Research and Professional Briefs

A Very-Low-Fat Vegan Diet Increases Intake of Protective Dietary Factors and Decreases Intake of Pathogenic Dietary Factors

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ABSTRACT

There is increasing evidence that dietary factors in plant-based diets are important in the prevention of chronic disease. This study examined protective (eg, antioxidant vitamins, carotenoids, and fiber) and pathogenic (eg, saturated fatty acids and cholesterol) dietary factors in a very-low-fat vegan diet. Ninety-three early-stage prostate cancer patients participated in a randomized controlled trial and were assigned to a very-low-fat (10% fat) vegan diet supplemented with soy protein and lifestyle changes or to usual care. Three-day food records were collected at baseline (n=42 intervention, n=43 control) and after 1 year (n=37 in each group). Analyses of changes in dietary intake of macronutrients, vitamins, minerals, carotenoids, and isoflavones from baseline to 1 year showed significantly increased intake of most protective dietary factors (eg, fiber increased from a mean of 31 to 59 g/day, lycopene increased from 8,693 to 34,464 μg/day) and significantly decreased intake of most pathogenic dietary factors (eg, saturated fatty acids decreased from 20 to 5 g/day, cholesterol decreased from 200 to 10 mg/day) in the intervention group compared to controls. These results suggest that a very-low-fat vegan diet can be useful in increasing intake of protective nutrients and phytochemicals and minimizing intake of dietary factors implicated in several chronic diseases.

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The prominent role of diet and other lifestyle factors in the prevention of chronic disease is widely accepted (1-6). Diet patterns emphasizing plant foods appear to be protective against several types of cancer, cardiovascular disease (CVD), diabetes, age-related macular degeneration, and overall mortality (5,7-15). One benefit of plant-based diets is that they contain very low or negligible amounts of saturated fat and are devoid of cholesterol. However, there is growing evidence that the inclusion of several protective dietary factors inherently present in plant foods (eg, antioxidants, carotenoids, and fiber) may confer benefits that are superior to mere avoidance of pathogenic factors such as saturated fat and cholesterol (7,15-20). For example, a recent ecologic study investigating the association between well-known cardioprotective nutrients (eg, folate, carotenoids, and fiber) and coronary mortality, found that 86% to 90% of the variation in coronary mortality in 19 European countries could be explained by low consumption of folate and fiber and a high n-6:n-3 fatty acid ratio (21).

The aim of this study was to examine intake of protective and pathogenic dietary factors in a very-low-fat vegan diet used in the Prostate Cancer Lifestyle Trial (13).

METHODS

Participants were men with early-stage prostate cancer (active surveillance) enrolled in the Prostate Cancer Lifestyle Trial, a randomized clinical trial investigating the effect of comprehensive lifestyle changes on the progression of prostate cancer. The University of California–San Francisco Committee on Human Research Institutional Review Board approved this study. The intervention, including dietary counseling, and main findings from this study have been reported previously (13,22,23). Briefly, participants in the intervention group were asked to follow an intensive lifestyle program, including an ad libitum very-low-fat vegan diet (22), moderate aerobic exercise, stress management, and social group support. To achieve a fat intake of approximately 10% of energy from fat, participants were instructed by a registered dietitian

Table 1. Changes in dietary intake from baseline to 1 year for intervention and control participants (n=37 each) in a study of the effects of a very-low-fat vegan diet in men with early-stage prostate cancer[a]

Variable	Baseline	1 y	Intervention vs control group	Baseline vs 1 y	Group×time interaction
	← *mean*±*standard deviation* →		← P *value* →		
Energy and macronutrients					
Energy (kcal)					
Intervention	2,077±512^{x}	2,283±603^{xy}	0.058	0.522	0.040
Control	2,052±482^{x}	1,942±482^{xz}			
Fat (g)					
Intervention	68±36^{x}	27±10^{y}	0.003	0.001	0.001
Control	65±27^{x}	60±26^{x}			
Energy from fat (%)					
Intervention	28±9^{x}	11±3^{y}	0.001	0.001	0.001
Control	28±9^{x}	27±9^{x}			
Saturated fatty acids (g)					
Intervention	20±13^{x}	5±2^{y}	0.002	0.001	0.001
Control	20±13^{x}	18±11^{x}			
Energy from saturated fatty acids (%)					
Intervention	8.1±4^{x}	1.8±1^{y}	0.001	0.001	0.001
Control	8.7±5^{x}	8±5^{x}			
Monounsaturated fatty acids (g)					
Intervention	25±16^{x}	7±3^{y}	0.001	0.001	0.001
Control	25±11^{x}	22±11^{x}			
Energy from monounsaturated fatty acids (%)					
Intervention	10±4^{x}	3±1^{y}	0.001	0.001	0.001
Control	11±4^{x}	10±4^{x}			
Polyunsatured fatty acids (g)					
Intervention	17±9^{x}	11±5^{y}	0.581	0.006	0.018
Control	15±6^{x}	14±6^{xy}			
Energy from polyunsatured fatty acids (%)					
Intervention	6.8±3^{x}	4.4±1^{y}	0.026	0.000	0.001
Control	6.6±3^{x}	6.5±2^{x}			
n-3 Fatty acids (g)					
Intervention	1.9±1	1.6±1	0.029	0.091	0.624
Control	2.6±3	2±1			
n-6 Fatty acids (g)					
Intervention	15±8^{x}	10±4^{y}	0.877	0.008	0.006
Control	12±5^{x}	13±5^{xy}			
n-6:n-3					
Intervention	8.6±5^{x}	6.9±2^{x}	0.080	0.281	0.025
Control	6.4±3^{x}	7±3^{x}			
***Trans*-fatty acids (g)**					
Intervention	3.4±3^{x}	0.8±1^{y}	0.004	0.001	0.002
Control	4.1±4^{x}	3.7±3^{x}			
Polyunsaturated fatty acid:saturated fatty acid					
Intervention	1.16±0.6^{x}	2.46±0.4^{y}	0.001	0.001	0.001
Control	1.1±0.8^{x}	1.19±0.7^{x}			
Cholesterol[b] (mg)					
Intervention	200±139^{x}	10±24^{y}	0.001	0.001	0.001
Control	222±150^{x}	175±130^{x}			
Cholesterol to saturated fatty acid index					
Intervention	30±19^{x}	5±2^{y}	0.001	0.001	0.001
Control	32±20^{x}	27±17^{x}			
Protein (g)					
Intervention	80±21^{x}	115±35^{y}	0.001	0.001	0.001
Control	79±22^{x}	83±27^{x}			
Energy from protein (%)					
Intervention	16±4^{x}	20±4^{y}	0.021	0.001	0.001
Control	16±4^{x}	17±4^{x}			

(continued)

Table 1. Changes in dietary intake from baseline to 1 year for intervention and control participants (n=37 each) in a study of the effects of a very-low-fat vegan diet in men with early-stage prostate cancer[a] (continued)

Variable	Baseline	1 y	Intervention vs control group	Baseline vs 1 y	Group×time interaction
Animal protein[b] (g)					
Intervention	39±21[x]	2±6[y]	0.001	0.001	0.001
Control	39±22[x]	39±23[x]			
Vegetable protein (g)					
Intervention	40±17[x]	112±36y	0.001	0.001	0.001
Control	40±23x	43±28[x]			
Carbohydrate (g)					
Intervention	294±79[x]	430±119[y]	0.001	0.001	0.001
Control	286±95[x]	273±84[x]			
Energy from carbohydrate (%)					
Intervention	57±13[x]	75±5[y]	0.001	0.001	0.001
Control	56±12x	57±12x			
Total sugars (g)					
Intervention	119±49[x]	149±56[y]	0.024	0.041	0.003
Control	113±48[x]	108±45[x]			
Added sugars (g)					
Intervention	56±34	51±31	0.651	0.571	0.347
Control	50±28	52±31			
Fructose (g)					
Intervention	30±16[x]	54±26[y]	0.001	0.001	0.001
Control	28±13[x]	27±14[x]			
Galactose (g)					
Intervention	0.56±0.9[x]	0.18±0.2[x]	0.867	0.208	0.017
Control	0.33±0.4[x]	0.45±0.8[x]			
Glucose (g)					
Intervention	31±14[x]	48±22[y]	0.001	0.001	0.001
Control	28±14[x]	27±13[x]			
Lactose (g)					
Intervention	8.4±8[x]	0.5±1[y]	0.003	0.001	0.001
Control	9.7±10[x]	8.8±8[x]			
Maltose (g)					
Intervention	3.8±3[x]	6.6±4[y]	0.010	0.001	0.001
Control	3.7±3	3.6±3[x]			
Sucrose (g)					
Intervention	46±26	39±16	0.970	0.141	0.433
Control	44±28	42±24			
Starch (g)					
Intervention	123.9±38[x]	189.8±54[y]	0.001	0.001	0.001
Control	121.4±47[x]	117.8±39[x]			
Total fiber (g)					
Intervention	31±14[x]	59±24[y]	0.001	0.001	0.001
Control	31±17[x]	30±14[x]			
Soluble fiber (g)					
Intervention	8±3[x]	15.6±7[y]	0.001	0.001	0.001
Control	8.2±4[x]	8±3[x]			
Insoluble fiber (g)					
Intervention	23±11[x]	43±17[y]	0.001	0.001	0.001
Control	22±13[x]	22±11[x]			
Vitamins					
Vitamin A (μg RE[c])					
Intervention	1,681±1,372[x]	2,481±1,665[y]	0.751	0.321	0.001
Control	2,195±1,927[x]	1,762±1,357[xy]			
Vitamin D (μg)					
Intervention	4.4±3[x]	6.4±3[x]	0.590	0.497	0.028
Control	6.3±6[x]	5.2±4[x]			
Vitamin E (mg)					
Intervention	12±11[x]	18±9[y]	0.591	0.101	0.012
Control	14±17[x]	12±17[xy]			

(continued)

Table 1. Changes in dietary intake from baseline to 1 year for intervention and control participants (n=37 each) in a study of the effects of a very-low-fat vegan diet in men with early-stage prostate cancer[a] (continued)

Variable	Baseline	1 y	Intervention vs control group	Baseline vs 1 y	Group×time interaction
Vitamin K (μg)					
Intervention	243±199	347±274	0.107	0.039	0.202
Control	212±160	237±254			
Vitamin C (mg)					
Intervention	171±109^{x}	324±149^{y}	0.049	0.001	0.001
Control	202±132^{x}	184±137^{x}			
Thiamin (vitamin B-1) (mg)					
Intervention	1.9±0^{x}	2.8±1^{y}	0.002	0.001	0.001
Control	1.9±1^{x}	2±1^{x}			
Riboflavin (vitamin B-2) (mg)					
Intervention	2±1^{x}	2.6±1^{y}	0.500	0.022	0.003
Control	2.3±1^{x}	2.2±1^{xy}			
Niacin (vitamin B-3) (mg)					
Intervention	24±8	27±11	0.608	0.089	0.331
Control	24±9	25±8			
Pantothenic acid (mg)					
Intervention	6.1±2^{x}	6.5±3^{x}	0.512	0.834	0.220
Control	6.2±2^{x}	5.9±2^{x}			
Vitamin B-6 (mg)					
Intervention	2.3±1^{x}	4.1±2^{y}	0.001	0.001	0.001
Control	2.3±1^{x}	2.4±1^{x}			
Vitamin B-12 (μg)					
Intervention	3.9±2	3.5±2	0.007	0.198	0.756
Control	5.4±3	4.7±3			
Folate (μg)					
Intervention	440±179^{x}	926±380^{y}	0.001	0.001	0.001
Control	443±240^{x}	477±234^{x}			
Minerals					
Calcium (mg)					
Intervention	804±352^{x}	1,310±580^{y}	0.003	0.001	0.001
Control	825±327^{x}	825±332^{x}			
Phosphorus (mg)					
Intervention	1,386±373^{x}	2,048±690^{y}	0.001	0.001	0.001
Control	1,342±425^{x}	1,360±433^{x}			
Magnesium (mg)					
Intervention	418±164^{x}	657±249^{y}	0.001	0.001	0.001
Control	396±162^{x}	412±179^{x}			
Sodium (mg)					
Intervention	3,642±1,223	4,069±1,392	0.841	0.346	0.192
Control	3,840±1,242	3,771±1,481			
Potassium (mg)					
Intervention	3,644±1,037^{x}	5,604±2,297^{y}	0.002	0.001	0.001
Control	3,725±1,434^{x}	3,516±1,313^{x}			
Iron (mg)					
Intervention	18±6^{x}	34±12^{y}	0.001	0.001	0.001
Control	18±8^{x}	19±9^{x}			
Zinc (mg)					
Intervention	11±4^{x}	18±6^{y}	0.001	0.001	0.001
Control	11±4^{x}	11±4^{x}			
Copper (mg)					
Intervention	1.9±1^{x}	3.6±1^{y}	0.001	0.001	0.001
Control	1.8±1^{x}	1.8±1^{x}			
Selenium (μg)					
Intervention	128±53	140±43	0.276	0.787	0.065
Control	133±52	118±32			
Manganese (mg)					
Intervention	5.8±3^{x}	11±4^{y}	0.001	0.001	0.001
Control	5.5±3^{x}	5.6±3^{x}			

(continued)

Table 1. Changes in dietary intake from baseline to 1 year for intervention and control participants (n=37 each) in a study of the effects of a very-low-fat vegan diet in men with early-stage prostate cancer[a] (continued)

Variable	Baseline	1 y	Intervention vs control group	Baseline vs 1 y	Group×time interaction
Carotenoids					
β-carotene (μg)					
Intervention	7,270±6,956^{x}	12,360±8,588^{y}	0.368	0.135	0.001
Control	9,422±9,606^{x}	7,228±7,347^{x}			
α-carotene (μg)					
Intervention	1,933±3,410	2,455±2,868	0.575	0.738	0.112
Control	2,253±3,692	1,456±2,412			
β-Cryptoxanthin (μg)					
Intervention	287±251	551±472	0.687	0.009	0.082
Control	361±338	416±529			
Lutein and zeaxanthin (μg)					
Intervention	4,837±3,769^{x}	8,588±8,178^{y}	0.119	0.012	0.034
Control	4,761±4,071^{x}	5,083±6,645^{xy}			
Lycopene (μg)					
Intervention	8,693±10,474^{x}	34,464±23,108^{y}	0.001	0.001	0.001
Control	8,942±9,987^{x}	9,292±8,588^{x}			
Isoflavones					
Total isoflavones (mg)					
Intervention	20±30^{x}	133±61^{y}	0.001	0.001	0.001
Control	18±40^{x}	24±33^{x}			
Isoflavones from diet (mg)					
Intervention	18±28^{x}	76±49^{y}	0.001	0.001	0.001
Control	17±39^{x}	22±29^{x}			
Isoflavones from supplement (mg)					
Intervention	1.6±6^{x}	56.8±27^{y}	0.001	0.001	0.001
Control	1±4^{x}	1.9±6^{x}			

[a]Superscripts (x,y,z) denote comparisons within columns and rows. Means with different superscripts are significantly different from one another ($P<0.05$, Bonferroni adjusted).
[b]Cholesterol and animal protein are higher than 0 mg/g in intervention group at 1 year due to a minor deviation from dietary instruction to consume an exclusively vegan diet.
[c]RE=retinol equivalents.

to avoid all sources of added fat (eg, oils and margarines) and high-fat foods (eg, nuts, peanuts, olives, avocados, chocolate, and coconut). Whole, unrefined foods were emphasized, and added sugar intake was recommended to <20 g/day. In addition, participants were asked to consume one 58-g serving of a fortified soy protein powder (SUPRO SOY, The Solae Company, St Louis, MO, formerly DuPont Technologies) once a day, to provide isoflavones because of their role in inhibiting prostate cancer genesis and growth (24,25). Also, daily consumption of 16 oz low-sodium tomato-based vegetable juice was recommended to provide an additional source of lycopene, considered protective against the progression of prostate cancer (26,27). Intervention participants also received daily micronutrient supplements specific to prostate cancer (eg, selenium), and an iron-free multivitamin, which were excluded from the dietary analyses. Control group participants were under the usual care of their physician, including recommendations for diet and lifestyle.

A registered dietitian instructed participants on how to complete 3-day food records and verified dietary data entry, as a measure of quality assurance. Data were analyzed using Nutrition Data System for Research software (NDS-R) (versions 4.01_29, 1999 and 4.02_30, 2000, Nutrition Coordinating Center, University of Minnesota, Minneapolis). Final calculations were completed using NDS-R version 2005. The NDS-R time-related database updates analytic data while maintaining nutrient profiles true to the version used for data collection. Isoflavone values specific for the soy protein supplement used in the intervention were provided by the manufacturer and substituted for the isoflavone value estimated by NDS-R. The analyses presented here are based on data from men who had complete 3-day food records at baseline (n=85) and 1 year (n=74).

Independent sample *t* tests were used to assess differences between groups at baseline. Group differences in nutrient changes (baseline to 1 year) were analyzed using analysis of variance for repeated measures, with group as a between subjects factor and time as a repeated factor. Bonferroni adjustments were made for multiple comparisons. Statistical analyses were performed using SPSS (version 14.0, 2005, SPSS, Inc, Chicago, IL).

RESULTS AND DISCUSSION

At baseline there were no significant differences between the intervention (n=42) and control (n=43) groups in age (mean 65±7 and 67±7 years, respectively), weight (80±13 kg for both), energy intake, or macro- and micro-

Table 2. Nutrient composition of fortified soy protein powder[a] (58 g) used in a study of the effects of a very-low-fat vegan diet in men with early-stage prostate cancer

Nutrient	Amount
Energy (kcal)	194
Fat (g)	1
Energy from fat (%)	4
Carbohydrate (g)	7
Energy from carbohydrate (%)	14
Protein (g)	40
Energy from protein (%)	82
Cholesterol	0
Vitamin A (RE[b]) (μg)	0
Vitamin D (μg)	5
Vitamin E (mg)	10
Vitamin K (μg)	0.48
Vitamin C (mg)	30
Thiamin (vitamin B-1) (mg)	0.1
Riboflavin (vitamin B-2) (mg)	0.8
Niacin (vitamin B-3) (mg)	0.7
Pantothenic acid (mg)	0.02
Vitamin B-6 (mg)	1
Vitamin B-12 (μg)	3
Folate (μg)	200
Calcium (mg)	500
Phosphorus (mg)	600
Magnesium (mg)	18
Sodium (mg)	540
Potassium (mg)	140
Iron (mg)	7.2
Zinc (mg)	7.5
Copper (mg)	0.74
Selenium (μg)	34
Isoflavones (mg)	80

[a]*SUPRO SOY*, The Solae Company, St Louis, MO, formerly DuPont Technologies.
[b]RE=retinol equivalents.

nutrients, with the exception of a lower n-6:n-3 fatty acid ratio and a higher intake of vitamin B-12 in the control group (data not shown). Changes in nutrient intake from baseline to one year are presented in Table 1. The nutrient content of SUPRO SOY is presented in Table 2. Compared with controls, intervention participants significantly increased their intake of most dietary factors associated with beneficial health effects and reduced their intake of most dietary factors known to increase the risk of chronic disease. This is congruent with the adoption of a diet rich in whole grains, fruits, vegetables, and legumes, moderate in sweets, and supplemented with soy protein.

In regard to macronutrients, the intervention group reported significantly increased intake of carbohydrate and protein (mostly vegetable protein), and decreased intake of fat and animal protein. The increase in carbohydrate intake was primarily due to increases in starch and sugars from fruits and vegetables, with no change in added sugars. Although intervention participants did not limit their daily added sugar intake to the recommended amount of 20 g, their intake at 1 year (51 g/day, approximately 9% of total energy) falls into the low range of what is consumed by Americans (40 to 121 g/day) (28). It is advisable to keep intake of table sugars low because of their association with prostate cancer mortality (29).

Fiber intake in the intervention group almost doubled during the 1-year period as a result of the large consumption of fiber-rich vegetables, fruits, whole grains, and legumes, and exceeded current recommendations (30). Increased fiber intake has been associated with lower risk of coronary heart disease, type 2 diabetes, colorectal cancer, and all-cause mortality (31-37).

The observed increase in vegetable protein consumption in the intervention group may also confer several health benefits. Vegetable proteins may be protective against cancer, especially cancers linked to insulin resistance, such as those of the breast and colon, as well as prostate cancer, CVD, and other chronic diseases through the promotion of increased glucagon activity, which in turn induces a series of metabolic reactions conducive to health (38). Ecologic studies have shown vegetable protein consumption to be negatively correlated with total cancer mortality (39) and consumption of animal products to be a strong predictor of prostate cancer mortality (29,40).

In the intervention group, total fat intake was reduced by 60%, and saturated fat intake by 75%. In addition to saturated fatty acids, intake of *trans*-fatty acids and cholesterol were also greatly reduced, significantly lowering the consumption of the most important dietary factors known to increase serum cholesterol (41-43) to a level even lower than currently recommended (3,44). Current epidemiologic knowledge supports the notion that saturated fat is associated with increased risk of cancer, especially of the prostate, breast, and colon (45), and that total fat may be implicated in prostate cancer (46).

With regard to individual fatty acid intake, there were no significant improvements in n-3 fatty acid intake or in the n-6:n-3 ratio in the intervention group after 1 year. This is not surprising because dietary sources of both plant and marine n-3 fatty acids (eg, flaxseeds, walnuts, and fish) were excluded from the intervention diet. The intervention group reported a significant decrease in n-6 fatty acids intake, and consumption at 1 year (about 4% of energy) was much lower than that typically observed in vegans (10% to 12%) (47). Intake of n-3 fatty acids at 1 year was similar to that usually seen in vegans (47). However, intervention participants were asked to take a fish oil supplement (3 g/day) (not included in the analyses). This amount, which provides 900 mg n-3 fatty acids, would be expected to lower the n-6:n-3 ratio. In addition to their well-known cardiovascular benefits (48), n-3 fatty acids may play an important role in the prevention of diabetes (48,49), inflammatory diseases (50), dementia, and age-related macular degeneration (51).

The intervention group also reported significant increases in the intake of most vitamins and minerals, compared to the controls. Vitamins A, E, and C at 1 year reached levels up to four times higher than the current Recommended Dietary Allowances (RDAs) (52,53). The observed increase in vitamin E, although unexpected from a diet that excluded oils and high-fat foods, can be explained by the consumption of fortified products, such as the soy protein supplement and several breakfast ce-

reals, as well as that of unprocessed grains and green leafy vegetables. Epidemiologic studies of dietary vitamin E suggest an inverse relationship with several cancers (54), and both dietary and serum vitamin E have been linked to a reduction in risk of prostate cancer (55). Furthermore, in the largest prospective study of diet and age-related macular degeneration to date, a dietary intake of antioxidant vitamins (ie, vitamins C and E, and β-carotene) and zinc at or above the RDA was associated with a 35% reduced risk of age-related macular degeneration (15). Intervention participants also increased their intake of folate by 110%, bringing their consumption to a level more than double the current adult RDA (56). Folate is well known for its cardioprotective role (21,57,58), and may be important in the prevention of several cancers (54), including prostate cancer (59,60). Although vitamin B-12 intake did not change significantly in the intervention group, consumption at 1 year was much higher than typically seen in vegans (61), exceeding current recommendations (56). This is most likely due to vitamin B-12 supplementation of the soy protein supplement.

Intervention participants reported a significantly increased intake of calcium, potassium, and magnesium, from the consumption of fortified soy products, fruits, and vegetables. Diets high in calcium, potassium, and magnesium have been shown to decrease blood pressure independently from their sodium content (62). Interestingly, the consumption of these three minerals was much higher (potassium and magnesium) or similar (calcium) than that observed in participants in the Dietary Approaches to Stop Hypertension trial (63), where the diet was specifically designed to increase the consumption of these minerals. High consumption of calcium has been associated with lower risk of colorectal cancer (64), but has been suggested to increase the risk of advanced and fatal prostate cancer (65). Nonetheless, the level consumed by intervention participants at 1 year corresponds to current dietary guidelines (66). Iron intake was also significantly increased in the intervention group, to a level higher than the current RDA for vegetarian adult men (14 mg/day) (52). However, the observed intake in this group is similar to that of other populations following predominantly plant-based diets (8). Although there is some evidence suggesting that iron may enhance the risk for heart disease by increasing low-density lipoprotein cholesterol oxidation (67), it is only heme iron that has been associated with an increase in heart disease risk (68-70). The intervention group also reported increased intake of zinc. The level reached at 1 year is in agreement with the recommendation by the Food and Nutrition Board for vegetarians to strive for a zinc intake 50% higher than the RDA due to the poor absorption of zinc from vegetarian sources (52,71). There is some initial evidence that zinc may be important in the prevention of prostate cancer (72) and may act synergistically with antioxidants to protect against age-related macular degeneration (15). Although the intake of selenium did not significantly change in either group, intervention patients reported consuming more than double the current adult RDA (53). Supplementation with selenium at 200 μg/day has been shown to reduce the incidence and progression of prostate cancer in patients with low baseline selenium levels (73). Selenium may also play a role in the prevention of CVD (74) and diabetes (75).

With the exception of α-carotene and β-cryptoxanthin, intake of all the major dietary carotenoids was substantially increased in intervention participants. For example, lycopene intake nearly quadrupled in 1 year (from 8,693 to 34,464 μg/day), mostly from the daily consumption of a tomato-based vegetable juice (23,377μg/8-oz serving). High dietary lycopene and plasma levels have been consistently associated with a reduced risk of prostate cancer (26,27). Moreover, there is suggestive evidence for a protective role of lycopene, either alone or in combination with other carotenoids, in the prevention of CVD (76-78). High plasma carotene concentrations have also been associated with lower risk of all-cause and cancer mortality (79). A role for lutein and zeaxanthin in eye health has been suggested by epidemiologic evidence of reduced risk of early and late stages of age-related macular degeneration with higher dietary intake or plasma concentrations of these two carotenoids (80-82). In addition, there is emerging evidence that lutein and zeaxanthin may reduce the risk of certain cancers, heart disease, and stroke (82).

The dietary intake of isoflavones increased markedly over 1 year in the intervention group, as expected with the daily consumption of the soy protein supplement and other soy food products, to a level even higher than that typically consumed by Asians (83). The consumption of soy foods has been associated with lower risk of several cancers, including prostate cancer (84,85). Given recent findings that protein rich in essential amino acids (including soy protein) may be associated with increased insulin-like growth factor-I (86,87), a hormone that has also been shown to promote tumor growth and inhibit apoptosis (88), it may be advisable for men with prostate cancer not to exceed the protein recommendations set by the Institute of Medicine (30,89). Although all the bioactive components in soy responsible for its beneficial effects have not yet been elucidated, there is some evidence indicating a role for isoflavones (24,90). In addition, even though isoflavones have not shown an appreciable hypocholesterolemic effect (91), they may enhance cardiovascular health by improving vascular function (92).

One limitation common to studies relying on self-report is the lack of serum indexes to validate dietary intake. However, serum total and low-density lipoprotein cholesterol were significantly reduced in the intervention group compared to controls (13). This suggests that the self-reported dietary intakes were reasonably reliable, at least in regard to dietary fat and cholesterol. Another limitation pertains to the use of supplements (eg, the soy protein powder), which may be difficult to consume long-term.

CONCLUSIONS

Adopting a very-low-fat vegan diet for at least 1 year increased the intake of several dietary constituents that may reduce the risk of many chronic diseases such as cancer, CVD, diabetes, and age-related macular degeneration, and decreased the intake of dietary components that have been implicated with an increased risk of these health problems.

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