Greater Frequency of Fruit and Vegetable Consumption Is Associated With Lower Prevalence of Peripheral Artery Disease

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Objective—Although fruit and vegetable (F&V) consumption is associated with lower risk of coronary heart disease and stroke, its association with peripheral artery disease (PAD) is less certain. We, thus, sought to characterize F&V intake and investigate the association between F&V consumption and presence of PAD in a large community sample.

Approach and Results—Self-referred participants at >20 000 US sites who completed medical and lifestyle questionnaires were evaluated by screening ankle brachial indices for PAD (ankle brachial index ≤0.9). Among 3 696 778 individuals, mean age was 64.1±10.2 years and 64.1% were female. Daily consumption of ≥3 servings of F&V was reported by 29.2%. Increasing age, female sex, white race, never smoking, being currently married, physical activity, increasing income, and frequent consumption of fish, nuts, and red meat were positively associated with daily consumption of F&V. After multivariable adjustment, there was a stepwise inverse association between F&V intake and PAD. Participants reporting daily intake of ≥3 servings of F&V had 18% lower odds of PAD than those reporting less than monthly consumption. In unadjusted and multivariable-adjusted models, the inverse association with F&V became stronger as ankle brachial index decreased. When stratified by smoking status, the association was present only among those subjects who currently or formerly smoked tobacco.

Conclusions—Our study demonstrates an inverse association of F&V consumption with prevalent PAD and overall low F&V consumption. These observations suggest the need to further efforts to increase F&V consumption and for more rigorous evaluation of the role of F&V in PAD prevention.

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Key Words: ankle brachial index ■ coronary heart disease ■ exercise ■ peripheral arterial disease ■ stroke

Fruits and vegetables (F&V) have long been regarded as essential to a healthy diet. The US Department of Agriculture/US Health and Human Services Dietary Guidelines for Americans recommend the consumption of at least 4.5 cups of F&V combined daily.[1,2] Despite multiple public education campaigns, few American adults report consuming F&V at suggested levels.[3] Furthermore, particular groups, including men, members of ethnic minorities, and those with low socioeconomic status average lower levels of consumption.[4–8]

Formal recommendations related to F&V consumption owe partly to observed associations of the foods with reduced risk of cancer (associations recent prospective studies have found to be much weaker than earlier research suggested[9]) and overall mortality.[10,11] Findings of benefit with F&V consumption have been more congruous in cardiovascular disease, although there are suggestions of differences by vascular territory. For example, inverse associations of F&V intake with coronary heart disease have been regularly observed,[11,12] although smaller studies have failed to show significant correlations.[13] Reductions in risk of stroke are consistent,[14] and potentially of greater magnitude than for coronary heart disease.[15] Finally, a recent study of abdominal aortic aneurysm found an inverse association of the condition with fruit, but not with vegetable, consumption.[16]

Despite the wealth of investigation into dietary composition and coronary heart disease and stroke risk, there has been limited investigation on dietary composition and peripheral artery disease (PAD), leading to calls for assessment of dietary components as they relate specifically to PAD.[17] Recently, an intervention to encourage adherence to a Mediterranean diet pattern was demonstrated to successfully reduce incident PAD.[18] However, the intervention did not focus on F&V, and intake of these foods did not significantly differ between treatment and control groups, so a role for these specific foods in PAD prevention could not be assessed. With this in mind, we

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Nonstandard Abbreviations and Acronyms	
ABI	ankle-brachial index
F&V	fruit and vegetable
PAD	peripheral artery disease

sought to investigate an association between F&V consumption and presence of PAD, in a large community-based sample of nearly 3.7 million American adults. We secondarily sought to study reported F&V consumption in this sample.

Materials and Methods

Materials and Methods are available in the online-only Data Supplement.

Results

Among 3 696 778 unique individuals, mean age was 64.1±10.2 years, 64.1% were female, and 89.1% were white. There were 233 958 (6.3%) cases of PAD as defined by ankle brachial index (ABI) ≤0.9 or history of lower extremity revascularization procedure. As noted previously, the prevalence of different cardiovascular risk factors in this sample was similar to that of the general US adult population.[19] Characteristics of the respondents categorized by reported frequency of F&V consumption are presented in Table 1. Nearly half of the sample reported consuming at least 3 servings of F&V on fewer than half the days of a week.

F&V Consumption

The proportion of participants reporting daily consumption of at least 3 servings of F&V daily differed markedly by age, sex, and race/ethnicity (Figure IA and IB in the online-only Data Supplement). Older white women were most likely to consume ≥3 servings of F&V daily. In contrast, younger black men were the least likely to report daily consumption of ≥3 servings of F&V.

There was notable variation in F&V consumption frequency by region (Table I in the online-only Data Supplement) and state (Table II in the online-only Data Supplement) of residence, and mean income of zip code provided by the respondent (Table III in the online-only Data Supplement). The Pacific region had the greatest proportion of respondents reporting intake of at least 3 servings of F&V on most days of the week, whereas less than half of subjects from South Central states reported consumption on most days of the week. The least frequent daily consumption of F&V was reported in Mississippi (21.5%), Louisiana (22.0%), Oklahoma (23.5%), Arkansas (24.0%), and Alabama (24.7%).

We built a logistic regression model to assess which of the 16 variables listed in Materials and Methods were predictive of daily intake of at least 3 servings of F&V. Increasing age, female sex, nonsedentary lifestyle, increasing income, and frequent consumption (most days of the week) of fish, nuts, and red meat were positively associated with daily consumption of F&V. Non-white race, current or former smoking, being currently unmarried, and frequent consumption of fast food were inversely associated with daily intake of at least 3 servings of F&V (Table IV in the online-only Data Supplement). The area under the receiver operating curve of this model was 0.693. The *P* value for goodness of fit testing was 0.59.

Peripheral Arterial Disease

After multivariable adjustment for age, sex, race/ethnicity, and clinical risk factors, a stepwise inverse association between F&V intake with the prevalence of PAD was apparent (Table 2, Figure [A], *P* for trend <0.001). Additional adjustment for income and dietary components other than F&V resulted in minimal attenuation of the association (*P* for goodness of fit=0.12). The association persisted, but was found to be slightly more pronounced in men (*P*<0.01) when adjusted analyses were stratified by sex (Table V in the online-only Data Supplement). Stratification of the sample by cigarette smoking status (current, former, and never) demonstrated that the inverse association of increasing F&V consumption with PAD was limited to subjects who currently or formerly smoked (Table 3).

Among all subjects with abnormal ABI, 73.2% (n=121 389) had ABI 0.9–0.7, 19.7% (n=32 648) had ABI 0.7–0.5, and 7.1% (n=11 717) had ABI <0.5. The inverse association with F&V intake was stronger with decreasing ABI in both crude and multivariable-adjusted models (Figure [B]).

Discussion

We present data from a self-referred sample of ≈1.6% of all American adults in which we observed an association of greater frequency of consumption of F&V with lower odds of prevalent PAD defined by abnormal ABI or history of previous lower extremity revascularization, but that a minority of participants reported consuming at least 3 servings of F&V on a daily basis. Our adjusted analyses demonstrated a stepwise reduction in odds for PAD with increasing consumption of F&V—associations which were stronger with increasingly abnormal ABI. Notably, this association was restricted to people who were current or former cigarette smokers.

Unfortunately, our findings about F&V consumption are in agreement with those of other, smaller surveys. Data from the 2007 to 2010 National Health and Nutrition Examination Surveys (NHANES) suggest that <20% of adult Americans consume F&V at the US Department of Agriculture's recommended levels,[8] with even lower prevalence found by the Centers for Disease Control and Prevention's Behavioral Risk Factor Surveillance System.[7] In our sample, 29.2% of subjects reported daily intake of at least 3 servings of F&V daily, with just over half reporting this degree of consumption on most days of the week. Our state-level data are also similar to that reported by the Centers for Disease Control,[20] in which individuals living in Southern states reported less frequent F&V consumption than did those residing in other regions. Furthermore, our sample mirrored smaller cohorts in which men, blacks, and relatively younger adults reported less frequent F&V intake than did women and other races.[4–7]

The degree to which the American population as a whole, and certain segments in particular, fail to achieve guideline-directed F&V consumption, has been recognized for more than

Table 1. Characteristics of Study Population Undergoing Vascular Screening Examinations at over 20 000 US Sites Between 2003 and 2008 Categorized by Reported Frequency of Consumption of at least 3 Servings of Fruits and Vegetables

	Less Than Once/mo	Once/wk—Once/mo	2 to 3×/wk	4 to 5×/wk	Daily
n (%)	250 648 (7.1)	532 731 (15.0)	921 000 (25.9)	811 518 (22.9)	1 035 194 (29.2)
Age (y)±SD	62.8±10.9	62.1±10.8	62.8±10.7	63.7±10.3	65.4±10.2
Male (%)	124 473 (51.1)	236 201 (45.6)	345 319 (38.6)	259 184 (32.8)	372 817 (27.1)
Race/Ethnicity					
White (%)	210 442 (84.0)	452 247 (84.9)	785 533 (85.3)	708 381 (87.3)	903 693 (87.3)
Black (%)	7863 (3.1)	17 601 (3.3)	30 677 (3.3)	22 947 (2.8)	25 684 (2.5)
Hispanic (%)	6920 (2.8)	14 274 (2.7)	23 211 (2.5)	16 421 (2.0)	21 077 (2.0)
Asian (%)	4929 (2.0)	10 628 (2.0)	18 448 (2.0)	13 554 (1.7)	18 803 (1.8)
BMI (kg/m^2)±SD	28.1±5.7	28.3±5.8	28.1±5.8	27.7±5.7	27.2±5.7
Hypertension (%)	119 144 (48.6)	252 040 (48.3)	436 926 (48.5)	379 978 (47.8)	483 730 (47.8)
Diabetes mellitus (%)	27 294 (10.9)	56 317 (10.6)	99 485 (10.8)	86 360 (10.6)	116 133 (11.2)
Hypercholesterolemia (%)	135 670 (54.1)	289 122 (54.3)	499 517 (54.2)	438 844 (54.1)	544 476 (52.6)
Family history of CVD (%)	57 618 (25.2)	124 021 (25.5)	216 205 (25.7)	191 083 (25.7)	238 406 (25.2)
Current smokers (%)	82 123 (33.4)	155 148 (29.7)	233 283 (25.8)	184 636 (23.2)	215 794 (21.3)
Sedentary lifestyle (%)	132 092 (55.1)	252 310 (49.4)	360 859 (40.8)	263 035 (33.6)	269 051 (26.9)
Marital status					
Married, %	66.6	68.1	68.9	70.6	70.1
Divorced, %	10.4	10.2	9.5	8.7	8.0
Single, %	10.7	9.6	8.7	7.6	7.4
Widowed, %	12.3	12.1	13.0	13.1	14.5
Daily nut consumption, %	7.0	6.5	9.2	14.1	26.1
Daily fish consumption, %	1.3	0.8	0.9	1.3	4.9
Daily red meat consumption, %	8.6	6.3	6.2	5.9	8.7
Daily fast food consumption, %	2.2	1.5	1.1	0.7	1.0

BMI indicates body mass index; and CVD, cardiovascular disease.

3 decades.[21] Although food consumption decisions are multifactorial (as supported by the modest value of our regression model to predict daily F&V consumption), 2 recognized hurdles to increased consumption are availability and cost. Indeed, in our geographically diverse sample, we found both greater income, as well as frequent intake of other costly foods such as fish and red meat, to be strongly predictive of daily F&V consumption.

Table 2. Odds Ratio for Peripheral Artery Disease (as Defined by Ankle Brachial Index <0.9 or Previous Revascularization) by Fruit and Vegetable Intake Relative to Less Than Once/Month Consumption of At Least 3 Servings of Fruits and Vegetables

	Less Than Once/mo	Once/wk—Once/mo	2 to 3×/wk	4 to 5×/wk	Daily
		OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Unadjusted	1.0	0.85 (0.83–0.86)	0.81 (0.80–0.83)	0.78 (0.76–0.79)	0.83 (0.81–0.84)
Adjusted for age, sex, race/ethnicity	1.0	0.86 (0.84–0.88)	0.78 (0.77–0.79)	0.71 (0.69–0.72)	0.68 (0.67–0.69)
Adjusted for age, sex, race/ethnicity, clinical risk factors	1.0	0.89 (0.87–0.91)	0.84 (0.83–0.86)	0.80 (0.78–0.81)	0.80 (0.79–0.82)
Adjusted for age, sex, race/ethnicity, clinical risk factors, income	1.0	0.89 (0.87–0.91)	0.84 (0.83–0.86)	0.80 (0.78–0.82)	0.81 (0.79–0.82)
Adjusted for age, sex, race/ethnicity, clinical risk factors, income, diet	1.0	0.89 (0.87–0.91)	0.84 (0.83–0.86)	0.80 (0.79–0.82)	0.81 (0.79–0.83)

Clinical risk factors include: diabetes mellitus, hypertension, hypercholesterolemia, sedentary lifestyle, tobacco use (current, former, and never), family history of vascular disease, and BMI (as a continuous variable). Diet includes consumption of nuts, fish, and red meat. BMI indicates body mass index (kg/m^2); CI, confidence interval; and OR, odds ratio.

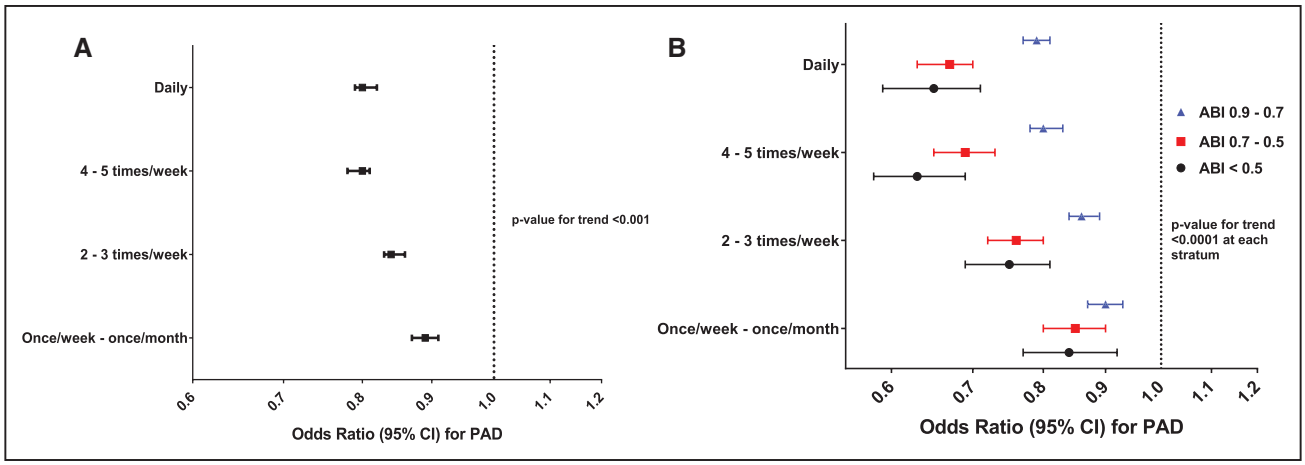

Figure. A, Adjusted odds ratios for any peripheral artery disease (PAD; ankle brachial index [ABI]<0.9) by fruit and vegetable intake relative to less than once/month consumption of at least 3 servings of fruits and vegetables. Adjusted model includes diabetes mellitus, hypertension, hypercholesterolemia, sedentary lifestyle, tobacco use (current, former, and never), family history of vascular disease, BMI (as a continuous variable), and consumption of nuts, fish, and red meat. **B**, Adjusted model includes variables as listed for panel **A**. CI indicates confidence interval.

Public marketing campaigns such as "5 A Day for Better Health" and the current "Fruits and Veggies—More Matters" have met with limited success in increasing consumption of F&V by American adults.[22] A large gap remains between goal and actual F&V consumption, leading experts to advocate for multimodality approaches to attain recommended consumption levels across the population.[23] Our observation of the levels of F&V intake in this large community-based sample highlights this divide. The limited sensitivity and specificity of our regression model demonstrates that this is certainly a complex endeavor. However, our analyses provide evidence of the need to focus on the, particularly, low F&V intake in certain groups, including non-whites, men, those living in Southern states, those with low incomes, and smokers.

In addition to confirming the overall low frequency of recommended levels of F&V intake among American adults, we further observed an association of greater consumption with lower odds of prevalent PAD defined by ABI ≤0.9. Our adjusted analyses demonstrated a stepwise reduction in odds for PAD with increasing consumption of F&V—associations which were stronger with more abnormal ABI measures.

Although several studies have found inverse associations of nutrients present in F&V with prevalent PAD[24–26] and incident claudication,[27] to our knowledge, this is only the second assessment of an association specifically between F&V consumption and PAD. The first was a report at year 12 of the Health Professionals Follow-Up Study.[28] In that cohort, 295 cases of incident, symptomatic PAD had been confirmed in the ≈44 000 men without diabetes mellitus or vascular disease at enrollment. In age-adjusted analyses, the investigators also found a step-wise reduction in risk of incident PAD by quintile of F&V intake. However, when smoking and exercise were included in the models, this association was attenuated and no longer statistically significant in this sample with a low incidence of PAD (0.7%). In our large sample with PAD (both symptomatic and asymptomatic defined by ABI ≤0.9) prevalence >6%, we detected a stepwise inverse association of F&V consumption with prevalent PAD that persisted with correction for age, sex, race/ethnicity, smoking, physical activity, income, and multiple other CVD risk factors, and was of greater magnitude with lower ABI.

When we stratified our sample by smoking status, we found that the inverse association of F&V intake with PAD was limited to subjects who formerly or currently used tobacco (Table 3). This observation has precedence. In the above-mentioned Health Professionals Follow-Up Study, the observed trend toward a reduced incidence of PAD with F&V intake was present in active smokers, but not in a combined group of never and former smokers.[28] Likewise, intake

Table 3. Odds Ratio for Peripheral Artery Disease (as Defined by Ankle Brachial Index <0.9 or Prior Revascularization) by Fruit and Vegetable Intake Relative to Less Than Once/Month Consumption of At Least 3 Servings of Fruits and Vegetables—Stratified by Smoking Status

	Less Than Once/mo	Once/wk–Once/mo	2 to 3×/wk	4 to 5×/wk	Daily
Smoking status		OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Current	1.0	0.86 (0.83–0.89)	0.78 (0.75–0.80)	0.70 (0.68–0.73)	0.65 (0.63–0.68)
Former	1.0	0.87 (0.84–0.91)	0.83 (0.80–0.86)	0.79 (0.76–0.82)	0.79 (0.76–0.82)
Never	1.0	0.97 (0.93–1.01)	0.98 (0.94–1.02)	0.97 (0.93–1.01)	1.02 (0.99–1.06)

Model is adjusted for all variables incorporated into final model of Table 2.

of nutrients prevalent in F&V—β-carotene, vitamin C, and lycopene—have been associated with reduced risk for developing claudication in male smokers,[27] and an association of vitamin C consumption with ABI in the Edinburgh Artery Study was seen only in individuals who had smoked, not in those who had never smoked.[29] An interaction of smoking with vitamin C intake and the risk of stroke has also been reported.[30] Hypothesized mechanisms underlying reduced atherosclerosis with F&V consumption generally involve action of micronutrients contained in the foods. Indeed, the prevailing explanation for the isolated associations in smokers is that antioxidant nutrients supplied via F&V only manifest detectable disease-preventing effects in the setting of significant oxidative stress, which occurs with smoking. Within the pathophysiology of PAD, oxidative stress is felt to be important in both the initiation and the progression of the disease,[31] and increased antioxidant capacity may inhibit this process.

Several other mechanisms are also hypothesized to explain any protection from cardiovascular disease acquired with frequent F&V consumption. One is through salicylic acid present in these foods.[32] A reduction in blood pressure, demonstrated in several randomized, controlled trials is another.[33,34] Although improved serum lipid profiles associated with the substitution of F&V for foods containing more fat or less fiber are also hypothesized to mediate inverse associations with atherosclerosis, high-quality experimental support for this is lacking.[35] The evidence for greater F&V consumption to afford reduced weight similarly lacks a strong evidentiary foundation[36,37] and seems contingent on the substitution of F&V for more calorically dense and low-fiber foods.[38]

Limitations of our analysis include its cross-sectional nature that does not allow for the assessment of longitudinal dietary consumption that is likely important in the development and progression of this chronic disease. Our survey instrument was not validated and left the definition of a "serving" to the determination of the participant. Furthermore, the presence of a single question about F&V consumption also does not allow for individual assessment of separate fruit or vegetable consumption with PAD prevalence, nor does it allow us to assess overall servings of F&V consumed by a participant. This introduces the potential for "miscategorization" of participants with infrequent consumption of many servings of F&V and those with frequent consumption of slightly fewer than 3 servings of the foods. However, any miscategorization would serve to bias our observations toward the null—suggesting that our observed effect potentially underestimates the size of the actual effect of F&V intake on PAD. In addition, despite this limitation, our survey instrument likely provides ranking validity, and the 5 categories of consumption represent strata of overall F&V intake. Furthermore, there is some evidence that suggests that for the purposes of categorizing total consumption of foods, that the frequency of intake is more important the number of servings.[39]

Despite our correction for over a dozen established risk factors for atherosclerotic disease and other variables, there are likely confounders which were not measured in our limited survey. Specifically, our data do not allow for the estimation of whole grain, alcohol, or total energy intake in our sample. Our survey also did not query the use of vitamin supplements. Given the previously reported associations and mechanistic plausibility of greater fiber or antioxidant vitamin intake with PAD prevention, whole grain consumption and the use of vitamin supplements are potentially unmeasured confounders of our findings. The absence of total energy intake could also confound associations given that greater total energy intake correlates with greater consumption of multiple food groups. This potential association is borne out in the propensity for those subjects who reported consuming F&V more frequently to also report more frequently consuming nuts and fish, but also red meat (Table 1). However, when analyses were restricted to those participants who reported eating nuts, fish, and red meat at least 4× weekly (as a surrogate for high energy intake), the inverse association of F&V with PAD was unchanged (data not shown).

Finally, although one strength of our study is our objective outcome of PAD defined by an abnormal value (≤0.9) on directly measured ABI (rather than symptomatic PAD, which may occur in the minority of patients with abnormal ABI[40]), ABI is not as sensitive or specific as angiography for the diagnosis of PAD.[41] One reason for impaired sensitivity in ABI is the predilection for elderly, diabetics, and patients with end-stage renal disease to have elevated, rather than reduced ABI. However, the persistence of our findings when restricted to severely reduced ABIs, as well as with the exclusion of diabetics (data not shown), strengthens the confidence that can be assigned to our conclusions.

Nonetheless, the major strengths of our study are its inclusion of nearly 3.7 million subjects, and its demonstration of a clear inverse association of prevalent PAD, as defined by a directly measured abnormal ABI, with F&V intake, even with correction for multiple established PAD risk factors. These findings are restricted to subjects who have a history of tobacco use, in accordance with previous studies of antioxidant micronutrients and PAD, and thus are suggestive of a possible mechanism underlying the association.

Our study adds to the burgeoning literature about dietary consumption and PAD, emphasizing the necessity of further studies into diet and PAD specifically, so that dietary recommendations and interventions for reducing the burden of this disease can be established. This study also provides further evidence that F&V consumption varies markedly by sex, race, and region of the United States, but is universally poor. This observation supports the continued need for programs to improve the dietary patterns of all Americans.

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Disclosures

None.

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Highlights

- There is a stepwise inverse association between fruit and vegetable (F&V) intake and prevalence of PAD.
- The inverse association of F&V intake with PAD is stronger with increasing severity of disease and restricted to current and former smokers.
- F&V intake at recommended levels is universally poor.
- F&V intake varies by demographics and geography.

Arteriosclerosis, Thrombosis, and Vascular Biology

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Greater Frequency of Fruit and Vegetable Consumption Is Associated With Lower Prevalence of Peripheral Artery Disease

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SUPPLEMENTAL MATERIAL

Materials and Methods

The study was based on data provided by Life Line Screening Inc. (Independence, OH) for research purposes. The data was provided without any financial considerations, and without any editorial control over analyses or resulting publications. The study population consisted of self-referred individuals who underwent vascular screening tests at more than 20,000 sites in the United States between 2003 and 2008. Before undergoing anthropometric measures, individuals completed an extensive questionnaire regarding demographics, risk factors, medical history, physical activity and dietary intake. Participants were asked to report their usual frequency of consumption of at least three servings of fruits and vegetables combined daily. Response options were: less than once monthly, between once monthly and once weekly, between two and three times weekly, between four and five times weekly, or daily.

Peripheral Artery Disease

For the measurement of PAD, systolic blood pressure was measured in both arms and both ankles. Left and right ankle brachial index (ABI) measurements were obtained by dividing the ankle systolic blood pressure (measured in the posterior tibial artery or dorsalis pedis artery if a posterior tibial artery Doppler signal was inaudible) by the highest of the two systolic blood pressures in the left or right arm (brachial artery), as previously described.[1] PAD was defined as an ABI <0.9 in either leg or prior lower extremity revascularization, in accordance with the recommendations of multiple organizations.[2, 3]

Hyperlipidemia was defined by reported physician diagnosis or medication use. Diabetes was defined by reported physician diagnosis or medication use. Hypertension was defined by reported physician diagnosis or anti-hypertensive medication use at the time of screening. Subjects reporting less than once weekly engagement in vigorous leisure time activity were considered to have a sedentary lifestyle. Obesity was defined as a body mass index (BMI) of ≥30kg/m^2. A positive family history of vascular disease was defined as having a first degree relative with a heart attack, stroke or peripheral arterial intervention prior to age 60.

Statistical Analyses

Logistic regression modeling was used to create a model predicting likelihood of daily consumption of at least three servings of fruits and vegetables employing 16 demographic, lifestyle and medical variables: age (as a continuous variable), sex, self-reported race/ethnicity, smoking status, non-sedentary lifestyle (participating in vigorous activity at least once weekly), diabetes, hypertension, hyperlipidemia, BMI (continuous), nut consumption, fish consumption, red meat consumption, fast food consumption, caffeine consumption, income quartile, and marital status. Stepwise variable selection to minimize the Bayesian information criterion was used to build the multivariable model.[4]

Stepwise multivariable logistic regression models were also used to determine the association between fruit and vegetable intake and PAD (ABI ≤0.9). Models were adjusted for the variables listed above, except for caffeine intake and marital status. Additional multivariable regression analyses using this model were performed with varying ABI ranges as the outcome variable: ABI 0.9 – 0.7, 0.7 – 0.5 and ABI <0.5). The Hosmer Lemeshow test was used to assess the goodness of fit for the two logistic regression models, using a sample of n = 5000 taken from the overall sample.

Further, given the known influence of gender and smoking on PAD risk, the fully adjusted logistic regression model for PAD was separately stratified by gender and smoking status

(current, former, never) to assess for the presence of an interaction with these variables. Significance of the interaction term was investigated using the Wald chi-squared test. All statistical analyses were performed with PASW (version 18·0, SPSS Inc, Chicago, Illinois), SAS (version 9·4, SAS Institute Inc.), and the R package (R Development Core Team).

Supplemental References

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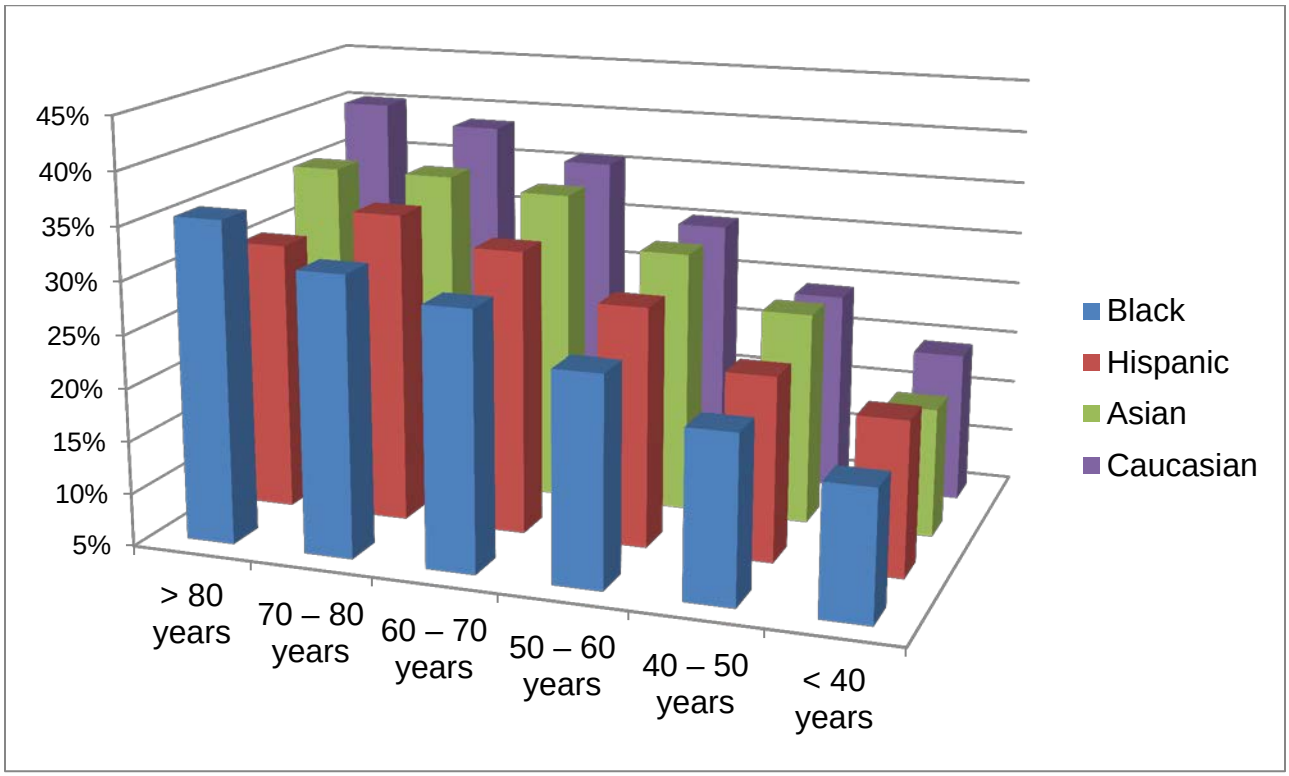
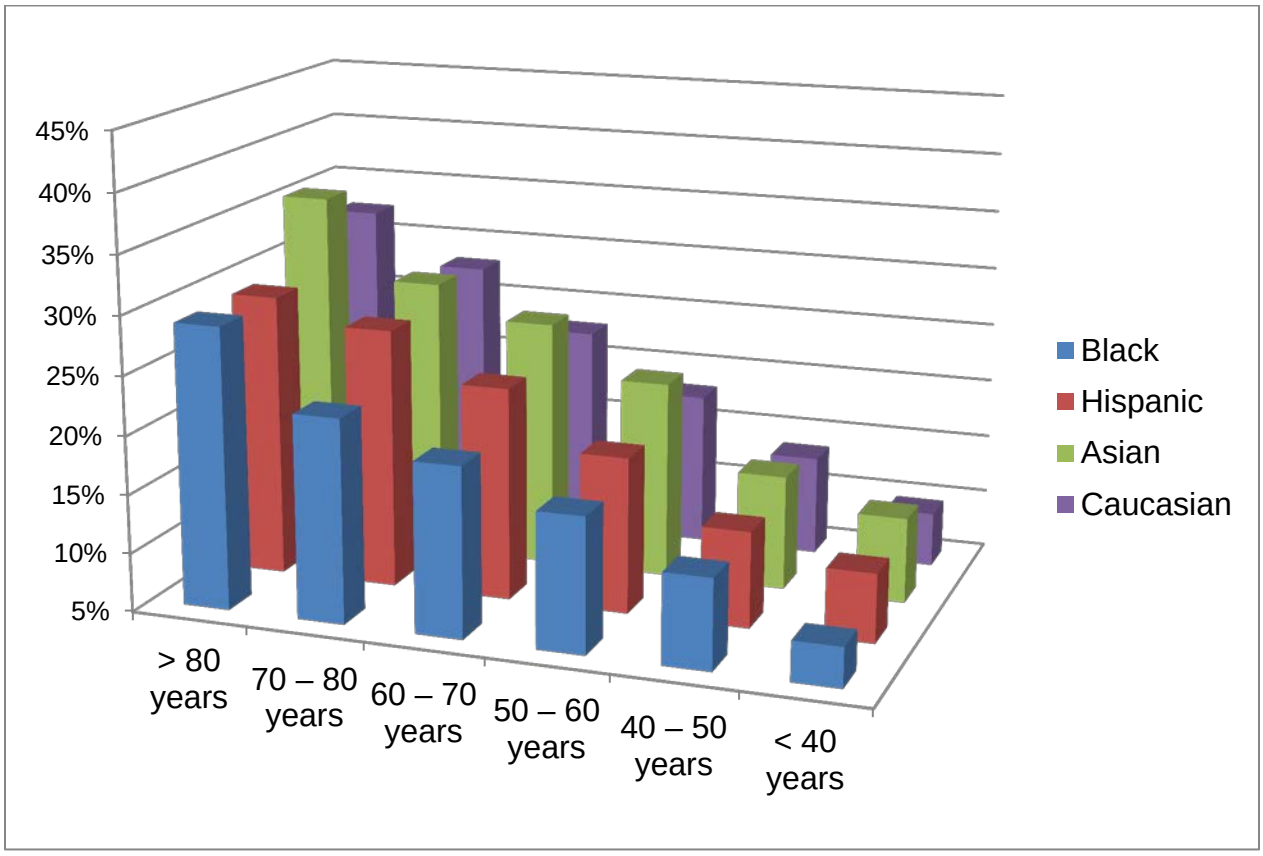
Supplemental Figures

Supplemental Figure IA. Percentage of women reporting daily consumption of at least three servings of fruits and vegetables



Supplemental Figure IB. Percentage of men reporting daily consumption of at least three servings of fruits and vegetables



Supplemental Tables

Supplemental Table I. Frequency of consumption of at least three servings of fruits and vegetables stratified by geographic region of residence of screening participants.

Region (n =)	**Less than once/month**	**Once/week - Once/month**	**2 - 3 times/week**	**4 - 5 times/week**	**Daily**
New England (n = 178121)	7.8%	14.0%	23.9%	21.6%	32.7%
Mid-Atlantic (n = 389922)	7.7%	14.8%	25.4%	21.6%	30.4%
East North Central (n =633782)	6.9%	15.5%	26.5%	22.8%	28.3%
West North Central (n = 281956)	6.3%	14.7%	26.2%	23.7%	29.0%
South Atlantic (n = 690319)	7.1%	14.9%	26.0%	23.0%	29.1%
East South Central (n = 142457)	7.7%	16.5%	27.8%	23.2%	24.9%
West South Central (n = 343295)	7.8%	16.8%	27.4%	22.8%	25.2%
Mountain (n = 233976)	6.3%	14.4%	25.7%	23.9%	29.8%
Pacific (n = 480079)	6.4%	13.7%	24.7%	23.3%	32.0%

Supplemental Table II. Frequency of consumption of at least three servings of fruits and vegetables by state of residence of screening participants

State (n =)	**<1x/mo**	**1x/wk - 1x/mo**	**2-3x/wk**	**4-5x/wk**	**Daily**
AK (n = 167)	4.2%	13.2%	23.4%	28.1%	31.1%
AL (n = 37729)	7.5%	15.6%	28.0%	23.8%	25.1%
AR (n = 26277)	8.3%	16.8%	27.7%	23.1%	24.0%
AZ (n = 1104)	7.6%	16.3%	26.4%	20.9%	28.8%
CA (n= 349421)	6.5%	13.9%	24.9%	23.0%	31.7%
CO (n = 78835)	5.6%	13.7%	25.1%	24.5%	31.1%
CT (n = 58682)	7.3%	13.3%	23.4%	22.2%	33.8%
DC (n = 4001)	6.2%	11.7%	24.0%	21.4%	36.7%
DE (n = 12498)	7.1%	14.3%	25.0%	22.5%	31.1%
FL (n = 207373)	7.6%	14.8%	25.4%	22.3%	30.0%
GA (n = 93209)	7.0%	15.6%	27.1%	23.9%	26.4%
HI (n = 136)	2.2%	11.8%	21.3%	30.2%	34.6%
IA (n = 46988)	6.2%	14.6%	26.3%	23.8%	29.2%
ID (n = 12686)	6.1%	14.0%	26.2%	23.6%	30.0%
IL (n = 198404)	6.9%	15.4%	26.4%	22.8%	28.6%
IN (n = 84582)	6.7%	16.3%	26.9%	23.3%	26.8%
KS (n = 38031)	6.3%	15.0%	26.0%	24.2%	28.7%
KY (n = 1128)	7.4%	17.7%	26.5%	23.8%	24.7%
LA (n = 32545)	10.0%	18.9%	28.6%	20.5%	22.0%
MA (n = 64996)	8.2%	14.5%	24.2%	21.2%	31.9%
MD (n = 74353)	6.9%	14.4%	25.3%	22.9%	30.6%
ME (n = 16178)	7.2%	13.7%	23.0%	22.4%	33.7%

State	<1x/mo	1x/wk - 1x/mo	2-3x/wk	4-5x/wk	Daily
MI (n = 122317)	6.9%	15.3%	26.1%	23.0%	28.7%
MN (n = 74767)	6.0%	14.2%	26.0%	24.0%	29.9%
MO (n = 78503)	6.8%	15.3%	26.2%	23.5%	28.3%
MS (n = 25841)	8.7%	18.5%	29.1%	22.3%	21.5%
MT (n = 11173)	6.2%	13.8%	25.8%	24.5%	29.7%
NC (n = 108874)	6.4%	14.9%	26.4%	23.9%	28.4%
ND (n = 6996)	5.5%	14.7%	27.1%	23.7%	29.1%
NE (n = 29260)	5.7%	14.2%	26.2%	24.4%	29.6%
NH (n = 20388)	7.4%	13.8%	23.9%	21.7%	33.3%
NJ (n = 105116)	8.2%	15.2%	25.3%	21.1%	30.2%
NM (n = 13249)	6.3%	15.4%	25.9%	23.3%	29.1%
NV (n = 26765)	8.3%	16.1%	26.4%	22.1%	27.2%
NY (n = 145170)	8.0%	14.6%	25.0%	21.5%	31.0%
OH (n = 154364)	7.0%	15.7%	26.7%	22.9%	27.8%
OK (n = 53442)	7.9%	17.6%	27.7%	23.4%	23.5%
OR (n = 48807)	5.7%	12.7%	24.5%	24.0%	33.1%
PA (n = 139636)	6.9%	14.6%	25.9%	22.4%	30.2%
RI (n = 9402)	8.9%	14.7%	24.2%	20.3%	32.0%
SC (n = 55728)	7.1%	15.8%	27.0%	23.4%	26.7%
SD (n = 7411)	6.0%	14.1%	26.4%	24.5%	29.0%
TN (n = 77759)	7.0%	15.9%	27.4%	23.6%	26.1%
TX (n = 231031)	7.3%	16.2%	27.1%	23.2%	26.3%
UT (n = 19960)	5.8%	13.7%	25.7%	24.7%	30.1%
VA (n = 112652)	6.0%	13.7%	25.5%	23.5%	31.3%

State	<1x/mo	1x/wk - 1x/mo	2-3x/wk	4-5x/wk	Daily
VT (n = 8475)	6.3%	12.6%	22.1%	23.6%	35.4%
WA (n = 881548)	5.9%	12.8%	24.2%	24.3%	32.8%
WI (n = 74115)	6.3%	14.7%	26.0%	23.2%	30.0%
WV (n = 21631)	7.7%	16.6%	26.7%	22.6%	26.6%
WY (n = 8686)	6.8%	14.7%	26.2%	23.5%	28.8%

Supplemental Table III. Frequency of consumption of at least three servings of fruits and vegetables stratified by quartile of income of screening participants (quartile 1 = lowest income, quartile 4 = highest income).

	Less than once/month	Once/week - Once/month	2 - 3 times/week	4 - 5 times/week	Daily
Quartile 1	7.7%	16.0%	26.9%	22.5%	26.9%
Quartile 2	7.1%	15.2%	26.2%	22.9%	28.6%
Quartile 3	6.9%	14.8%	25.7%	22.9%	29.6%
Quartile 4	6.5%	13.9%	24.9%	23.1%	31.5%

Supplemental Table IV. Univariate and multivariable odds ratios for individual characteristics employed in a logistic regression model for daily consumption of at least three servings of fruits and vegetables. Chi-square value was significant with $p < 0.0001$ for all.

	Univariate OR (95% CI)	**Multivariable OR (95% CI)**
Age (continuous, by year)	1.019 (1.019 – 1.019)	1.022 (1.022 – 1.023)
BMI (continuous, by unit kg/m^2)	0.977 (0.976 – 0.977)	0.996 (0.996 – 0.997)
African American	0.778 (0.769 – 0.788)	0.807 (0.794 – 0.820)
Asian	0.855 (0.842 – 0.868)	0.854 (0.836 – 0.872)
Hispanic	0.759 (0.748 – 0.769)	0.799 (0.784 – 0.814)
Female	1.761 (1.753 – 1.769)	1.933 (1.922 – 1.945)
Non-sedentary	1.965 (1.956 – 1.974)	1.888 (1.877 – 1.899)
Divorced	0.822 (0.816 – 0.828)	0.756 (0.749 – 0.764)
Single	0.785 (0.779 – 0.791)	0.812 (0.803 – 0.820)
Widowed	1.072 (1.065 – 1.079)	0.735 (0.728 – 0.741)
Current smoker	0.690 (0.687 – 0.694)	0.764 (0.759 – 0.769)
Former smoker	0.859 (0.854 – 0.863)	0.873 (0.867 – 0.879)
Consumption of fish on most days of the week	3.082 (3.055 – 3.110)	2.637 (2.606 – 2.668)
Consumption of nuts on most days of the week	2.669 (2.656 – 2.682)	2.220 (2.206 – 2.234)
Consumption of red meat on most days of the week	1.081 (1.076 – 1.087)	1.286 (1.278 – 1.295)
Consumption of fast food on most days of the week	0.548 (0.542 – 0.555)	0.598 (0.589 – 0.608)
Consumption of two or more caffeinated beverages daily	1.039 (1.034 – 1.045)	0.981 (0.974 – 0.987)
2nd Income quartile	1.090 (1.083 – 1.069)	1.063 (1.055 – 1.071)
3rd Income quartile	1.136 (1.129 – 1.143)	1.103 (1.095 – 1.111)
4th Income quartile	1.237 (1.229 – 1.244)	1.186 (1.176 – 1.195)
Hypercholesterolemia	0.961 (0.957 – 0.965)	0.933 (0.928 – 0.938)
Diabetes	1.023 (1.016 – 1.030)	1.126 (1.115 – 1.136)
Hypertension	0.974 (0.970 – 0.978)	0.976 (0.970 – 0.981)

BMI – Body Mass Index, CI – Confidence Interval, OR – Odds ratio

Supplemental Table V. Adjusted odds ratios for PAD by fruit and vegetable intake relative to less than once/month consumption of at least three servings of fruits and vegetables.

Adjusted for age, race/ethnicity, clinical risk factors, income, and diet and stratified by sex.

	Less than once/month	Once/week - Once/month	2 - 3 times/week	4 - 5 times/week	Daily
		OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Women	1.0	0.91 (0.88 – 0.94)	0.87 (0.85 – 0.90)	0.83 (0.81 – 0.86)	0.84 (0.82 – 0.86)
Men	1.0	0.86 (0.83 – 0.89)	0.81 (0.79 – 0.84)	0.77 (0.74 – 0.80)	0.77 (0.75 – 0.80)

BMI – Body Mass Index (kg/m^2), CI – Confidence Interval, OR – Odds ratio, PAD – Peripheral Arterial Disease, SES – socioeconomic status

Clinical risk factors include: diabetes, hypertension, hypercholesterolemia, sedentary lifestyle, tobacco use (current, former, never), family history of vascular disease and BMI (as a continuous variable)

Diet includes consumption of nuts, fish, red meat