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Research Article

Dietary Patterns and Self-reported Incident Disability in Older Adults

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Abstract

Background or Objectives: Disability in older adults is associated with low quality of life and higher mortality. Diet may be a potentially important public health strategy for disability prevention in aging. We examined the relations of the Mediterranean, Dietary Approaches to Stop Hypertension (DASH), and Mediterranean–DASH Intervention for Neurodegenerative Delay (MIND) diets to functional disability in the Rush Memory and Aging Project.
Methods: A total of 809 participants (mean age = 80.7 ± 7.2 years, 74% female) without functional disability at baseline were followed for an average of 5.3 years. Standardized measures for self-reported disability including, activities of daily living ADL), instrumental ADL, and mobility disability were assessed annually. The diet scores were computed based on a validated food frequency questionnaire administered at baseline.
Results: In Cox proportional hazards models adjusted for age, sex, education, smoking, physical activity, and total calories, the second (hazard ratio = 0.75, 95% CI: 0.60–0.95) and third tertiles (hazard ratio = 0.67, 95% CI: 0.53–0.86) of MIND diet scores had lower rates of ADL disability compared to the lowest tertile (*p* for trend = .001), whereas only the third tertiles of the Mediterranean (hazard ratio = 0.73, 95% CI: 0.57–0.94) and DASH (hazard ratio = 0.75, 95% CI: 0.59–0.95) diets were significantly associated with ADL disability. Instrumental ADL disability was inversely and linearly associated with the MIND diet score only (*p* for trend = .04). Mobility disability was associated with the MIND (*p* for trend = .02), Mediterranean (*p* for trend = .05) and DASH (*p* for trend = .02) diet scores.
Conclusion: These findings are encouraging that diet may be an effective strategy for the prevention of functional disability in older adults.

Keywords: Nutrition, Functional performance, Epidemiology, Disability, Diet, Longitudinal.

It is well established that the prevalence of disability increases with older age (1). However, among recent cohorts of older adults in the United States, the trends in late-life disability are increasing (2), and to date, few modifiable risk factors have been identified (3–5). Several studies report less disability in those who eat as per the healthy dietary guidelines (6,7) or consume the traditional Mediterranean (8–10) or Japanese diets (11). However, it is possible that other dietary patterns related to cognitive functions may be particularly beneficial to reduce physical and functional disabilities. Previously, we found that the Mediterranean–Dietary Approaches to Stop Hypertension (DASH) Intervention for Neurodegenerative Delay (MIND) diet was associated with a slower decline in cognitive abilities and reduced risk of Alzheimer's disease (12,13). In this study, we investigated the associations of the MIND, Mediterranean, and DASH diets with self-reported disability in three functional domains: activities daily living (ADL), instrumental activities of daily living (IADL), and mobility

Materials and Methods

The study was conducted among participants of the Rush Memory and Aging Project (MAP). The MAP cohort includes residents from more than 40 retirement communities and subsidized housing facilities in the Chicago area. To be eligible, residents had to be free of dementia and agree to brain donation at their death. From 1997

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to 2017, 1,887 participants were enrolled in the study. Details of this ongoing longitudinal study have been published (14). Briefly, participants undergo structured, comprehensive evaluations annually. Dietary assessments using the food frequency questionnaires were introduced in 2004 and were completed by 1,068 participants without dementia (at the time of assessment). For this study of diet and incident disability, we analyzed 809 MAP participants (age range = 58–97 years) who had no dependence in ADL (n = 191 with ADL disability at the baseline food frequency questionnaire assessment), had at least one follow-up disability assessment (n = 66 without follow-up), and had baseline data on the covariates for the basic model (age, sex, education, smoking, physical activity, and total calories; n = 2 had missing data on physical activity). The analytic sample was comparable to all 1,887 MAP participants enrolled in the study in terms of mean age (80.7 vs 79.9 years), percentage of female participants (74% vs 74%), body mass index (BMI; 27.0 vs 27.3), frequency of participation in cognitive activities (3.2 vs 3.2), percentage of current or past smokers (42% vs 42%), and percentages with hypertension (75% vs 75%) and diabetes (21% vs 20%). However, due to the exclusion of those with dementia at baseline, the analytic sample had higher cognitive scores than the total MAP cohort (standardized score means of 0.06 vs −0.01). To analyze the association of diet with IADL and mobility disability incidence, we only included those without baseline IADL (n = 471) or mobility disability (n = 551), respectively. The institutional review board of Rush University Medical Center approved this study, and all the participants gave the written consent forms.

Assessment of Disability

Participants responded to questions from three standardized measures of disability: the Katz ADL, which assesses help needed for feeding, bathing, dressing, toileting, transferring, and walking across a small room (15); the Duke IADL (16), which measures independence in telephone use, meal preparation, money management, medication management, light and heavy housekeeping, shopping, and local travel; and the Rosow–Breslau mobility index (17), which assesses help needed for walking up and down a flight of stairs, walking a half mile, and doing heavy housework. For all three scores, participants were asked to rate their ability to perform (no help, help, unable to do) different activities and the responses were dichotomized as no help and need help or unable to do. Incident disability for each index was defined as the first report for help (i.e. dependency) or inability to perform one or more tasks of that measure.

Diet Assessment

Diet pattern scores were computed using a validated modified Harvard semiquantitative food frequency questionnaire administered at baseline (18). The food frequency questionnaires inquire about usual frequency of intake of 144 food items over the previous 12 months. The frequency of consumption of foods was multiplied by the nutrient content for either the natural portion size (e.g. one banana) or the typical serving size based on sex-specific mean portion sizes reported by the oldest men and women of national surveys. Dietary intake of energy (kilocalorie), total fat (grams), and saturated fat (grams) was computed by multiplying the frequency of intake by the kilocalorie or fat gram content for each food item and then summing over all items. Each diet score was then computed using the frequency of consumption of various food items within each food component of the specific diet as described later.

The MIND diet score was developed based on the best scientific evidence of the foods and nutrients shown to be important for brain health, and includes 10 brain healthy food groups (green leafy vegetables, other vegetables, nuts, berries, beans, whole grains, fish, poultry, olive oil, and wine) and 5 unhealthy food groups (red meats, butter and stick margarine, cheese, pastries and sweets, and fried and/or fast food). All 15 individual dietary components were scored from 0 (low adherence to the recommended servings) to 1 (high adherence) and then summed together to get the MIND diet score (range: 0–15) (12).

The Mediterranean diet pattern (MedDiet) score was computed as described by Panagiotakos and colleagues (19), which uses serving quantities of the traditional Greek Mediterranean diet as the comparison metric. It includes 11 dietary components, each scored 0–5 and then summed for a total score ranging from 0 to 55 (20). The DASH diet score is composed of seven food groups and three dietary components (total fat, saturated fat, and sodium). We used scoring as described in a previous diet trial in which each component was scored 0, 0.5, or 1, and then summed for a total score ranging from 0 to 10. More detailed description of the three diet scores has been described earlier (13,21).

Model Covariates

Data for model covariates were obtained from structured evaluations completed at the study baseline, which for the purposes of this study was the yearly evaluation that included the first valid diet assessment. Covariates included questions on age (in years), education (years of regular schooling), smoking history (never, past, or current smoker), BMI computed from measured weight and height and modeled as two indicator variables (BMI ≤ 20 and BMI ≥ 30), depressive symptoms (assessed by a modified 10-item version of the Center for Epidemiological Studies-Depression Scale (22)), physical activity (hours per week based on self-reported minutes spent for walking, exercise, yard work, calisthenics, biking, and water exercise) (23), diabetes (self-reported or taking any diabetic medications), hypertension (present if any current use of antihypertensive medication or measured systolic and diastolic blood pressure ≥160 and 90 mm Hg, respectively), stroke (based on medical history and neurological examination), and myocardial infarction (self-reported history or use of digoxin) (14). The global cognitive score is a composite measure of 19 cognitive tests (24) computed by taking the average z-scores of the individual tests (z-score computations of raw test scores used the baseline means and standard deviations of the entire cohort).

Statistical Methods

We used Cox proportional hazard models to investigate whether each of the MIND, Mediterranean, and DASH diet scores was associated with the incidence of ADL, IADL, or mobility disability. The Schoenfeld residuals test was applied to check the proportional hazard assumption for survival models. The diet pattern associations were examined first in basic-adjusted models that included established risk factors for disability: age, sex, education, smoking, physical activity, and total energy intake. Secondary analyses added variables to the basic model that could be considered as clinical sequelae of disability (BMI and depressive symptoms) or mediators of observed associations (cardiovascular conditions and cognition). We modeled the dietary scores as indicator variables for the second and third tertiles of highest scores compared to the referent lowest tertile of scores. To examine linear trends of the diet associations, we also modeled categorical variables of the diet scores in which all records within a tertile were scored the median value. We report the *p*-value for the linear trend variables. In addition, to treat death as a competing risk, we ran all the models where follow-up time was censored, considering disability or death as an event, whichever occurred first. All analyses were performed using SAS 9.4.

Results

The analytic sample was on average 80.7 years (±7.2) of age, had a mean education of 15 (±3) years, and was primarily female participants (74%). At baseline, 22% of participants had diabetes, 75% hypertension, 15% myocardial infarction, and 12% stroke. Mean diet scores were 7.9 for MIND (range, 3–13), 31.8 for MedDiet (range, 18–46), and 4.2 for DASH (range, 1–8.5). The MIND diet score was moderately correlated with both the MedDiet (*r* = .68) and DASH (*r* = .61) scores. MedDiet and DASH diet scores were also moderately correlated (*r* = .52). Participants with higher MIND diet scores were more likely to be female, more physically active, and to report fewer depressive symptoms and cardiovascular conditions than participants with low scores (Table 1).

Dietary Patterns and Risk of Incidence Disability in ADL

Over an average follow up of 5.3 (± 3.4) years, 438 participants (54%) developed ADL disability. In the basic model adjusted for age, sex, education, physical activity, and total calories, the participants in the highest tertile of MIND diet scores (median score of 10) had a statistically significant 33% reduction in ADL disability risk compared to those in the lowest tertile of scores (median of 6.5). Persons in the second tertile of MIND scores (median of 8) also had a statistically significant lower risk of ADL disability (by 24%; Table 2). The effect estimates were only slightly modified in further analyses that added to the basic model BMI and depressive symptoms, factors that could be considered confounders but also clinical sequela of disability (Table 2).

In similar analyses of the MedDiet and DASH diet scores and incident ADL disability, statistically significant associations were observed only for the highest tertiles, with reductions of 27% and 25% for the MedDiet and DASH scores, respectively (Table 2). Additional adjustments for BMI and depressive symptoms slightly modified the associations for both diet patterns for the highest tertiles (MedDiet: hazard ratio [HR] = 0.76 (0.59–0.97), *p*-value for trend = .03; DASH: HR = 0.76 (0.60–0.97), *p*-value for trend = .04). We further examined whether the observed diet associations with the ADL disability were mediated by their effects on cardiovascular conditions by including terms for hypertension, diabetes, stroke, and myocardial infarction in the basic model. However, the results did not change materially for the MIND, Mediterranean, or DASH diet associations (Table 2).

In previous studies of the MAP cohort, all three diet patterns were associated with slower cognitive decline (12,21). In sensitivity analyses, we investigated whether the diet relations with ADL disability could be attributed to their protective associations with cognition by adjusting for cognitive scores in the basic model. The findings did not change materially for the highest tertiles of the MIND diet (HR = 0.73, 95% CI: 0.57–0.93), MedDiet (HR = 0.79, 95% CI: 0.61–1.01) or DASH diet (HR = 0.90 (0.82–0.99). These results suggest that the diet relations with ADL disability may be independent of its effect on cognition.

Dietary Patterns and Risk of Incident Disability in IADL

We next examined the associations of the different diets on activities requiring advanced cognitive facilities (i.e. IADL). These analyses were restricted to 471 MAP participants who reported no IADL disability at the baseline. Over the follow-up of 4.2 (± 3.1) years, 376 developed IADL disability (80%). Higher MIND diet scores were inversely associated with IADL disability risk (*p* for trend = .04). The risk reduction was 20% for those in the second tertile of MIND diet scores and 21% for those in the highest tertile when compared to those in the lowest tertile of scores (Table 3). When we further adjusted for BMI and depressive symptoms (the potential clinical sequelae of functional disability), the association became marginally significant (Table 3).

Table 1. Baseline Characteristics by Tertile of MIND Diet Score Among 809 Memory and Aging Project Participants, 2004–2017

		Tertile of MIND Diet Score		
	N	T1	T2	T3
Median MIND diet score	809	6.5	8.0	10.0
Age, mean ± *SD* (years)	809	80.9 ± 7.2	81.3 ± 7.0	79.8 ± 7.0
Male (%)	809	29	25	23
Education, mean ± *SD* (years)	809	14.4 ± 3.1	15.2 ± 2.8	15.6 ± 2.9
Smoking, never (%)	809	54	60	59
Physical activity weekly, mean ± *SD*, (hours)	809	2.6 ± 2.9	3.8 ± 4.3	4.4 ± 3.8
Body mass index, mean ± *SD*	794	27.5 ± 5.1	27.2 ± 4.9	26.2 ± 5.1
Depressive symptoms, mean ± *SD*, number	809	1.2 ± 1.7	0.9 ± 1.3	0.7 ± 1.3
Total energy, mean ± *SD* (kcal/d)	809	1659 ± 550	1775 ± 561	1767 ± 466
Global Cognitive score, mean ± *SD*	809	−0.02 ± 0.63	0.23 ± 0.53	0.26 ± 0.55
Medical conditions				
Diabetes (%)	809	27	20	19
Hypertension (%)	802	78	73	71
Myocardial infarctions (%)	871	17	11	17
Stroke (%)	740	13	9	11

Note: DASH = Dietary Approaches to Stop Hypertension; MIND = Mediterranean–DASH Diet Intervention for Neurodegenerative Delay; *SD* = standard deviation.

Table 2. Proportional Hazard Ratios and 95% Confidence Intervals of Estimated Effects of Tertiles of MIND, Mediterranean, and DASH diet Scores on Time to Incident Disability on Activities of Daily Living scale (n = 809) in Memory and Aging Project Participants Over a Mean 5.3 Years of Follow-up, 2004–2017

	Score Range	No. of Events/*N*	Model 1†	Model 2‡	Model 3§
MIND Diet Score					
T1	3.0–7.0	175/293	1.0 (Ref)	1.0 (Ref)	1.0 (Ref)
T2	7.5–8.5	139/265	0.75 (0.60–0.95)	0.78 (0.62–0.98)	0.76 (0.60–0.96)
T3	9.0–13.0	124/251	0.67 (0.53–0.86)	0.71 (0.56–0.91)	0.65 (0.51–0.84)
p trend			.002	.01	.001
Mediterranean Diet Score					
T1	18–30	179/316	1.0 (Ref)	1.0 (Ref)	1.0 (Ref)
T2	31–34	135/246	0.80 (0.63–1.01)	0.84 (0.66–1.06)	0.81 (0.63–1.03)
T3	35–46	124/247	0.73 (0.57–0.94)	0.76 (0.59–0.97)	0.73 (0.56–0.95)
p trend			.01	.03	.02
DASH Diet Score					
T1	1.0–3.5	199/349	1.0 (Ref)	1.0 (Ref)	1.0 (Ref)
T2	4.0–4.5	129/219	0.92 (0.73–1.15)	0.94 (0.75–1.19)	0.94 (0.74–1.20)
T3	5.0–8.5	110/241	0.74 (0.58–0.95)	0.76 (0.60–0.98)	0.77 (0.60–0.98)
p trend			.02	.04	.05

Notes: Cox-Proportional hazard model was used. DASH = Dietary Approaches to Stop Hypertension; MIND = Mediterranean–DASH Diet Intervention for Neurodegenerative Delay; T1 = tertile 1; T2 = tertile 2; T3 = tertile 3.

†Model 1 adjusted for age, sex, education, smoking, physical activity, and total calories. ‡Model 2 adjusted for Model 1 + body mass index + depressive symptoms. §Model 3 adjusted for Model 1 + cardiovascular conditions (including diabetes, hypertension, stroke and myocardial infarction).

Table 3. Proportional Hazard Ratios and 95% Confidence Intervals of Estimated Effects of Tertiles of MIND, Mediterranean, and DASH Diet Scores on Time to Incident Disability on Instrumental Activities of Daily Living (n = 471) in Memory and Aging Project Participants Over a Mean 4.2 Years of Follow-up, 2004–2017

	Score Range	No. of Events/*N*	Model 1†	Model 2‡	Model 3§
MIND Diet Score					
T1	3.0–7.0	177/209	1.0 (Ref)	1.0 (Ref)	1.0 (Ref)
T2	7.5–8.5	105/136	0.80 (0.62–1.02)	0.84 (0.65–1.08)	0.81 (0.62–1.04)
T3	9.0–13.0	94/126	0.79 (0.60–1.03)	0.79 (0.60–1.04)	0.81 (0.61–1.07)
p trend			.04	.06	.09
Mediterranean Diet Score					
T1	18–30	139/167	1.0 (Ref)	1.0 (Ref)	1.0 (Ref)
T2	31–34	150/182	0.99 (0.77–1.26)	1.01 (0.79–1.29)	0.99 (0.76–1.28)
T3	35–46	87/122	0.76 (0.56–1.01)	0.75 (0.56–1.01)	0.86 (0.63–1.18)
p trend			.08	.09	.40
DASH Diet Score					
T1	2.0–3.5	160/198	1.0 (Ref)	1.0 (Ref)	1.0 (Ref)
T2	4.0–4.5	101/122	1.05 (0.82–1.36)	1.06 (0.82–1.37)	1.13 (0.86–1.48)
T3	5.0–8.5	115/151	0.81 (0.63–1.04)	0.81 (0.63–1.05)	0.86 (0.66–1.12)
p trend			.15	.16	.39

Notes: Cox-Proportional hazard model was used. DASH = Dietary Approaches to Stop Hypertension; MIND = Mediterranean–DASH Diet Intervention for Neurodegenerative Delay; T1 = tertile 1; T2 = tertile 2; T3 = tertile 3.

†Model 1 adjusted for age, sex, education, smoking, physical activity, and total calories. ‡Model 2 adjusted for Model 1 + body mass index + depressive symptoms. §Model 3 adjusted for Model 1 + cardiovascular conditions (including diabetes, hypertension, stroke and myocardial infarction).

Of the two other diet patterns, only the top tertiles of the MedDiet and DASH diet scores were marginally significantly associated with IADL disability (Table 3). When further adjusted for BMI and depressive symptoms, the highest tertile of MedDiet scores was still weakly associated with IADL disability risk but that for DASH was not (Table 3).

The addition of vascular conditions to the basic model suggested that these factors may mediate the protective relation observed for the MIND diet and IADL as the association was no longer statistically significant (Table 3).

IADL involve advanced cognitive facilities. When we adjusted for cognitive score in the basic models, the estimates of effect were reduced and marginally significant for the highest tertiles of all three diet scores (MIND diet: HR = 0.79 [0.60–1.02]; MedDiet: HR = 0.77 [0.57–1.03]; and DASH diet: HR = 0.82 ([0.64–1.05]). These analyses suggest that the relation of diet to IADL disability may be partially mediated by diet effects on cognition.

Dietary Pattern and Risk of Incidence Mobility Disability

The final set of analyses investigated the associations of the three dietary patterns with incident mobility disability among 515 of the MAP participants without disability at the baseline. A total of 381 (74 %) disability cases developed over the average follow-up period of 3.8 (±3.0) years. Similar to our findings for the other types of disability, higher MIND diet scores were associated with lower incidence of mobility disability, by 30% in the second tertile of scores and 22% in the third when compared to those with the lowest scores, whereas only the highest tertiles of the MedDiet and DASH diet scores were significantly associated with reduced risk (Table 4). With further adjustments for BMI and depressive symptoms, the only significant associations were for the second tertile of MIND diet scores and the third tertile of DASH diet scores (Table 4). Controlling for potential mediators including cardiovascular conditions did not change the effect estimates (Table 4). Adjustment for cognitive scores in the basic model resulted in reduced estimates of effect and marginal statistical associations for the top tertiles of MIND (HR = 0.79, 95% CI = 0.61–1.02) and the MedDiet score (HR = 0.78, 95% CI = 0.60–1.02), whereas, significant relations were observed for the top tertile of DASH scores (HR = 0.72, 95% CI = 0.56–0.92) and the middle tertile of MIND (HR = 0.73, 95% CI = 0.57–0.94) scores.

Further analyses modeling death as a competing risk resulted in similar findings except that the effect estimates between the MedDiet and ADL became weaker, and those for the MIND and MedDiet scores with IADL disability became stronger (Supplementary Table 2).

We considered that many older persons may transition in and out of dependency on just one task due to temporary illness and injury (25). To examine the relation of diet to more severe disability, we analyzed the data after redefining disability as dependency on two or more tasks. With the new cutoff points, 40% of the sample developed ADL disability, 62% developed IADL disability, and 59% developed mobility disability. The associations of the MIND and MedDiet scores with ADL disability were very similar as in the original analytical sample (MIND: tertile 3 vs tertile 1: HR = 0.73 [95% CI: 0.56–0.96], tertile 2 vs tertile 1: HR = 0.73 [95% CI: 0.56–0.94; *p* for trend = .03] and MedDiet: tertile 3 vs tertile 1: HR = 0.74 [95% CI: 0.56–0.98]; *p* trend = .04). However, the DASH diet score was no longer statistically significant (tertile 3 vs tertile 1: HR = 0.81 [95% CI: 0.62–1.06]; *p* for trend = .12). The effect estimates for risk of IADL disability were also protective with higher MIND diet scores (tertile 3 vs tertile 1: HR = 0.72 [95% CI: 0.56–0.94]; tertile 2 vs tertile 1: HR = 0.68 [95% CI: 0.55–0.84], *p* for trend = .01). Results of analyses with the MedDiet became nonsignificant, whereas the DASH score associations (tertile 3 vs tertile 1: HR = 0.79 [95% CI: 0.63–1.00]; *p* for trend = .04) were not materially different from that of the primary analysis. The relations of the three diet scores and mobility disability were also retained in these analyses (MIND: tertile 3 vs tertile 1: HR = 0.73 [95% CI: 0.57–0.93], tertile 2 vs tertile 1: HR = 0.78 [95% CI: 0.62–0.98], *p* for trend = .01); MedDiet: tertile 3 vs tertile 1: HR = 0.78 [95% CI: 0.61–1.00], *p* for trend = .05 and DASH: tertile 3 vs. tertile 1: HR = 0.73 [95% CI: 0.58–0.93], *p* for trend = .01).

Discussion

In this community-based study of older adults, healthy dietary patterns were associated with reduced risk of developing self-reported disability. High and even intermediate scores on the MIND diet were associated with lower risk of disability on all three domains of functioning ability, including basic self-care tasks, mobility, and instrumental tasks in daily functioning. By contrast, only the highest scorers on the Mediterranean and DASH diets were associated with ADL and mobility disability prevention. Thus, older adults who consume healthy diets may be less likely to develop a disability.

Our findings are supported by a number of studies showing less disability in older adults with higher scores on the Mediterranean diet (8–10), Healthy Eating Index (6), and healthy Australian diet (7). We did not find a very robust association between the Mediterranean diet and mobility disability as reported earlier in the Senior-(Estudio de Nutrición y Riesgo cardiovascular en España) cohort using the same Rosow–Breslau measure (9).

One possible mechanism for these observed relations is the protective diet effects on a number of cardiovascular-related conditions. However, the MIND, Mediterranean, and DASH diet relations with

Table 4. Proportional Hazard Ratios and 95% Confidence Intervals of Estimated Effects of Tertiles of MIND, Mediterranean, and DASH Diet Scores on Time to Incident Mobility Disability on Rosow–Breslau Scale (*n* = 515) in Memory and Aging Project Participants Over a Mean 3.8 Years of Follow-up, 2004–2017

	Score Range	No. of Events/*N*	Model 1[†]	Model 2[‡]	Model 3[§]
MIND Diet Score					
T1	3.0–7.0	184/229	1.0 (Ref)	1.0 (Ref)	1.0 (Ref)
T2	7.5–8.5	103/156	0.69 (0.54–0.88)	0.74 (0.58–0.96)	0.69 (0.56–0.94)
T3	9.0–13.0	94/130	0.78 (0.60–1.01)	0.83 (0.64–1.08)	0.80 (0.61–1.05)
p trend			.02	.07	.04
Mediterranean Diet Score					
T1	18–30	149/183	1.0 (Ref)	1.0 (Ref)	1.0 (Ref)
T2	31–34	116/163	0.85 (0.66–1.10)	0.87 (0.67–1.13)	0.87 (0.66–1.13)
T3	35–46	116/169	0.77 (0.59–1.00)	0.81 (0.62–1.07)	0.82 (0.62–1.08)
p trend			.05	.15	.16
DASH Diet Score					
T1	3.0–3.5	168/215	1.0 (Ref)	1.0 (Ref)	1.0 (Ref)
T2	4.0–4.5	108/138	0.90 (0.70–1.15)	0.93 (0.73–1.20)	0.93 (0.71–1.20)
T3	5.0–8.5	105/162	0.70 (0.55–0.91)	0.71 (0.55–0.92)	0.76 (0.58–0.99)
p trend			.01	.01	.05

Notes: Cox-Proportional hazard model was used. DASH = Dietary Approaches to Stop Hypertension; MIND = Mediterranean–DASH Diet Intervention for Neurodegenerative Delay; T1 = tertile 1; T2 = tertile 2; T3 = tertile 3.

[†]Model 1 adjusted for age, sex, education, smoking, physical activity, and total calories. [‡]Model 2 adjusted for Model 1 + body mass index + depressive symptoms. [§]Model 3 adjusted for Model 1 + cardiovascular conditions (including diabetes, hypertension, stroke, and myocardial infarction).

ADL disability remained in analyses where we adjusted for these potential mediators suggesting that nonvascular mechanisms also play a role. Interestingly, findings of an inverse association for the MIND and Mediterranean diets on IADL disability became weaker with adjustment for these factors thus indicating vascular mechanisms may be involved.

The MIND diet was created to focus on foods and nutrients that have compelling scientific evidence for brain health in various prospective studies and animal models. In previous studies, higher MIND diet scores were associated with a slower decline in cognitive abilities (12) and reduced risk of Alzheimer's disease (13). Previous studies from the MAP cohort have found that cognitive and motor functions share common risk factors and similar brain pathologies, suggesting that they have common underlying pathophysiology (26). Thus, diet may be a modifiable risk factor for both cognition and motor function in aging.

In our previous studies, the MIND diet associations with cognitive decline and Alzheimer's risk appeared to be stronger than either the Mediterranean or DASH diets (12,13). In the present analysis, we also report that moderate or high adherence to the MIND diet is associated with decreased risk of disability, whereas only the high concordance to the Mediterranean and DASH diets resulted in statistically significant reductions in disability. We speculate that it is the MIND diet focus on brain-healthy foods that accounts for the MIND diet associations with motor and cognitive function with even moderate adherence. Weekly consumption of berries and almost daily consumption of green leafy vegetables are two specified foods in the MIND diet. Berry consumption was reported to enhance motor performance (balance and coordination) in mice (27) and marginally improve gait speed and total steps error in older adults (28). In the recent analysis, green leafy vegetables were found to be associated with slower cognitive decline (29). Our findings are supported by another study of older adults that reported at least one serving of fruit or vegetables per day was associated with lower risk of disability (3). The MIND, Mediterranean, and DASH diets are all plant-based, and as such, they are rich in various vitamins that are reported to be associated with disability at the systemic level. For example, higher plasma carotenoid levels (abundant in various vegetable and fruits) were found to be associated with reduced walking disability (30) and frailty (31), and higher serum levels of vitamin E (high in vegetable oils, nuts, and whole grains) were associated with lower risk of frailty (32).

Some of the important strengths of our study include its longitudinal design with 12 years of follow-up, the community-based cohort, dietary assessments with a comprehensive, validated questionnaire for older adults, and repeated annual assessment of disability. Limitations of the study include the nondiverse study population that limits the generalizability of these results to non-Hispanic, black older adults and its observational design that prevents establishing causality between diet and disability.

The prevalence of disability in the aging population is increasing and contributes to the lower quality of life and substantial economic burden. As there are limited known modifiable risk factors for functional disability, considering healthy dietary patterns for older adults may have a great public health impact.

Supplementary Material

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

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Conflict of Interest Disclosures

Authors have no disclosures to report.

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