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DIET IS ASSOCIATED WITH ANKLE-BRACHIAL INDEX, INFLAMMATION, AND AMBULATION IN PATIENTS WITH INTERMITTENT CLAUDICATION

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Abstract

Objectives.—The aims of this investigation were (a) to determine whether the daily dietary intake of nutrients by patients with peripheral artery disease (PAD) and intermittent claudication (IC) met recommended levels for adults older than 50 years of age, and (b) to determine whether meeting recommended levels of nutrients was associated with ankle-brachial index (ABI), inflammation, and ambulation of patients with PAD and IC.

Methods.—A total of 48 patients were assessed on their dietary intake of 20 nutrients during a three-day period. Patients were further characterized on demographic variables, comorbid conditions, cardiovascular risk factors, ABI, 6-minute walk distance, and high-sensitivity C-reactive protein (hsCRP).

Results.—Few patients met the daily recommended intakes for calcium (4%), fiber (6%), vitamin E (6%), trans fatty acids (13%), vitamin A (15%), total sugars (19%), potassium (23%), sodium (29%), saturated fat (29%), and vitamin C (31%), and none of the patients met the daily recommended intake of vitamin D (0%). Overall, patients met few of the 20 dietary recommendations, as the median score was 7 recommendations. Only 17 of 48 patients met more than 7 of the recommendations. For the ABI regression model adjusted for age, sex, race, smoking, hypertension, dyslipidemia, body mass index, and percentage body fat, total sugars was the only significant predictor ($p < .001$) as patients who did not meet the recommendation had lower

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ABI values. For the hsCRP adjusted regression model, omega-3 polyunsaturated fatty acids ($p=.001$) was the strongest significant predictor, indicating that those who did not meet the recommendation had higher hsCRP values. Finally, for the 6-minute walk distance adjusted regression model, folate ($p=.011$), and dietary score index ($p=.014$) were significant predictors, as those who did not meet the recommendation for folate and those who met five or fewer of the 20 recommendations had shorter 6-minute walk distances.

Conclusions.—Patients with PAD and IC consume a low nutrient dense diet that is deficient in many vitamins, calcium, fruits, and vegetables, and contains too much added sugar, saturated and trans fats, and processed foods. Additionally, more severe PAD, greater inflammation, and ambulatory dysfunction are independently associated with aspects of a low nutrient dense diet, such as too much intake of added sugars, low intake of omega-3 polyunsaturated fatty acids and folate, and only meeting the recommended intakes of five or fewer nutrients.

Table of Contents Summary

This prospective cross-sectional study of 48 patients with intermittent claudication found that they met few of a total of 20 dietary recommendations. Patients with intermittent claudication consume a low nutrient dense diet, which is predictive of lower ankle-brachial index, greater inflammation, and impaired ambulation. Patients should adopt a healthier eating pattern consisting of intakes of nutrient dense foods from each food group

INTRODUCTION

Peripheral artery disease (PAD) is highly prevalent, as 202 million people are affected worldwide,¹ and prevalence continues to grow.¹ Additionally, PAD is costly,² leads to poor quality of life,³ and is associated with a high rate of all-cause and cardiovascular mortality.⁴ The primary symptom of PAD is leg pain during ambulation, known as intermittent claudication (IC),⁵ resulting in ambulatory dysfunction,⁶ impaired functional status which declines over time,^{7,8} and low daily physical activity.⁹

Patients with PAD and IC have numerous cardiovascular and metabolic co-morbid conditions including dyslipidemia, hypertension, diabetes, smoking, obesity, abdominal obesity and metabolic syndrome.^{5,10-14} Despite the impact that diet has on these cardiovascular and metabolic risk factors,^{15,16} relatively little is known about the nutritional intakes and eating patterns of people with PAD and IC.¹⁷⁻²¹ General dietary recommendations for those with cardiovascular disease typically include dietary intakes high in fruits, vegetables, whole grains, and fiber, and low in fat, saturated fat, cholesterol and sodium.²² We found in a previous study that very few patients with PAD and IC met the daily recommendation for dietary fiber,¹⁹ indicating that the patients had diets low in whole grains, fruits, vegetables, and legumes. Increased fiber intake is associated with lower C-reactive protein levels,²³ and there is increasing evidence that it may have a protective effect against developing PAD.^{17,24-26} Thus, patients with PAD and IC may benefit from dietary intakes high in fruits, vegetables, whole grains, and fiber, which may reduce inflammation and atherosclerosis, and improve ambulation.

The aims of this investigation were (a) to determine whether the daily dietary intake of nutrients by patients with PAD and IC met the recommended levels for adults greater than 50 years of age, and (b) to determine whether meeting recommended levels of nutrients was associated with ankle-brachial index (ABI), inflammation, and ambulation of patients with PAD and IC. We hypothesized that the majority of patients consume a low nutrient dense diet, and that dietary intakes of fat, sugar, and cholesterol would be associated with lower ABI values, greater inflammation, and impaired ambulatory function.

METHODS

Patients

Approval and Informed Consent.—The procedures of this study were approved by the institutional review board from the University of Oklahoma Health Sciences Center, and written informed consent was obtained from each patient prior to beginning the investigation.

Recruitment.—Patients who had PAD and IC (Fontaine Stage II and Rutherford Grade I)⁵ and who were not currently exercising were recruited from vascular laboratories and vascular clinics for possible enrollment into the study.

Medical Screening through History and Physical Examination

Protocol.—Patients were evaluated in the morning at the Clinical Research Center.²⁷ Patients arrived in the morning fasted, but were allowed to take their usual medications. To begin the study visit, patients completed the consent form, and their vital signs, demographic information, height, weight, body mass index, anthropometric measurements, and waist circumference²⁸ were recorded by research personnel. Subsequently, patients had blood samples drawn by study nurses, which were then sent to a central lab for analyses for fasting blood chemistries. Patients then underwent a medical history and physical examination by study physicians, in which IC history, co-morbid conditions, cardiovascular risk factors and current medications were recorded. Based on this battery of baseline assessments, patients were coded on cardiovascular risk factors and co-morbid conditions according to standard definitions,²⁹ and patients were characterized on the presence, severity, and symptoms of PAD.

Inclusion and Exclusion Criteria.—Patients with PAD and IC were included in this study if they met the following criteria: (a) history of ambulatory leg pain, and (b) presence of PAD defined by an ABI ≤ 0.90 ¹³ and/or a history of lower extremity revascularization. Patients were excluded for the following conditions: (a) absence of PAD (ABI > 0.90), (b) non-compressible vessels (ABI > 1.40), (c) asymptomatic PAD (Fontaine Stage I; Rutherford Grade 0),¹³ (d) critical limb ischemia PAD (Fontaine stage III and IV; Rutherford Grade II-IV),¹³ (e) use of medications indicated for the treatment of IC (cilostazol or pentoxifylline) initiated within 3 months prior to investigation, (f) exercise limited by other diseases or conditions, (g) active cancer, and (h) stage 5 chronic kidney disease (end stage), as defined by an estimated glomerular filtration rate < 15 ml/min per 1.73 m.³⁰

Tests and Measurements

Dietary Intake.—Patients were assessed for nutrient intake during a three-day period. During an initial interview by the research study coordinator (PSM), who was trained by a nutritionist (AWK) to obtain accurate dietary intake, patients were given detailed verbal and written instructions to record all food and beverages consumed for three consecutive days, one of which was a weekend day. A 3-day food record has acceptable validity compared to a longer, more burdensome 9-day food record, and is considered an appropriate dietary assessment tool.³¹ Food models were shown during the interview and written instructions were given to the patients to help them estimate portion sizes. After the three-day period, the records were returned and reviewed with the patients to better ensure completeness, preparation methods, and food description. Any questionable entry was clarified during this session. Dietary records were obtained and nutrient data were processed using FoodWorks® nutrient analysis software (The Nutrition Company, Long Valley, NJ). The dietary intake of 20 nutrients were calculated, and this data was then coded in a binary format (yes or no) on whether the intake of each nutrient met the recommended intakes established by the National Academy of Medicine for most nutrients, and by organizations such as the American Heart Association when appropriate. To better assess the concepts of a healthy eating pattern and nutrient density,³² we summed the coded data of the 20 nutrients to provide a total dietary score of meeting the recommendations, with possible scores ranging from 0 (does not meet any of the nutrient recommendations) to 20 (meets all of the nutrient recommendations). The total dietary score was then dichotomized into whether patients met five or fewer recommendations, or if they met six or more recommendations.

ABI.—After 10 minutes of supine rest, the ankle and brachial systolic blood pressures were obtained according to standard guidelines.³³ The ABI was calculated as ankle systolic pressure/brachial systolic pressure.

6-Minute Walk Test.—Patients performed a 6-minute walk test in which two cones were placed 100 ft apart in a marked corridor.³⁴ Trained exercise technicians supervised the test and instructed the patients to walk as many laps around the cones as possible. The total distance walked during the test was recorded in feet, and subsequently converted to meters.

High Sensitivity C-Reactive Protein (hsCRP).—Concentration of hsCRP was quantified using a high-sensitivity Near Infrared Particles Immunoassay. A commercially available device, the SYNCHRON LX-20 (Beckman-Coulter; California, USA), was used to perform the assay.³⁵

Statistical Analyses

Means (standard deviations, SD) are presented for continuous variables, and frequencies with percentage (%) are for categorical variables (Tables I-II). The normality assumption for continuous variables was checked based on Shapiro-Wilk tests, and log-transformation was applied, as appropriate. Univariate analysis between continuous dietary variables and clinical exercise outcome variables were performed by calculating Spearman's rank correlation coefficients with significance evaluation based on t-tests (Table III). Thereafter, multiple regression analyses were conducted to investigate the association between each binary

dietary variable and three clinical exercise outcomes, ABI, high-sensitivity C-reactive protein and 6-minute walk distance adjusted for potential confounding variables including age, sex, race, smoking, hypertension, dyslipidemia, body mass index and percentage body fat (Table IV). The parameter estimates with standard error and 95% confidence interval (CI) as well as adjusted p-values based on Wald tests were obtained. In addition, the partial R² values quantifying the partial correlation of determination for the variable of interest were achieved from multiple regressions. All hypothesis tests were two-sided with the significance level of .05. Data was analyzed using SAS 9.4 Software (SAS Institute, Cary, North Carolina).

RESULTS

The clinical characteristics of 48 patients are shown in Table I. The group consisted of older patients with a mean BMI approaching the obese category, with 40 patients who were either overweight or obese, 7 who were normal weight, and 1 who was underweight. The mean ABI of 0.71 is indicative of moderately severe PAD, the mean hsCRP of 6.2 mg/L is in the abnormally elevated range, and the mean 6-minute walk distance of 349 meters is low and reflects ambulatory impairment. Cardiovascular risk factors and comorbid conditions were highly prevalent, particularly for dyslipidemia (96%), hypertension (90%), history of lower extremity revascularization (54%), obesity (46%), and diabetes (40%).

The dietary variables in the patients are displayed in Table II. On average, the patients consumed 1,784 kilocalories daily, of which the macronutrient composition consisted of approximately 17% from protein, 46% from carbohydrate, and 38% from fat. Compared to the recommended intakes of nutrients, few patients met the daily recommended intakes for calcium (4%), fiber (6%), vitamin E (6%), trans fatty acids (13%), vitamin A (15%), total sugars (19%), potassium (23%), sodium (29%), saturated fat (29%), and vitamin C (31%), and none of the patients met the daily recommended intake of vitamin D (0%). Overall, patients met few of the 20 total dietary recommendations that we investigated, as the median score was 7 recommendations (Figure 1). Only 17 of 48 patients met more than 7 of the recommendations (Figure 1).

Correlations analysis between dietary variables and clinical exercise outcome variables are shown in Table III. Total sugars was negatively associated with ABI ($p<.05$), as patients who consumed higher amounts of total sugars had lower ABI values which indicates more severe PAD. Folate intake was negatively associated with hsCRP ($p<.05$), as those who consumed higher amounts of folate had lower hsCRP values, indicative of a lower inflammatory state. None of the diet variables were significantly associated with 6-minute walk distance on a univariate basis.

Regression coefficient summary for binary dietary variables included in multivariable regression models on ABI, hsCRP, and 6-minute walk distance, adjusted for age, sex, race, smoking, hypertension, dyslipidemia, body mass index, and percentage body fat, are shown in Table IV. The binary dietary variables were recorded either as a value of 0 (does not meet the daily recommendation) or as a value of 1 (meets the daily recommendation). For the ABI regression model, total sugars was the only significant predictor ($p<.001$) having a positive

estimate (association), indicating that patients who did not meet the recommendation (score=0) had lower ABI values than those who met the recommendation (Figure 2 and Table IV). For the hsCRP regression model, omega-3 polyunsaturated fatty acids ($p=.001$), potassium ($p=.049$), and sodium ($p=.049$) were significant predictors, indicating that those who did not meet the recommendations for omega-3 polyunsaturated fatty acids and potassium (scores=0), and those who met the recommendation for sodium (score=1) had higher hsCRP values. Additionally, there was a trend towards significance ($p=.072$) for the dietary score index, as patients who met five or fewer of the 20 recommendations had higher hsCRP values than those who met six or more recommendations. Finally, for the 6-minute walk distance regression model, folate ($p=.011$), and dietary score index ($p=.014$) were significant predictors, as those who did not meet the recommendation for folate (score=0) had a shorter 6-minute walk distance than those who met the recommendation (score=1), and those who met five or fewer of the 20 recommendations had shorter 6-minute walk distances than those who met six or more recommendations (Figure 3 and Table IV). There was a trend towards significance ($p=.054$) for vitamin E, as patients who did not meet the recommendation (score=0) had shorter 6-minute walk distances.

DISCUSSION

A novel finding of this study was that none of the patients with PAD met the recommendation for vitamin D, less than 10% met the recommendations for calcium, fiber, and Vitamin E, and less than 20% met the recommendations for trans fatty acids, vitamin A, and total sugars. Another major finding was that not meeting the recommendation for total sugar intake was a predictor of lower ABI, not meeting the recommendation for omega-3 polyunsaturated fatty acid intake was the strongest predictor of elevated hsCRP, and not meeting the recommendation for folate and only meeting five or fewer of the 20 recommendations were the strongest predictors of shorter 6-minute walk distance.

Poor Eating Pattern of Patients with PAD

The finding that few patients with PAD and IC met the recommended values of many of the 20 nutrients is best appreciated when examining our total dietary score displayed in Figure 1. The median number of recommendations that the patients met was only seven out of 20, with intakes in Vitamin D, calcium, fiber, and vitamin E being especially poor. These results partially support our previous study, as vitamin E and fiber intakes were also low in male veterans with PAD and IC.¹⁹ We did not assess vitamin D and calcium intakes previously, thus our current findings that none of the 48 patients in the current study met the vitamin D recommendation and only two patients (4%) met the calcium recommendation are new observations in our laboratory. This is similar to a previous paper that found only 4.5% of patients with PAD met the recommendation for calcium intake.²¹ Given that more than 80% of the US population falls below the recommended intake of dairy foods,³⁶ it is even more impressive that patients with PAD have intakes of vitamin D and calcium which appear even worse. The low intakes of vitamin D and calcium are particularly alarming and clinically relevant, given that low vitamin D levels, as measured by 25-hydroxyvitamin D via radioimmunoassay, is associated with faster decline in 6-minute walk distance and short physical performance battery score in patients with PAD.³⁷ It was not possible in this study

to determine whether meeting the recommended intakes of vitamin D and calcium were associated with 6-minute walk distance because too few of patients met these recommendations to allow for comparison. However, the poor intakes of vitamin D and calcium both contributed towards a poor total dietary score index, which was independently associated with 6-minute walk distance.

Another key finding in the current investigation was that very few patients with PAD and IC met the daily recommendation for dietary fiber. This indicates that the patients had diets low in whole grains, fruits, vegetables, and legumes. Fiber may be beneficial in reducing inflammation, as there is a strong relationship between increased fiber intake and lower hsCRP.²³ Furthermore, dietary fiber may have a protective effect against developing PAD, as a positive association between cereal fiber and ABI was found in the Edinburgh Artery study,²⁴ the Health Professional's Follow-up study,²⁵ and a recent report examining data from the National Health and Nutrition Examination Survey.¹⁷ The benefit of dietary fiber is dose-dependent, as the risk of PAD decreased with each quartile increase in fiber intake.¹⁷ A recently published 20 year cohort from the prospective Malmö Diet and Cancer study showed that adherence to the recommendation for dietary fiber intake was associated with a reduced risk of PAD.²⁶ Thus, increasing dietary fiber intake may be protective against developing PAD, and may provide some cardiovascular benefits in patients who already have PAD, possibly by reducing inflammation and improving vascular function.

Nutritional Predictors of ABI, CRP, and 6MWD

A unique aspect of this study was that we determined whether inadequate intake of various key nutrients was detrimental to vascular, inflammatory, and functional measurements in patients with PAD and IC. We did this by performing multivariable regression models adjusting for demographic and clinical variables. For ABI, the only nutritional predictor was the intake of total sugars, indicating that those who did not meet the recommendation (n=39; 81%) because they consumed too much total sugar each day had lower ABI values than those who met the recommendation. Since the patients had relatively low intakes of fiber and vitamins, their high intake of total sugar likely comes from high amounts of added sugars rather than from excessive intake of fruits. Our finding supports previous work reporting that added sugars to the diet induce atherosclerosis and cardiovascular diseases through the mechanism of elevated reactive oxygen species.³⁸ Examples of added dietary sugars include table sugar, corn syrup, honey, and sweeteners in processed foods and beverages. Our results that total sugars is an independent predictor of ABI suggests that added sugars may be atherogenic which worsens PAD in patients with IC, and that this association is independent of demographic and clinical variables which include age, sex, race, smoking, hypertension, dyslipidemia, body mass index, and percentage body fat.

In the analyses for hsCRP, values were log-transformed because they were not normally distributed. For the regression model of log hsCRP, the strongest nutritional predictor was the intake of omega-3 polyunsaturated fatty acids, indicating that patient who did not meet the daily recommendation (n = 32; 67%) had higher hsCRP values than those who met the recommendation. Our finding supports previous work that shows omega-3 polyunsaturated fatty acid intake decreases production of inflammatory cytokines and mediators,³⁹ and

decreases inflammatory signals and monocyte adhesion in endothelial cells.⁴⁰ Our results indicate that patients with PAD and IC who are deficient in their intake of omega-3 polyunsaturated fatty acids have higher levels of hsCRP, and this association is independent of demographic and clinical variables.

For the regression model of 6-minute walk distance, the significant nutritional predictors were intake of folate and the dietary score index, indicating that patients who did not meet the daily recommendation of folate and patients who only met five or fewer of the total number of dietary recommendations had impaired 6-minute walk distance. Although deficiency in folate intake is associated with hyperhomocysteinemia and risk of PAD,³⁹ the current study may be the first to report the effect of folate intake on 6-minute walk distance in patients with PAD and IC. Of particular interest, the dietary score index was a significant predictor of 6-minute walk distance. Furthermore, the mean difference of 104 meters in 6-minute walk distance shown in Figure 1 represents a large difference between patients who met five or fewer dietary recommendations compared to those who met six or more recommendations, which far exceeds the threshold value of 34 meters required to be considered a large minimal clinically important difference.⁴¹

We believe that the dietary score index is the single best assessment of nutritional intake in our patients because it is the only variable that attempts to quantify a healthy eating pattern of nutrient dense foods. As such, our results indicate that patients who consume a healthier, well-balanced diet of nutrient dense foods, such as whole grains, fruits, vegetables, and legumes have better ambulatory function than patients who have a poor overall eating pattern. A healthy eating pattern of consuming nutrient dense foods may also improve inflammation, as there was a borderline association between the dietary score index and hsCRP. This concept favors the approach of adopting a healthy dietary pattern to improve deficiencies in a variety of nutrients to improve ambulation, and perhaps inflammation, in patients with PAD and IC rather than narrowly focusing on improving a single nutrient via dietary supplements.

Limitations

There are several limitations to this study. As a clinical study, there may have been a self-selection bias related to participating. Patients who agreed to participate were volunteers and may have been the most affluent, with the greatest interest in clinical research, the best access to transportation, and the best health compared with non-volunteers. The sample size is small which may have reduced the generalizability and robustness of the dietary results, as well as limited the statistical power to detect significant associations among variables. The results are only generalizable to patients with PAD and IC and not to patients with different stages of PAD, such as those with asymptomatic PAD or to those with critical limb ischemia. However, our results are representative of patients with IC because of the typically high prevalence of comorbid conditions. There are limitations associated with the cross-sectional design of the study. The correlations calculated between dietary variables and the clinical variables do not allow causality to be established, as it is possible that diet influences clinical measurements or vice versa. Another limitation is that dietary intake was measured with a 3-day food record, which is subject to errors of self-report, particularly with under-estimation

of dietary intake. Using multiple 3-day food records that are averaged may reduce errors and improve accuracy. Additionally, regional variations in diet should be considered, as Oklahoma City ranks low on daily consumption of fruits and vegetables, and high on prevalence of obesity and diabetes among the 50 largest metropolitan areas of the United States.⁴² Finally, the effect of meeting the recommendation for vitamin D on ABI, hsCRP, and 6-minute walk distance could not be assessed because none of the patients consumed enough vitamin D. As such, significant associations between vitamin D and the clinical measures were not possible to detect.

Conclusion and Clinical Significance

In conclusion, patients with PAD and IC consume a low nutrient dense diet that is deficient in vitamins, calcium, fruits, and vegetables, and that consists of too much total sugar, saturated and trans fats, and processed foods. Additionally, more severe PAD, greater inflammation, and ambulatory dysfunction are independently associated with aspects of a low nutrient dense eating pattern, such as too much intake of added sugars, low intake of omega-3 polyunsaturated fatty acids and folate, and only meeting the recommendations of five or fewer nutrients. The clinical significance is that to obtain a higher dietary score by meeting more of the recommendations of various nutrients, patients with PAD and IC should adopt a healthier eating pattern consisting of intakes of nutrient dense foods from each food group. Following these dietary recommendations will likely result in reduced symptoms of PAD, lower inflammation, and better function. Patients with PAD and IC should be considered for referral to receive dietary counseling.

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ARTICLE HIGHLIGHTS

Type of Research: Single-center, prospective, cross-sectional study.

Key Findings: Patients with intermittent claudication met few of 20 dietary recommendations, as the median score was only 7 recommendations being met. In adjusted regression models, total sugar intake was predictive of ankle-brachial index ($p<.001$), omega-3 polyunsaturated fatty acid intake was predictive of high sensitivity C-reactive protein ($p=.001$), and total dietary score index ($p=.014$) and folate intake ($p=.011$) were predictive of 6-minute walk distance.

Take home Message: Patients with intermittent claudication consume a low nutrient dense diet with many deficiencies. These dietary deficiencies are predictive of lower ankle-brachial index, greater inflammation, and impaired ambulation.

Figure 1.
Histogram of the total diet score in patients with peripheral artery disease and intermittent claudication.

Figure 2. Ankle-brachial index (ABI) in patients who did not meet the total sugars recommendation (total sugar index = 0) and in patients who met the total sugars recommendation (total sugars index = 1) ($p < .001$).

Figure 3. 6-minute walk distance in patients who met five or fewer of the 20 dietary recommendations (score index = 0) and in patients who met six or more recommendations (score index = 1) ($p = .014$).

Table I.

Clinical characteristics of patients with peripheral artery disease and intermittent claudication (n = 48).

Variables	Values
	<u>Mean (SD)</u>
Age (years)	69 (11)
Weight (kg)	86.1 (16.1)
Height (cm)	170.7 (8.2)
Body Mass Index (kg/m ²)	29.6 (5.3)
Percentage Body Fat (%)	33.4 (7.7)
Ankle-Brachial Index	0.71 (0.26)
High-sensitivity C-reactive protein (mg/L)	6.2 (9.0)
6-Minute Walk Distance (m)	349 (105)
<u>Number (Percentage %) of Patients with Characteristics Present</u>	
Sex (% Men)	32 (67)
Race (% Caucasian)	29 (62)
Education (% High school graduates)	42 (88)
Current Smoking (% yes)	14 (29)
Hypertension (% yes)	43 (90)
Dyslipidemia (% yes)	46 (96)
Diabetes (% yes)	19 (40)
Obesity (% yes)	22 (46)
Lower Extremity Revascularization (% yes)	25 (54)
Coronary Artery Disease (% yes)	13 (28)
Cerebrovascular Disease (% yes)	8 (17)
Chronic Obstructive Pulmonary Disease (% yes)	6 (13)

Table II.

Daily nutrient intake in patients with peripheral artery disease and intermittent claudication.

Variables	Mean (SD)	Recommended Intakes *	Number (Percentage %) of Patients Meeting Recommendations
Kilocalories	1784 (612)		
Protein (grams)	78 (59)	> 0.8 g/kg body weight	23 (48)
Carbohydrate (grams)	208 (88)	45-65% of Kcal	21 (44)
Dietary Fiber (grams)	17 (9)	M: > 38 g F: > 25 g	3 (6)
Total Sugars (grams)	85 (66)	< 10% of Kcal	9 (19)
Total Fat (grams)	76 (39)	20-35% of Kcal	21 (44)
Saturated Fat (grams)	23 (10)	< 10% of Kcal	14 (29)
Monounsaturated Fat (grams)	27 (17)	10-25% of Kcal	35 (73)
Cholesterol (mg)	190 (243)	< 300 mg	37 (77)
Trans Fatty Acids (grams)	0.4 (0.7)	0 g	6 (13)
Omega-3 polyunsaturated fatty acids (grams)	1.3 (0.9)	M: > 1.6 g F: > 1.1. g	16 (33)
Alcohol (grams)	1.9 (6.6)	M: < 28 g F: < 14 g	47 (98)
Calcium (mg)	639 (257)	M: 51-70 yrs: > 1000 mg M: > 70 yrs: > 1200 mg F: > 1200 mg	2 (4)
Iron (mg)	14.0 (5.8)	> 8 mg	41 (85)
Potassium (mg)	2325 (834)	M: > 3400 mg F: > 2600 mg	11 (23)
Sodium (mg)	2978 (1173)	1500-2300 mg	14 (29)
Vitamin A (mcg)	552 (365)	M: > 900 mcg F: > 700 mcg	7 (15)
Vitamin C (mg)	66 (48)	M: > 90 mg F: > 75 mg	15 (31)
Vitamin D (mcg)	1.8 (2.6)	51-70 yrs: > 15 mcg > 70 yrs: > 20 mcg	0 (0)
Vitamin E (mg)	6.4 (6.5)	> 15 mg	3 (6)
Folate (mcg)	407 (203)	> 400 mcg	20 (42)

* Recommendations for most nutrients are from Dietary Reference Intake reports by the National Academies Press, the publishing arm of the National Academy of Medicine (www.nap.edu). Recommended values were taken for men and women > 50 years of age. Recommendation for sugars, saturated fat, trans fat, and alcohol is from U.S. Department of Health and Human Services and U.S. Department of Agriculture. 2015 – 2020 Dietary Guidelines for Americans. 8th Edition. December 2015. (<https://health.gov/dietaryguidelines/2015/guidelines/>).

Table III.

Univariate regression models between continuous dietary variables and clinical exercise outcome variables in patients with peripheral artery disease and intermittent claudication. Values are Spearman correlation coefficients.

Continuous Dietary Variables	ABI	Log hsCRP	6MWD
Kilocalories	−0.01	−0.06	−0.01
Protein	0.02	0.02	0.04
Carbohydrate	−0.08	−0.14	−0.11
Dietary Fiber	0.13	−0.07	0.13
Total Sugars	−0.31 *	−0.03	−0.21
Total Fat	−0.02	−0.05	0.03
Saturated Fat	−0.02	−0.04	0.01
Monounsaturated Fat	−0.01	−0.07	0.15
Cholesterol	−0.01	0.02	−0.08
Trans Fatty Acids	0.05	0.06	−0.09
Omega-3 polyunsaturated fatty acids	0.10	−0.01	−0.06
Alcohol	0.18	0.17	0.16
Calcium	0.07	−0.15	−0.09
Iron	−0.06	−0.26	0.22
Potassium	−0.01	−0.16	0.15
Sodium	0.11	−0.10	0.16
Vitamin A	0.06	−0.27	0.13
Vitamin C	0.12	0.00	0.10
Vitamin D	−0.04	0.09	−0.12
Vitamin E	0.03	−0.10	0.13
Folate	0.06	−0.32 *	0.22
Total Dietary Score	0.05	−0.10	0.27

*
(p < .05)

ABI = ankle-brachial index

hsCRP = high sensitivity C-reactive protein

6MWD = 6-minute walk distance

Table IV.

Regression coefficient summary for binary dietary variables* included in multivariable regression models on ABI, log transformed high-sensitivity C-reactive protein, and 6-minute walk distance in patients with peripheral artery disease and intermittent claudication.

Outcome and Predictor Variables	Estimate (SE)	95% CI	Partial R ²	P Value
Outcome: ABI				
<u>Predictor:</u>				
Total Sugars	0.27 (0.06)	0.15, 0.40	0.37	< .001
Outcome: log hsCRP				
<u>Predictors:</u>				
Total Omega-3 polyunsaturated fatty acids	-1.40 (0.40)	-2.17, -0.62	0.27	.001
Potassium	-0.95 (0.46)	-1.85, -0.04	0.11	.049
Sodium	0.83 (0.40)	0.03, 1.62	0.11	.049
Dietary Score Index	-0.99 (0.53)	-2.04, 0.05	0.09	.072
Outcome: 6MWD				
<u>Predictors:</u>				
Folate	97.70 (36.14)	26.87, 168.53	0.18	.011
Dietary Score Index	122.01 (46.88)	30.11, 213.90	0.17	.014
Vitamin E	130.87 (65.48)	2.52, 259.22	0.11	.054

* Binary dietary variables were recorded either as a value of 0 (does not meet the daily recommendation) or as a value of 1 (meets the daily recommendation).

Regression models were adjusted for age, sex, race, smoking, hypertension, dyslipidemia, body mass index, and percentage body fat.

ABI = ankle-brachial index, hsCRP = high sensitivity C-reactive protein, 6MWD = 6-minute walk distance