencing nut intake and its processing, observational studies are still necessary to explore the effects of nut consumption on health.

We observed a different effect of nuts between sexes. On the one hand, we found a protective effect on self-reported agility and mobility impairments among men, suggesting that nuts could contribute to preserve muscle integrity. Some authors report that older women

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Table 3. Hazard Ratios (95% Confidence Interval) for the Association Between Nut Consumption and Physical Function Impairment During 7.2 Years of Follow-up—Women

<table>
<thead>
<tr>
<th>Physical Function Domains</th>
<th>Nonconsumers</th>
<th>&lt;Median*</th>
<th>≥Median*</th>
<th>p-Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impaired agility</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Person-years, n</td>
<td>1,352</td>
<td>1,298</td>
<td>1,348</td>
<td></td>
</tr>
<tr>
<td>Incident cases, n</td>
<td>113</td>
<td>109</td>
<td>97</td>
<td></td>
</tr>
<tr>
<td>Model 1</td>
<td>1.00</td>
<td>1.00 (0.77–1.30)</td>
<td>0.85 (0.65–1.11)</td>
<td>.23</td>
</tr>
<tr>
<td>Model 2</td>
<td>1.00</td>
<td>0.84 (0.63–1.13)</td>
<td>1.08 (0.79–1.47)</td>
<td>.92</td>
</tr>
<tr>
<td>Model 3</td>
<td>1.00</td>
<td>1.09 (0.82–1.44)</td>
<td>0.95 (0.71–1.28)</td>
<td>.77</td>
</tr>
<tr>
<td>Impaired mobility</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Person-years, n</td>
<td>1,501</td>
<td>1,372</td>
<td>1,429</td>
<td></td>
</tr>
<tr>
<td>Incident cases, n</td>
<td>85</td>
<td>89</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>Model 1</td>
<td>1.00</td>
<td>1.17 (0.87–1.58)</td>
<td>1.05 (0.78–1.42)</td>
<td>.74</td>
</tr>
<tr>
<td>Model 2</td>
<td>1.00</td>
<td>1.09 (0.79–1.50)</td>
<td>1.24 (0.88–1.76)</td>
<td>.22</td>
</tr>
<tr>
<td>Model 3</td>
<td>1.00</td>
<td>1.26 (0.92–1.73)</td>
<td>1.18 (0.85–1.64)</td>
<td>.29</td>
</tr>
<tr>
<td>Low grip strength†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Person-years, n</td>
<td>1,135</td>
<td>1,229</td>
<td>1,228</td>
<td></td>
</tr>
<tr>
<td>Incident cases, n</td>
<td>58</td>
<td>70</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>Model 1</td>
<td>1.00</td>
<td>1.16 (0.82–1.65)</td>
<td>0.70 (0.47–1.03)</td>
<td>.08</td>
</tr>
<tr>
<td>Model 2</td>
<td>1.00</td>
<td>0.84 (0.57–1.25)</td>
<td>0.88 (0.56–1.40)</td>
<td>.46</td>
</tr>
<tr>
<td>Model 3</td>
<td>1.00</td>
<td>1.20 (0.83–1.73)</td>
<td>0.72 (0.47–1.09)</td>
<td>.16</td>
</tr>
<tr>
<td>Slow gait speed‡</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Person-years, n</td>
<td>1,115</td>
<td>1,250</td>
<td>1,209</td>
<td></td>
</tr>
<tr>
<td>Incident cases, n</td>
<td>52</td>
<td>69</td>
<td>69</td>
<td></td>
</tr>
<tr>
<td>Model 1</td>
<td>1.00</td>
<td>1.27 (0.89–1.82)</td>
<td>1.23 (0.86–1.77)</td>
<td>.27</td>
</tr>
<tr>
<td>Model 2</td>
<td>1.00</td>
<td>0.97 (0.67–1.41)</td>
<td>1.11 (0.74–1.69)</td>
<td>.69</td>
</tr>
<tr>
<td>Model 3</td>
<td>1.00</td>
<td>1.28 (0.88–1.87)</td>
<td>1.32 (0.89–1.95)</td>
<td>.16</td>
</tr>
<tr>
<td>Impaired overall physical function§</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Person-years, n</td>
<td>1,637</td>
<td>1,572</td>
<td>1,623</td>
<td></td>
</tr>
<tr>
<td>Incident cases, n</td>
<td>127</td>
<td>96</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>Model 1</td>
<td>1.00</td>
<td>0.76 (0.58–0.99)</td>
<td>0.66 (0.50–0.85)</td>
<td>.002</td>
</tr>
<tr>
<td>Model 2</td>
<td>1.00</td>
<td>0.71 (0.520.96)</td>
<td>0.71 (0.51–0.99)</td>
<td>.02</td>
</tr>
<tr>
<td>Model 3</td>
<td>1.00</td>
<td>0.79 (0.60–1.04)</td>
<td>0.65 (0.48–0.87)</td>
<td>.004</td>
</tr>
</tbody>
</table>

Model 1: adjusted for age (y). Model 2: additionally adjusted for education (primary or less, secondary, university); smoking (never, former, current smoker); time spent watching television (quintiles of h/wk); energy intake (quintiles of kcal/d); alcohol consumption (none, moderate, heavy drinker); BMI (quintiles of kg/m²); Trichopoulou index (quintiles) and prevalence of hypertension, diabetes, cardiovascular disease, musculoskeletal disease, cancer, chronic lung disease, and depression. Model 3: additionally adjusted for leisure time physical activity (MET-h/wk), cognitive impairment (MMSE cut-off point 23), and suffering an episode of fall or hospitalization during follow-up (yes, no).

*Median intake among nuts consumers (women) = 11.5 g/d.
†Lowest quintile of grip strength, adjusted for sex and body mass index.
‡Lowest quintile of walking speed, adjusted for sex and height.
§≥10-point decrease in the SF-12 physical component summary score from baseline to follow-up.
do not increase muscle strength to the same magnitude as men when undergo physical training, which suggests that women’s muscle may be more resilient to change during aging; therefore, this could explain why the benefits associated with nuts were not evident in women for the outcomes related to muscle integrity (40). On the other hand, the protective effect of nuts on self-reported overall physical function in women but not men could be due to the fact that women suffer a greater deterioration of general health with aging compared with men, so they have higher potential for improvement (41). This hypothesis agrees with the results from two large cohort studies that found a more pronounced inverse effect of nut consumption on mortality in women than in men (42,43). In addition, one could also speculate about sex differences on the responses to self-reported measurements, as women could have been more prone to declare incident self-reported impairments than men due to socially established gender roles, and vice-versa. However, further studies are warranted to confirm these sex differences and to find their underlying mechanisms.

This study has several limitations. First, although we used a validated diet history, there could be some recall bias in diet assessment; in any case, this type of bias usually tends to underestimate study associations. Second, despite we collected data on many subtypes of nuts, their low consumption did not allow to perform stratified analyses by each subtype. However, previous research has reported the similar effect of all subtypes of nuts (4), suggesting that it is more important the overall characteristics of the whole group of foods than the specific components of each of them. Third, diet history actually reflects participants’ diet choices, but not their reasons; thereby, there was probable some subjects with nuts allergy among nonconsumers. Nevertheless, it is not expected that their inclusion would have modified findings. Fourth, we did not account for variations in some lifestyles during the follow-up, since most of them are long-term established habits in older adults; thereby they have been presumable maintained during the study period. Fifth, we used three self-reported measurements of physical function, with the consequent potential for bias. However, although subjective physical function measures may be less reliable than its objective measurement, self-reported function has been shown to predict an early decline in performance and early disease (44). In addition, we did not find an association between nut consumption and low grip strength and gait speed. It is possible that the cutoff points selected were not sensitive to evidence differences associated with nut intake. Finally, some residual confounding cannot be ruled out; in fact, nut consumption may still reflect better diet choices despite we adjusted the analyses for a diet quality index and for total energy intake.

In conclusion, nut consumption was prospectively associated with lower risk of self-reported impaired agility and mobility in older men, and with moderately lower risk of impaired overall physical function in older women. However, no association was observed with low grip strength and gait speed. The suggested protective effect of nut consumption on physical function merits further examination.

Supplementary Material
Supplementary data is available at The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences online.

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Conflict of Interest
None declared.

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