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Dairy Foods and Risk of Stroke

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Abstract

Background—Consumption of milk and other dairy foods has been inconsistently associated with risk of stroke. We examined the association between dairy food intake and risk of stroke subtypes within the Alpha-Tocopherol, Beta-Carotene Cancer Prevention Study.

Methods—Between 1985 and 1988, 26,556 Finnish male smokers aged 50–69 years who had no history of stroke completed a food frequency questionnaire. We used Cox proportional hazards models to estimate relative risks (RR) and 95% confidence intervals (CI), adjusted for potential confounders.

Results—During a mean follow-up of 13.6 years, 2702 cerebral infarctions, 383 intracerebral hemorrhages, and 196 subarachnoid hemorrhages were ascertained. We observed positive associations between whole milk intake and risk of intracerebral hemorrhage (RR = 1.41 for the highest versus lowest quintile of intake; 95% CI = 1.02–1.96) and between yogurt intake and subarachnoid hemorrhage (RR = 1.83 for the highest versus lowest quintile of intake; 95% CI = 1.20–2.80). Men in the highest quintile of cream intake had a modest decreased risk of cerebral infarction (RR = 0.81; 95% CI = 0.72–0.92) and intracerebral hemorrhage (RR = 0.72; 95% CI = 0.52–1.00). There were no strong associations between intakes of total dairy, low fat milk, sour milk, cheese, ice cream, or butter and risk of any stroke subtype.

Conclusions—These findings suggest that intake of certain dairy foods may be associated with risk of stroke.

Keywords

dairy; diet; epidemiology; milk; prospective studies; stroke

Dairy consumption has been inversely associated with blood pressure in some observational studies,[1, 2] and hypertension is a potent risk factor for stroke.[3] Low-fat dairy foods are one of the main components of the Dietary Approaches to Stop Hypertension (DASH) diet, which has been shown to lower blood pressure.[4] Dairy consumption has also been inversely related to the insulin resistance syndrome,[1, 5, 6] which may be a risk factor for stroke.[7, 8] However, prospective studies on milk and total dairy intake in relation to stroke incidence or mortality have produced inconsistent results.[9–13] Most previous studies had a small number

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of cases[9–11] and did not distinguish stroke subtypes.[9, 10, 12] Moreover, there is a paucity of prospective data on dairy foods other than milk in relation to stroke incidence.[10]

We therefore prospectively evaluated the relation between intake of total dairy and specific dairy foods and the risk of stroke subtypes among Finnish male smokers participating in the Alpha-Tocopherol, Beta-Carotene Cancer Prevention (ATBC) Study.

METHODS

Study Population

The ATBC Study was a randomized, double-blind, placebo-controlled, primary prevention trial that was originally designed to test whether alpha-tocopherol (50 mg/day), beta-carotene (20 mg/day) or both could reduce cancer incidence in male smokers.[14] The cohort consists of 29,133 men, aged 50 to 69 years, who resided in southwestern Finland and smoked five or more cigarettes per day at baseline. Participants were recruited into the trial between 1985 and 1988 and the trial ended in April 1993, with registry-based follow-up continuing thereafter. Study eligibility was assessed before randomization; men who had prior cancer (other than nonmelanoma skin cancer or carcinoma *in situ*) or other serious illness that might limit long-term participation, as well as those who received anticoagulant therapy or used supplements containing vitamin E (>20 mg/d), vitamin A (>20 000 IU/d) or beta-carotene (>6 mg/d) were ineligible. Detailed information on dietary intake was provided by 26,556 (93%) of the randomized participants who had no history of stroke at baseline.

Written informed consent was obtained from each participant before randomization. The study was approved by the institutional review boards of the National Public Health Institute of Finland and the US National Cancer Institute.

Assessment of Diet

Dietary intake was assessed using a validated self-administered food frequency questionnaire that included 276 food items and mixed dishes commonly consumed in Finland.[15] The questionnaire was used with a portion-size color picture booklet of 122 photographs of foods, each with 3 to 5 different portion sizes. Participants were asked to report their average consumption and portion size for each food during the past year. Frequencies were reported as the number of times per month, week, or day. At the first visit, the questionnaire, together with the picture booklet, was given to the participant to be filled in at home. At the second baseline visit, 2 weeks later, the questionnaire was returned, and a trained nurse checked and completed it, spending on average 30 minutes interviewing the participant about possible discrepancies. Thereafter, a senior nutritionist reviewed centrally the questionnaire and decided on final approval. The questionnaire was rejected if the participant had not been involved in filling it, or if the consumption of certain foods exceeded preset reasonable limits. The questionnaire was satisfactorily completed by 27,111 participants (93 percent).

Intakes of dairy foods, in grams per day, were calculated by multiplying the frequency of intake of individual dairy items by their weights, estimated from the specified portion size. In the calculations, we also included intake of dairy foods from mixed dishes. The average daily intakes of individual dairy items were combined to compute intake of total dairy, including low-fat milk, whole milk, sour milk, yogurt, cheese, cream, ice cream, and butter.

The dietary method was validated in a pilot study carried out among 190 men before the study.[15] The men completed the food frequency questionnaire at the beginning and end of a six-month period, and they kept food consumption records for 24 days (2 × 12 days) in the interim period. The correlation between the dietary questionnaire and the food records was 0.7 for total dairy foods.[15]

Assessment of Nondietary Factors

At baseline, study participants provided information on general characteristics and medical, smoking, and physical activity histories.[14] Trained medical staff measured height, weight, and blood pressure using standard procedures. Body mass index (BMI) was calculated by dividing the measured weight in kilograms by the square of height in meters. A blood sample was obtained from participants after an overnight fast and serum was stored at −70°C. Serum total cholesterol and high-density lipoprotein (HDL) cholesterol levels were determined enzymatically (CHOD-PAP method, Boehringer Mannheim).

Ascertainment of Stroke

The study endpoint was first-ever stroke that occurred between the date of randomization and December 31, 2004. The strokes were further divided into cerebral infarction, intracerebral hemorrhage, subarachnoid hemorrhage and unspecified stroke. The endpoints were identified by record linkage with the National Hospital Discharge Register and the National Register of Causes of Death. Both registers used the codes of the *International Classification of Diseases* (ICD): the 8th edition was used until the end of 1986, the 9th edition through the end of 1996, and the 10th edition thereafter. The end points comprised ICD-8 codes 430–434 and 436, ICD-9 codes 430–431, 433–434 and 436, and ICD-10 codes I60, I61, I63, and I64, excluding ICD-8 codes 431.01 and 431.91 denoting subdural hemorrhage and ICD-9 codes 4330X, 4331X, 4339X, and 4349X representing occlusion or cerebral or precerebral artery stenosis without cerebral infarction. In a reviewed sample, the diagnoses of cerebral infarction, subarachnoid hemorrhage, and intracerebral hemorrhage proved correct by strict preset criteria[16, 17] in 90%, 79%, and 82% of the discharge diagnoses and in 92%, 95%, and 91% of the causes of death, respectively.[18]

Statistical Analysis

We computed person-time of follow-up for each participant from the date of randomization to the date of occurrence of first stroke, death from any cause, or December 31, 2004, whichever came first. When the risk estimates for a subtype of stroke were analyzed, the other subtypes were treated as censored. Participants were categorized into quintiles of dairy intake based on the distribution in the study population. Cox proportional hazards models were used to estimate relative risks (RR) and 95% confidence intervals (CI), with simultaneous adjustment for age at baseline, supplementation group, education, cardiovascular risk factors (number of cigarettes smoked per day, BMI, serum total cholesterol, serum HDL cholesterol, history of diabetes or coronary heart disease and leisure-time physical activity), and intakes of total energy, alcohol, caffeine, sugar, red meat, poultry, fish, fruit, fruit juices, vegetables, potatoes, whole grains, and refined grains. Baseline systolic and diastolic blood pressures were not included in the main model because of the suspected role of blood pressure as a mediator of the possible effect of dairy intake on stroke risk.

Tests of linear trend across quintiles of dairy intake were performed by assigning the median value to each quintile and modeling these values as a continuous variable. To assess possible effect modification, we conducted analyses stratified by age, cardiovascular risk factors, and supplementation group. The statistical significance of interactions was tested by including a cross product term of the dairy intake variable and the stratification variable. The statistical analyses were conducted with Stata software, version 9.2 (StataCorp, College Station, Texas). In the interpretation of the results, we focused on the point estimates and their 95% CIs, rather than on testing.

RESULTS

Baseline characteristics of the study population according to total dairy intake are presented in Table 1. The mean (± SD) daily intake of dairy foods was 788.6 g (± 403.5 g). Compared with men with a low dairy intake, those with a higher intake tended to have a slightly higher BMI, lower systolic blood pressure, higher intakes of total energy intake, red meat, potato, whole grains, and refined grains, and lower intakes of alcohol, poultry, and vegetables. Furthermore, men with a high dairy intake were somewhat more likely to have a history of diabetes.

During a mean follow-up of 13.6 years (360,187 person-years), 2702 cerebral infarctions, 383 intracerebral hemorrhages, 196 subarachnoid hemorrhages, and 84 unspecified strokes were ascertained. The associations between intakes of total dairy and individual dairy foods and risk of stroke are shown in Table 2. We observed no strong associations between total dairy intake and risk of any subtype of stroke. Additional adjustment for systolic and diastolic blood pressure had negligible impact on the results. The association between dairy intake and stroke risk was not modified by age, cardiovascular risk factors (alcohol intake, cigarettes/d, smoking years, BMI, hypertension, serum total cholesterol, serum HDL cholesterol, physical activity), or supplementation group (data not shown).

Among individual dairy foods, positive associations were observed between whole milk intake and risk of intracerabral hemorrhage (RR = 1.41 for highest versus lowest quintile; 95% CI = 1.02–1.96) and between yogurt intake and risk of subarachnoid hemorrhage (RR = 1.83 for highest versus lowest quintile; 95% CI = 1.20–2.80). For butter intake, the risk of intracerabral hemorrhage was moderately increased for men in the highest quintile compared with those in the lowest one (RR = 1.44; 95% CI = 1.01–2.07). Men in the highest quintile of cream intake had a modestly lower risk of cerebral infarction (RR = 0.81; 95% CI = 0.72–0.92) and intracerabral hemorrhage (RR = 0.72; 95% CI = 0.52–1.00) compared with those in the lowest quintile of cream intake. There were no strong associations between intake of low fat milk, sour milk, cheese, or ice cream and risk of any stroke subtype.

To assess whether the observed associations of whole milk, yogurt, and cream intake with stroke could be attributed to dairy-related nutrients such as calcium, phosphorus, potassium, magnesium, myristic acid (a marker of dairy fat), and vitamin D, we included these nutrients simultaneously with whole milk, yogurt, or cream in the model. Adjustment for these dairy-related nutrients did not appreciably change the results. For instance, the multivariate RR for comparison of the highest with the lowest quintile of cream intake was 0.80 (95% CI = 0.70–0.91) for cerebral infarction and 0.67 (95% CI = 0.48–0.94) for intracerabral hemorrhage.

DISCUSSION

In this prospective cohort of male smokers, with a high mean dairy intake, we found moderate positive associations between intake of whole milk and intracerabral hemorrhage and between yogurt intake and subarachnoid hemorrhage. In contrast, a high cream intake was associated with a modestly reduced risk of cerebral infarction and intracerabral hemorrhage (19% and 28% decrease in risk, respectively).

Some but not all previous prospective studies have reported inverse associations between milk or dairy intake and the risk of stroke. In a cohort study of 3150 men of Japanese ancestry living in Hawaii, with 22 years of follow-up, men who were nondrinkers of milk experienced stroke at twice the rate of men who consumed 16 oz/d or more.[9] In the Nurses' Health Study among 85,764 US women followed up for 14 years, a high intake of milk (≥2 cups/d) was associated with a moderately decreased risk of ischemic stroke (RR = 0.74; 95%

CI = 0.51–1.06).[10] In a Japanese cohort, milk intake was not associated with risk of stroke; however, men and women who consumed dairy almost daily had a 27% lower risk of stroke compared with those who never consumed dairy.[13] In the Caerphilly Cohort Study among 2512 British men followed up for 20–24 years, those who consumed 1 pint or more of milk per day had a 34% lower risk of ischemic stroke (RR = 0.66; 95% CI = 0.24–1.81) compared with those who never drank milk.[11] No association between milk intake and stroke was observed in a cohort of 5765 Scottish men.[12]

The association between dairy items other than milk and risk of stroke was examined in the Nurses' Health Study.[10] In that cohort study, an inverse association was observed between hard cheese intake and risk of ischemic stroke (RR = 0.63 for ≥1 time/d versus almost never consumption; 95% CI = 0.40–0.99) and weak inverse associations were found for intakes of yogurt (*P* for trend = 0.06) and ice cream (*P* for trend = 0.14). In our study, there were no strong associations between cheese and ice cream intakes and risk of stroke.

In the present study, a high intake of cream was inversely associated with risk of cerebral infarction and intracerabral hemorrhage and these associations remained when we controlled for dairy related nutrients, including calcium, potassium, phosphorus, magnesium, myristic acid, and vitamin D. This suggests that other factors in cream may account for the observed association. Cream is a rich source of conjugated linoleic acid (CLA). Some animal feeding studies showed that CLA improved plasma lipid profile[19] and inhibited progression and promoted the regression of atherosclerosis.[20, 21] The effect of CLA supplementation on blood lipid concentrations has been examined in several randomized trials, with inconsistent results. Some studies showed that CLA supplementation significantly reduced plasma triacylglycerol concentrations,[22] plasma total and low-density lipoprotein (LDL) cholesterol concentrations,[23] or the ratio of LDL to HDL cholesterol.[24] Other studies found no statistically significant effect on plasma lipid profile.[25, 26] Tricon et al.[27] reported that when purified *cis*-9,*trans*-11 (the principal form of CLA in dairy foods) and *trans*-10,*cis*-12 CLAs were supplemented to healthy men, they had divergent effects on blood lipid profile: *cis*-9,*trans*-11 CLA decreased the ratio of LDL to HDL cholesterol and total to HDL cholesterol, whereas *trans*-10,*cis*-12 CLA increased these ratios. CLA supplementation has also been demonstrated to significantly reduce fibrinogen concentrations.[24] Thus, the observed inverse association between cream intake and risk of cerebral infarction and intracerabral hemorrhage might be mediated through effects on the blood lipid profile and fibrinogen concentrations.

Major strengths of our study include its prospective design and the large number of stroke cases, which provided ample statistical power to detect associations. In addition, the extensive information on cardiovascular risk factors allowed comprehensive adjustment for potential confounders. Limitations of our study include the lack of generalizability, measurement error, and the range of dairy intake. Because our study population consisted entirely of older male smokers (a group at high risk of stroke), our findings may not be generalizable to nonsmokers or to women. Measurement error in the assessment of dietary intakes is inevitable and will have led to some misclassification of dairy intake and attenuated risk estimates. We only used dietary intake assessed at baseline, which may have contributed to misclassification because of changes in dairy intake during follow-up. Approximately 22% of the participants reported having stopped smoking during the trial but unfortunately we do not have smoking data for the whole follow-up of this study. However, residual confounding by smoking dose is unlikely in our study because the smoking exposures were not confounders and the relation between dairy intake and stroke risk was not modified by cigarettes smoked per day or by years of smoking. The range of dairy intake in our population may have been too narrow or may have been above or below a threshold needed to observe an association if one existed. The average intake of dairy foods in our population was quite high. The association between dairy foods and stroke may differ in populations with lower dairy intake.

In summary, results from this prospective cohort study in men suggest that intake of whole milk, yogurt, and cream may be associated with risk of stroke. The possible association between intake of specific dairy foods and stroke warrants further investigation.

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Abbreviations

CI	confidence interval
HDL	high-density lipoprotein
RR	relative risk

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TABLE 1

Baseline Characteristics by Quintiles of Total Dairy Intake Among 26,556 Men in the ATBC Study[*]

	Quintiles of total dairy intake				
	1	**2**	**3**	**4**	**5**
Median intake, g/d	286.5	560.4	756.2	968.0	1295.6
Age, years	57.2	57.7	57.9	57.9	57.4
Elementary school education, %	35.0	24.6	18.7	16.5	13.9
Smoking, cigarettes/d	20.7	20.3	19.8	20.1	21.2
Body mass index, kg/m^2	26.0	26.0	26.2	26.3	26.8
Systolic blood pressure, mm Hg	143.0	141.6	141.6	141.6	141.8
Diastolic blood pressure, mm Hg	88.2	87.5	87.4	87.4	87.6
Serum total cholesterol, mmol/L	6.22	6.27	6.27	6.23	6.21
Serum HDL cholesterol, mmol/L	1.21	1.20	1.19	1.18	1.19
Diabetes, %	5.2	5.4	5.7	6.2	6.5
History of heart disease, %	10.7	10.8	11.6	10.9	10.9
Physically active, %[†]	57.5	59.6	59.9	60.3	56.2
Daily intake					
Energy, kcal	2254	2410	2618	2848	3327
Alcohol, g	22.8	18.1	16.8	16.2	16.5
Caffeine, mg	553.8	561.6	551.0	555.8	565.5
Sugar, g	36.8	37.6	37.3	35.6	32.9
Red meat, g	69.3	68.2	70.5	72.3	76.5
Poultry, g	14.7	12.9	12.0	11.6	11.2
Fish, g	39.0	37.5	38.4	40.0	42.1
Fruits, g	92.5	90.0	92.8	92.3	96.1
Fruit juices, g	29.8	23.3	22.2	22.2	24.2
Vegetables, g[‡]	91.6	82.9	80.3	78.1	77.9
Potatoes, g	163.2	171.3	181.1	188.0	196.0
Whole grains, g	194.1	217.5	239.0	254.9	280.1
Refined grains, g	84.4	94.9	107.4	117.3	141.4

[*] All variables except age are standardized to the age distribution of the cohort. Values are means unless otherwise indicated.

†Moderate or heavy activity at leisure time.

‡Excludes potatoes and legumes.

TABLE 2

Multivariate Relative Risks* of Stroke Subtypes by Quintiles of Dairy Intake Among 26,556 Men in the ATBC Study, 1985–2004

Dairy Item by Quintile†	Median Intake (g/d)	Cerebral Infarction			Intracerebral Hemorrhage			Subarachnoid Hemorrhage		
		No. Cases	RR‡	95% CI‡	No. Cases	RR	95% CI	No. Cases	RR	95% CI
Total dairy										
Q1	286.5	491	1.00	Ref‡	77	1.00	Ref	33	1.00	Ref
Q2	560.4	574	1.23	1.09–1.39	83	1.19	0.86–1.63	37	1.13	0.70–1.83
Q3	756.2	535	1.10	0.97–1.25	73	1.06	0.76–1.48	37	1.13	0.69–1.84
Q4	968.0	574	1.22	1.07–1.39	77	1.21	0.86–1.71	39	1.12	0.68–1.86
Q5	1295.6	528	1.14	0.99–1.32	73	1.32	0.89–1.94	50	1.35	0.80–2.29
P for trend			0.12			0.19			0.30	
Low fat milk										
Q1	64.3	533	1.00	Ref	80	1.00	Ref	33	1.00	Ref
Q2	147.8	515	0.97	0.86–1.10	79	1.06	0.77–1.47	39	1.17	0.72–1.91
Q3	243.6	572	1.09	0.96–1.24	76	1.06	0.76–1.47	43	1.31	0.81–2.13
Q4	417.8	533	1.00	0.88–1.13	87	1.23	0.89–1.70	35	1.03	0.62–1.71
Q5	782.6	549	1.04	0.92–1.18	61	0.91	0.64–1.30	46	1.31	0.81–2.12
P for trend			0.60			0.62			0.48	
Whole milk										
Q1	0	1430	1.00	Ref	195	1.00	Ref	103	1.00	Ref
Q2	170.0	290	0.98	0.86–1.12	52	1.21	0.89–1.66	22	1.01	0.63–1.63
Q3	340.0	320	1.17	1.03–1.33	39	1.03	0.72–1.46	24	1.21	0.76–1.94
Q4	510.0	282	1.20	1.05–1.37	36	1.17	0.80–1.69	12	0.71	0.39–1.32
Q5	850.0	380	1.08	0.95–1.23	61	1.41	1.02–1.96	35	1.24	0.80–1.92
P for trend			0.04			0.05			0.50	
Sour milk										
Q1	0	760	1.00	Ref	117	1.00	Ref	48	1.00	Ref
Q2	15.7	466	1.07	0.95–1.20	72	1.07	0.80–1.45	32	1.12	0.711.75
Q3	73.7	486	0.97	0.86–1.09	70	0.93	0.691.25	41	1.23	0.80–1.88
Q4	183.3	496	1.10	0.98–1.24	64	0.92	0.67–1.25	35	1.20	0.76–1.87
Q5	412.1	494	0.99	0.89–1.12	60	0.80	0.59.1.10	40	1.25	0.81–1.92

Dairy Item by Quintile[†]	Median Intake (g/d)	Cerebral Infarction No. Cases	RR[‡]	95% CI[‡]	Intracerebral Hemorrhage No. Cases	RR	95% CI	Subarachnoid Hemorrhage No. Cases	RR	95% CI
P for trend			0.92			0.11			0.39	
Yogurt										
Q1	0	1950	1.00	Ref	277	1.00	Ref	114	1.00	Ref
Q2	6.7	146	0.83	0.70–0.99	21	0.83	0.53–1.30	16	1.37	0.80–2.36
Q3	19.1	180	0.83	0.71–0.97	30	1.00	0.68–1.46	22	1.57	0.99–2.50
Q4	28.6	162	0.95	0.81–1.11	27	1.15	0.77–1.77	15	1.36	0.79–2.34
Q5	85.7	264	1.08	0.95–1.24	28	0.86	0.58–1.28	29	1.83	1.20–2.80
P for trend			0.33			0.58			0.01	
Cheese										
Q1	3.2	564	1.00	Ref	84	1.00	Ref	37	1.00	Ref
Q2	9.6	607	1.04	0.92–1.17	82	0.99	0.73–1.35	42	1.12	0.71–1.75
Q3	16.8	534	1.00	0.88–1.13	71	0.92	0.661.37	42	1.08	0.68–1.72
Q4	28.7	526	0.98	0.87–1.11	72	0.95	0.69–1.33	31	0.80	0.49–1.33
Q5	60.0	471	0.88	0.77–1.01	74	1.01	0.72–1.41	44	1.07	0.66–1.72
P for trend			0.02			0.90			0.98	
Cream										
Q1	2.3	627	1.00	Ref	102	1.00	Ref	32	1.00	Ref
Q2	4.6	576	0.94	0.84–1.06	71	0.74	0.54–1.01	43	1.27	0.79–2.05
Q3	7.0	502	0.84	0.74–0.95	74	0.79	0.58–1.10	40	1.23	0.75–2.02
Q4	11.7	480	0.81	0.71–0.92	68	0.77	0.54–1.08	38	1.13	0.67–1.91
Q5	50.5	517	0.81	0.72–0.92	68	0.72	0.52–1.00	43	1.27	0.78–2.08
P for trend			0.02			0.26			0.58	
Ice cream										
Q1	0	1400	1.00	Ref	183	1.00	Ref	87	1.00	Ref
Q2	1.0	193	0.90	0.78–1.05	34	1.21	0.84–1.76	20	1.30	0.79–2.16
Q3	2.2	344	0.94	0.83–1.06	48	1.02	0.74–1.42	22	0.84	0.52–1.35
Q4	4.4	361	0.88	0.78–0.99	53	1.00	0.73–1.37	34	1.09	0.72–1.65
Q5	11.0	404	0.92	0.81–1.03	65	1.21	0.89–1.63	33	0.97	0.63–1.49
P for trend			0.14			0.30			0.86	
Butter										

Dairy Item by Quintile†	Median Intake (g/d)	Cerebral Infarction			Intracerebral Hemorrhage			Subarachnoid Hemorrhage		
		No. Cases	RR‡	95% CI‡	No. Cases	RR	95% CI	No. Cases	RR	95% CI
Q1	2.8	538	1.00	Ref	73	1.00	Ref	35	1.00	Ref
Q2	18.2	547	1.00	0.89–1.13	87	1.15	0.84–1.57	41	1.17	0.74–1.86
Q3	35.7	536	0.99	0.88–1.12	77	1.05	0.75–1.45	36	1.03	0.64–1.67
Q4	52.2	545	1.01	0.89–1.15	60	0.89	0.62–1.26	42	1.13	0.71–1.81
Q5	79.0	536	1.00	0.87–1.14	86	1.44	1.01–2.07	42	0.98	0.59–1.64
P for trend			0.99			0.19			0.87	

* Adjusted for age, supplementation group, education, cigarettes smoked daily, BMI, serum total cholesterol, serum HDL cholesterol, histories of diabetes and heart disease, leisure-time physical activity, and intakes of total energy, alcohol, caffeine, sugar, red meat, poultry, fish, fruit, fruit juices, vegetables, potatoes, whole grains, and refined grains.

† For whole milk, sour milk, yogurt, and ice cream, participants with an intake of 0 g/d was used as referent group and those with intakes of >0 g/d were categorized into quartiles of intake.

‡ RR, relative risk; CI, confidence interval; Ref, referent.