Vitamin B-6 intake is related to physical performance in European older adults: results of the New Dietary Strategies Addressing the Specific Needs of the Elderly Population for Healthy Aging in Europe (NU-AGE) study

Pol Grootswagers,[1,2] Marco Mensink,[2] Agnes AM Berendsen,[2] Carolien PJ Deen,[3] Ido P Kema,[3] Stephan JL Bakker,[4] Aurelia Santoro,[5] Claudio Franceschi,[5,6,7] Nathalie Meunier,[8] Corinne Malpuech-Brugère,[9] Agata Bialecka-Debek,[10] Katarzyna Rolf,[10] Susan Fairweather-Tait,[11] Amy Jennings,[11] Edith JM Feskens,[2] and Lisette CPGM de Groot[2]

[1]TI Food and Nutrition, Wageningen, Netherlands; [2]Division of Human Nutrition and Health, Wageningen University, Wageningen, Netherlands; [3]Department of Laboratory Medicine, University of Groningen, University Medical Center Groningen, Groningen, Netherlands; [4]Department of Internal Medicine, University of Groningen, University Medical Center Groningen, Groningen, Netherlands; [5]Department of Experimental, Diagnostic, and Specialty Medicine and CIG Interdepartmental Center "L. Galvani," Alma Mater Studiorum, University of Bologna, Bologna, Italy; [6]Department of Experimental, Diagnostic, and Specialty Medicine, Alma Mater Studiorum, University of Bologna, Bologna, Italy; [7]Department of Applied Mathematics, Institute of Information Technology, Mathematics, and Mechanics, Lobachevsky State University of Nizhny Novgorod–National Research University, Nizhny Novgorod, Russia; [8]CHU Clermont-Ferrand, CRNH Auvergne, Clermont-Ferrand, France; [9]Université Clermont Auvergne, INRA, UNH, Unité de Nutrition Humaine, CRNH Auvergne, F-63000 Clermont-Ferrand, France; [10]Department of Human Nutrition, Warsaw University of Life Sciences–SGGW, Warsaw, Poland; and [11]Department of Nutrition and Preventive Medicine, Norwich Medical School, University of East Anglia, Norwich, United Kingdom

ABSTRACT

Background: Maintenance of high physical performance during aging might be supported by an adequate dietary intake of niacin, vitamins B-6 and B-12, and folate because these B vitamins are involved in multiple processes related to muscle functioning. However, not much is known about the association between dietary intake of these B vitamins and physical performance.

Objectives: The objectives of this study were to investigate the association between dietary intake of niacin, vitamins B-6 and B-12, and folate and physical performance in older adults and to explore mediation by niacin status and homocysteine concentrations.

Methods: We used baseline data from the New Dietary Strategies Addressing the Specific Needs of the Elderly Population for Healthy Aging in Europe (NU-AGE) trial, which included $n = 1249$ healthy older adults (aged 65–79 y) with complete data on dietary intake measured with 7-d food records and questionnaires on vitamin supplement use and physical performance measured with the short physical performance battery and handgrip dynamometry. Associations were assessed by adjusted linear mixed models.

Results: Intake of vitamin B-6 was related to lower chair rise test time [β: –0.033 ± 0.016 s (log); $P = 0.043$]. Vitamin B-6 intake was also significantly associated with handgrip strength, but for this association, a significant interaction effect between vitamin B-6 intake and physical activity level was found. In participants with the lowest level of physical activity, higher intake of vitamin B-6 tended to be associated with greater handgrip strength (β: 1.5 ± 0.8 kg; $P = 0.051$), whereas in participants in the highest quartile of physical activity, higher intake was associated with lower handgrip strength (β: –1.4 ± 0.7 kg; $P = 0.041$). No evidence was found for an association between intake of niacin, vitamin B-12, or folate and physical performance or for mediation by niacin status or homocysteine concentrations.

Conclusions: Vitamin B-6 intake was associated with better chair rise test time in a population of European healthy older adults and also with greater handgrip strength in participants with low physical activity only. Homocysteine concentrations did not mediate these associations. The NU-AGE trial was registered at clinicaltrials.gov as NCT01754012. *Am J Clin Nutr* 2021;00:1–9.

Keywords: muscle, physical function, homocysteine, niacin, vitamin B-6, vitamin B-12, folate

Introduction

Life expectancy has been steadily increasing during the past 200 y (1). However, the extra years of life are often lived in poor health. To age more healthily, older adults need to maintain a high level of physical performance in daily life because this is related to increased independence and a higher quality of life (2). Furthermore, high physical performance reduces chances of hospitalization (3), cognitive decline (4), and mortality (5). B vitamins have been suggested to protect against age-related physical decline (6). However, the exact role of B vitamin intake in relation to physical performance in older adults is unknown, and evidence for associations is scarce.

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B vitamins play an important role in at least 3 mechanisms related to physical performance. First, intake of vitamins B-6, B-12, and folate reduces homocysteine concentrations (7). High concentrations of homocysteine induce inflammation and decrease neurological functioning, which might lead to decreased physical performance (8). This is in line with multiple studies that have shown that homocysteine concentrations are inversely associated with quadriceps strength (9), chair rise test performance (10), and gait speed (10–12). Second, niacin, vitamins B-6 and B-12, and folate contribute to the functioning of mitochondria (13). Mitochondrial functioning is impaired by elevated homocysteine concentrations (14). Thus, lowering intracellular homocysteine concentrations by adequate vitamin B-6, vitamin B-12, and folate intakes may improve mitochondrial functioning, which can benefit physical performance (15). In addition, dietary intake of niacin (and its precursor tryptophan) can lead to increased concentrations of NAD (16). Increasing NAD concentrations by pharmacological agents has been shown to be an effective intervention to improve mitochondrial functioning in humans (17). In mice, long-term administration of an NAD precursor reduced age-related physiological decline (18). Third, B vitamins may preserve muscle quality via their antioxidant properties (19) and by improving neuromuscular functioning (6). Taken together, B vitamins may contribute to physical performance via suppressing homocysteine concentrations, improving mitochondrial functioning, and preserving muscle quality.

Despite these indications of an important role of B vitamin intake in relation to physical performance, only 2 observational studies have investigated this association, within the same cohort. These studies showed that adequate intake of vitamin B-6, vitamin B-12, and folate led to lower risk of impaired mobility (20) and frailty (21). In these 2 studies, dietary intake was assessed via the dietary history method, and level of physical performance was self-reported. In this article, we report the results of our investigation of the association between objectively measured physical performance, as measured by handgrip strength, walking speed, and chair rise test, and dietary intake, as measured by detailed 7-d food records, in a large European cohort of older adults. In addition, we explore potential mediation by homocysteine concentrations and niacin status.

Methods

Study design

We used baseline data from the New Dietary Strategies Addressing the Specific Needs of the Elderly Population for Healthy Aging in Europe (NU-AGE) study for this analysis. The NU-AGE study is a dietary intervention trial that was performed in 5 centers in different European countries (France, Italy, the Netherlands, Poland, and the United Kingdom). It is registered at clinicaltrials.gov under NCT01754012. The study design and participant recruitment have been described in detail elsewhere (22, 23). In summary, 2668 apparently healthy, community-dwelling older adults (aged 65–79 y) were recruited for the trial, of which 1518 attended the screening and 1296 eligible participants were included (for flowchart, see **Supplemental Figure 1**). The primary outcome of the NU-AGE trial was the change in C-reactive protein after 1 y of dietary intervention. For this study, we used data obtained before the start of the dietary intervention of 1249 participants who completed the baseline dietary intake assessment.

Dietary intake

Dietary intake was assessed through 7-d food records. Before the measurement period, participants were trained in describing foods, portion sizes, preparation methods, complex recipes, and overall level of detail (24, 25). Participants reported portion sizes in relation to national household measures, pictures, or as measured in grams or millimeters. Dietitians or research nutritionists, who were trained in a standardized way to reduce between-center variation, reviewed the level of detail of the completed food records during a home visit (in the Netherlands and United Kingdom) or at the research center (Poland, Italy, and France). Food records were coded according to standardized coding procedures. Nutrient content was calculated by using local food composition tables [NEVO 2011 in the Netherlands (26), McCance and Widdowson in the UK (27), INRAN and BDA in Italy (28, 29), NFNI in Poland (30), and CIQUAL French food composition table in France (31)]. Participants from the French center were excluded for vitamin B-12 analyses due to unreliable intake data for this vitamin. Supplementary vitamin B intake was assessed by means of an additional questionnaire, and participants using vitamin B–containing supplements were identified and excluded from a sensitivity analysis. Niacin equivalents were calculated as follows: niacin (mg)   [tryptophan (mg)/60]. Tryptophan intake was estimated from total protein intake by assuming an average abundance of 1.1% (32).

Physical performance

Physical performance was measured at all centers by the Short Physical Performance Battery (SPPB) and handgrip strength. The SPPB was performed following the protocol described by Guralnik et al. (33) and consisted of a 2.44-m usual gait speed test, a balance test in 3 foot positions of increasing difficulty, and a 5-time chair rise test. Handgrip strength was measured by dynamometry (Scandidact Smedley's Hand Dynamometer) to the nearest 0.1 kg, in standing position with the arm flexed at $90°$.

For each hand, the maximum value of 3 repetitions was used for analysis. The measurements of physical performance were standardized over the 5 centers. The standardization was done by joint training sessions in Warsaw and Wageningen, where representatives from all 5 centers were present. Physical activity was expressed in Physical Activity Scale for Elderly (PASE) questionnaire-based PASE scores (34). These questionnaires were self-administered and checked by a researcher.

Biochemical analyses

Urine samples were collected during day 7 of the dietary intake assessment, which was 1 d prior to physical performance assessment. Participants were instructed to discard the first urine of the day and to collect all following urine, including the first urine of the second day, in standard containers that contained 2.7 mL of 1% sodium azide solution. Total urine volume was recorded, and urine was aliquoted in cryovials and stored at –80°C until analysis. Urinary N^1-methylnicotinamide (NMN) and N-methyl-2-pyridone-carboxamide (2-Pyr) concentrations were measured at University Medical Centrum Groningen, the Netherlands, by the validated LC (Luna HILIC column; Phenomenex) isotope dilution MS/MS method (Quattro Premier; Waters), as described previously (35). The sum of the 2 metabolite concentrations was multiplied by total 24-h urine volume to obtain 24-h urinary niacin metabolite excretion, which is considered a biomarker of niacin status (36).

Plasma homocysteine concentrations were assessed by the enzymatic method (Olympus AU400 chemistry analyzer; Beckman) in the Nigrisoli hospital in Bologna, Italy, as described previously (37).

Statistical analysis

For descriptive purposes, energy-adjusted tertiles of the 4 vitamins (niacin, B-6, B-12, and folate) were created using the residual method (38). Descriptive statistics are presented as means ± SDs for normally distributed values and as medians (25th–75th percentile) for skewed variables. Skewed outcome variables (walk time and chair rise test time) were log transformed. All analyses were performed using SAS software version 9.4 (SAS Institute).

Associations between intake of B vitamins and measures of physical performance were assessed via mixed linear models. Continuous, unadjusted measures of the B vitamins were used as exposure, and energy adjustment was performed via adding energy intake to the model. Possible effect modification by physical activity level was tested by adding the interaction term exposure∗physical activity to the model. The interaction model was used when the interaction model showed an improved model fit over the model without interaction term, as concluded from likelihood ratio tests using maximum likelihood estimation (39).

Three models of increasing complexity were built to adjust for confounding factors. The first model only adjusted for age and sex. The second model additionally adjusted for energy intake, drinking status (non, light, or heavy), smoking status (never, former, or current), education level (low, medium, or high), and physical activity level. The third model additionally adjusted for protein intake and study center. Adjustment for study center was performed by including study center as a random factor in a random intercept model.

Additional analyses were done to test for a possible mediating effect of niacin metabolites in the niacin–physical function relation and for homocysteine concentrations in the vitamin B-6, vitamin B-12, folate–physical performance relation. We calculated a normalized combined vitamin score for vitamin B-6, vitamin B-12, and folate by dividing all values by the mean intake of the specific vitamin and summing up those values. For example, if a participant had an intake around the mean for vitamin B-6, vitamin B-12, and folate, the combined score for this participant was ~3. We followed the mediation analysis method described by Preacher and Hayes (40) and concluded that there was no evidence for mediation when the potential mediator was not associated with either exposure or outcome. Associations between mediator and exposure or outcome were performed by using the fully adjusted models.

We performed 2 sensitivity analyses. The first sensitivity analysis was performed to assess the influence of possible under- or overreporters of energy intake. For this analysis, we excluded participants with a daily average energy intake outside the 500- to 4000-kcal range and participants with an energy intake to basal metabolic rate [estimated by Schofield's equation (41)] ratio outside the 0.8—2.66 range. In the newly created data set, we reran the programs of the second and third models and compared outputs. The second sensitivity analysis excluded participants using vitamin B–containing supplements.

Results

Participants ($n = 1249$) had a mean age of 71 ± 4 y, and 56% were women (**Table 1**). The study population had a high level of physical functioning, with a median SPPB score of 12. Measures of physical performance were similar over the 5 centers, except for high handgrip strength in participants from the United Kingdom, even despite the higher female proportion in this center. The UK participants also showed higher scores on the PASE questionnaire and had the highest intakes of niacin, vitamin B-6, and vitamin B-12. Participants from France had the highest daily average energy and protein intake but the lowest BMI. On the other hand, participants from Italy had the lowest average daily intake of energy, protein, and vitamin B-12 and the lowest score on the PASE questionnaire. In the Netherlands, participants had the lowest intake levels of 3 out of 4 B vitamins: niacin, vitamin B-6, and folate.

Characteristics of the participants per energy-adjusted tertiles of niacin, vitamin B-6, folate, or vitamin B-12 intake are presented in **Table 2**. Apart from folate intake, the gender distribution was similar in all 3 tertiles. For folate intake, a higher proportion of men was observed in the first tertile compared with the other tertiles. Participants with higher folate intake were more likely to have a lower body weight and handgrip strength, whereas participants with higher intake of niacin, vitamin B-6, and vitamin B-12 were more likely to have higher body weight and handgrip strength. Other measures of physical performance were similar in the different tertiles of all the vitamins. Participants with lower intakes of vitamin B-6, vitamin B-12, and folate were more likely to have fewer years of education. Low-folate consumers were more often heavy drinkers (≥14 units per week),

TABLE 1 Baseline characteristics of the total study sample and per study center[1]

	Total (n = 1249)	Italy (n = 273)	United Kingdom (n = 272)	The Netherlands (n = 252)	Poland (n = 251)	France (n = 201)
Gender, % female	56	52	64	56	57	50
Age, y	70.9 ± 4.0	71.7 ± 3.9	70.1 ± 4.0	71.0 ± 4.0	71.4 ± 3.8	71.2 ± 3.9
Height, cm	166 ± 9	164 ± 10	166 ± 9	169 ± 8	164 ± 9	166 ± 9
Weight, kg	73.6 ± 13.4	73.0 ± 12.6	74.0 ± 13.7	74.6 ± 13.2	75.3 ± 14.2	70.1 ± 12.6
BMI, kg/m^2	26.7 ± 4.0	27.2 ± 3.9	26.8 ± 4.1	26.0 ± 3.6	28.0 ± 4.2	25.4 ± 3.5
Diabetes, %	5	6	3	4	8	4
Hypertension, %	41	49	29	33	61	33
Hypercholesterolemia, %	33	48	22	25	38	31
Osteoporosis, %	12	12	4	10	20	13
Smoker, % never/former/current	53/42/5	44/49/7	60/38/2	51/46/3	49/44/7	66/31/3
Drinker,[2] % non/light/heavy	17/71/11	31/53/16	10/82/9	13/72/15	21/55/24	10/71/18
Education,[3] low/medium/high	13/52/35	39/39/22	1/83/16	13/56/31	1/28/71	11/53/36
PASE score	133 ± 55	113 ± 50	149 ± 53	137 ± 53	131 ± 62	133 ± 52
Homocysteine, μmol/L	12.6 ± 4.3	14.5 ± 4.2	12.8 ± 3.8	11.1 ± 3.0	12.5 ± 5.2	11.9 ± 4.2
Niacin intake,[4] mg/d	17.0 (13.9–20.7)	17.2 (13.7–20.9)	18.4 (15.6–22.2)	15.7 (13.3–18.6)	17.0 (13.4–21.3)	16.5 (13.7-20.0)
Vitamin B-6 intake, mg/d	1.8 ± 0.6	1.6 ± 0.5	2.0 ± 0.6	1.6 ± 0.5	2.0 ± 0.7	1.7 ± 0.4
Folate intake, μg/d	290 ± 97	271 ± 106	309 ± 96	255 ± 71	297 ± 98	323 ± 93
Vitamin B-12 intake,[4] μg/d)	4.3 (3.0–6.3)	2.7 (1.9–4.1)	5.9 (4.5–7.8)	4.3 (3.4–5.6)	4.1 (2.9–6.3)	NA
Protein intake, g/d	75 ± 18	67 ± 14	77 ± 16	76 ± 16	77 ± 22	81 ± 17
Energy intake, kcal/d	1864 ± 445	1711 ± 381	1895 ± 382	1908 ± 411	1822 ± 512	2026 ± 484
B supplement users, %	19	15	20	26	21	11
Dominant handgrip strength, kg	31.5 ± 9.5	30.9 ± 9.7	34.5 ± 9.0	30.5 ± 9.2	30.3 ± 9.8	31.0 ± 8.8
Total SPPB score[4]	12 (11–12)	12 (11–12)	12 (11–12)	12 (11–12)	12 (11–12)	12 (11–12)
Repeated chair rise time, s	10.3 ± 2.8	10.3 ± 2.9	10.6 ± 2.8	10.0 ± 2.7	10.2 ± 2.7	10.3 ± 2.6
Time to walk 2.44 m, s	2.4 ± 0.6	2.3 ± 0.6	2.3 ± 0.6	2.5 ± 0.5	2.5 ± 0.6	2.6 ± 0.5

[1]Values are means ± SDs unless stated otherwise. NA, not applicable; PASE, Physical Activity Scale for the Elderly; SPPB, Short Physical Performance Battery.

[2]Light drinker, 1–14 units per week; heavy drinker, ≥14 units per week.

[3]Low, 0–8 y; medium, 9–13 y, high, ≥14 y.

[4]Median (IQR).

whereas low-B-12 consumers were more often nondrinkers. Participants with higher intake of any of the 4 vitamins consumed more protein and more of the other 3 B vitamins. Significant correlations were observed for the 6 pairs of B vitamins, ranging from $r = 0.22$ for the correlation between intake of niacin and vitamin B-12 to $r = 0.61$ for the correlation between intake of vitamin B-6 and folate. Participants with a high intake of folate or vitamin B-12 were more likely to have lower homocysteine concentrations.

Table 3 presents the associations between intake of the 4 B vitamins and measures of physical performance. Intake of vitamin B-6 was related to improved chair rise test time [β: -0.033 ± 0.016 s (log); $P = 0.043$], translating to a 3.2% lower chair rise time per milligram higher vitamin B-6 intake. Niacin and vitamin B-6 intakes were significantly and positively associated with handgrip strength. However, for these associations, there was a significant interaction between vitamin intake and physical activity level. In participants with the lowest level of physical activity, intake of vitamin B-6 tended to be positively associated with handgrip strength (**Table 4**; β: 1.5 ± 0.8 kg; $P = 0.051$], whereas the associations were negative in participants with the highest level of physical activity (β: -1.4 ± 0.7 kg; $P = 0.041$; interaction effect: $P = 0.003$). There were no significant associations between niacin intake and handgrip strength at any physical activity level. Participants in the highest physical activity quartile had a higher handgrip strength

compared with those in the lowest physical activity quartile (: 4.4 ± 0.7 kg; $P < 0.0001$; **Supplemental Table 1**). They also had a higher intake level of total energy (: 170 ± 37 kcal; $P < 0.0001$), protein (: 6 ± 1 g; $P < 0.0001$), and vitamin B-6 (: 0.2 ± 0.0 mg; $P < 0.001$) but not niacin (: 0.5 ± 0.5 mg; $P = 0.309$).

Results of mediation analyses are presented in **Supplemental Table 2.** Combined normalized intake of vitamin B-6, vitamin B-12, and folate was related to lower homocysteine concentrations in the fully adjusted model ($P = 0.003$). A higher intake of each of the vitamins was related to lower homocysteine concentrations (β vitamin B-6: -0.46 ± 0.26 μmol/L, $P = 0.084$; β folate: -0.003 ± 0.001 μmol/L, $P = 0.056$; and β vitamin B-12: -0.08 ± 0.03 μmol/L, $P = 0.024$). However, homocysteine concentrations were not related to handgrip strength, walk time, or repeated chair rise test time ($P > 0.10$ for all outcomes).

Intake of niacin equivalents was associated with total urinary niacin metabolites (β: 0.53 ± 0.26 μmol/L; $P = 0.045$). Intake of niacin by itself was not associated with the niacin metabolites (β: 0.48 ± 0.33 μmol/L; $P = 0.147$). The sum of the urinary metabolites was not associated with handgrip strength, walking time, or chair rise test ($P > 0.30$ for all outcomes).

Excluding energy misreporters ($n = 28$ underreporters, $n = 0$ overreporters) resulted in an attenuated, but still significant, association between vitamin B-6 intake and handgrip strength (with effect modification by physical activity level) and attenuation to

TABLE 2 Baseline characteristics per tertile of B vitamin intake[1]

	Niacin			Vitamin B-6			Folate			Vitamin B-12		
	Tertile 1	Tertile 2	Tertile 3	Tertile 1	Tertile 2	Tertile 3	Tertile 1	Tertile 2	Tertile 3	Tertile 1	Tertile 2	Tertile 3
n	415	417	417	416	417	416	416	417	416	349	350	349
Gender, % female	57	60	52	55	57	56	47	62	59	54	61	57
Age, y	71 ± 4	71 ± 4	71 ± 4	71 ± 4	71 ± 4	71 ± 4	71 ± 4	71 ± 4	71 ± 4	71 ± 4	71 ± 4	71 ± 4
Height, cm	166 ± 9	165 ± 9	166 ± 9	166 ± 9	165 ± 10	166 ± 9	167 ± 9	165 ± 9	165 ± 9	165 ± 9	165 ± 9	166 ± 9
Weight, kg	71.9 ± 12.5	73.4 ± 13.8	75.4 ± 13.7	72.8 ± 12.8	73.9 ± 13.8	74.0 ± 13.6	75.8 ± 12.9	72.8 ± 13.8	72.1 ± 13.3	73.4 ± 12.8	73.0 ± 13.3	76.2 ± 14.1
BMI, kg/m²	26.1 ± 3.5	26.8 ± 4.1	27.4 ± 4.1	26.3 ± 3.6	27.0 ± 4.0	26.9 ± 4.2	27.0 ± 3.6	26.8 ± 4.2	26.4 ± 3.9	26.9 ± 3.8	26.6 ± 3.9	27.5 ± 4.2
Diabetes, %	4	4	7	3	5	7	7	2	6	7	4	4
Hypertension, %	35	42	46	36	44	44	44	41	39	44	40	44
Hypercholesterolemia, %	29	32	38	31	31	37	33	32	34	36	31	33
Osteoporosis, %	16	10	9	14	11	10	10	14	12	14	13	8
Smoker, % never/former/current	60/37/3	53/44/3	47/46/7	55/40/2	52/44/4	53/43/4	47/46/7	59/38/3	54/42/4	50/43/7	49/46/4	53/44/3
Drinker;[2] % non/light/heavy	19/63/18	18/68/14	15/67/17	17/63/21	16/69/14	19/67/14	16/64/20	17/69/14	20/66/14	29/55/16	14/70/17	14/71/15
Education,[3] low/medium/high	13/52/35	15/48/37	12/56/32	18/46/36	15/53/32	8/57/35	18/52/30	12/52/36	11/52/37	23/46/31	11/51/37	7/58/34
PASE score	134 ± 54	131 ± 56	133 ± 56	133 ± 58	129 ± 53	137 ± 55	131 ± 56	133 ± 55	134 ± 56	124 ± 59	135 ± 50	139 ± 58
Homocysteine, μmol/L	12.9 ± 4.7	12.5 ± 4.2	12.5 ± 3.8	12.8 ± 4.3	12.6 ± 4.6	12.4 ± 3.8	13.1 ± 4.4	12.3 ± 4.3	12.4 ± 3.9	13.9 ± 4.7	12.1 ± 4.0	12.2 ± 3.7
Niacin intake,[4] mg/d	13.1 (11.1–14.9)	16.7 (14.9–18.6)	22.1 (19.7–25.8)	14.5 (12.1–17.7)	16.5 (14.0–19.6)	20.2 (17.1–24.4)	16.0 (13.1–19.2)	16.1 (13.4–19.2)	19.3 (15.7–23.4)	15.9 (12.9–19.5)	16.4 (13.5–19.9)	18.6 (15.7–22.3)
Vitamin B-6 intake, mg/d	1.5 ± 0.4	1.7 ± 0.4	2.2 ± 0.6	1.4 ± 0.3	1.7 ± 0.3	2.3 ± 0.6	1.6 ± 0.5	1.7 ± 0.5	2.1 ± 0.6	1.7 ± 0.5	1.8 ± 0.6	2.0 ± 0.6
Folate intake, μg/d	264 ± 82	281 ± 91	323 ± 106	248 ± 77	278 ± 82	342 ± 104	208 ± 49	274 ± 43	387 ± 87	272 ± 102	271 ± 78	307 ± 103
Vitamin B-12 intake,[4] μg/d	3.8 (2.6–5.2)	4.2 (2.9–5.9)	4.9 (3.5–8.0)	3.8 (2.5–5.2)	4.2 (3.0–6.0)	4.9 (3.5–7.6)	4.0 (2.6–5.7)	4.3 (3.1–6.1)	4.7 (3.1–7.5)	2.5 (1.9–3.2)	4.2 (3.6–4.8)	7.5 (6.1–10.0)
Protein intake, g/d	71 ± 16	74 ± 15	81 ± 20	71 ± 16	74 ± 16	81 ± 20	73 ± 17	74 ± 16	79 ± 19	69 ± 17	73 ± 15	81 ± 19
Energy intake, kcal/d	1901 ± 457	1815 ± 414	1876 ± 458	1912 ± 461	1815 ± 417	1865 ± 450	1882 ± 463	1833 ± 419	1877 ± 450	1849 ± 448	1777 ± 398	1873 ± 437
B supplement users, %	21	20	18	18	18	22	14	22	21	18	24	20
Dominant handgrip strength, kg	30.8 ± 9.3	31.2 ± 9.4	32.5 ± 9.6	30.8 ± 9.5	31.4 ± 9.3	32.2 ± 9.6	32.6 ± 9.7	30.8 ± 9.0	31.1 ± 9.6	31.0 ± 9.8	30.7 ± 9.1	33.1 ± 9.7
Total SPPB score[4]	12 (11–12)	12 (11–12)	12 (11–12)	12 (11–12)	12 (11–12)	12 (11–12)	12 (11–12)	12 (11–12)	12 (11–12)	12 (11–12)	12 (11–12)	12 (11–12)
Repeated chair rise time, s	10.3 ± 2.9	10.3 ± 2.5	10.2 ± 2.8	10.2 ± 2.5	10.5 ± 3.1	10.2 ± 2.7	10.3 ± 2.6	10.4 ± 3.0	10.2 ± 2.7	10.2 ± 2.9	10.4 ± 2.7	10.2 ± 2.7
Time to walk 2.44 m, s	2.5 ± 0.6	2.5 ± 0.6	2.4 ± 0.5	2.5 ± 0.5	2.5 ± 0.6	2.4 ± 0.5	2.4 ± 0.5	2.5 ± 0.6	2.4 ± 0.4	2.4 ± 0.6	2.4 ± 0.6	2.4 ± 0.6

[1] Values are means ± SDs unless stated otherwise. PASE, Physical Activity Scale for the Elderly; SPPB, Short Physical Performance Battery.

[2] Light drinker, 1–14 units per week; heavy drinker, ≥14 units per week.

[3] Low, 0–8 y; medium, 9–13 y; high, ≥14 y.

[4] Median (IQR).