An intricate interaction: Dietary fatty acid intake influences hypertension risk

February 21 2019

Characteristics	All subjects	Hypertension	Normal BP	P value
No. of subjects	633	350	283	
Men, n (%)	299 (47)	196 (56)	103 (36)	<0.001
Age	61.0 (11.5)	64.5 (10.7)	56.7 (11.0)	<0.001
Smoking status, n (%)				0.311
Never or Ex-smoker	503 (79)	273 (78)	230 (81)	
Current	130 (21)	77 (22)	53 (19)	
Drinking habit, n (%)				<0.001
yes	268 (42)	178 (51)	90 (32)	
no	365 (58)	172 (49)	193 (68)	
Exercise habit, n (%)				0.496
yes	345 (55)	195 (56)	150 (53)	
no	288 (45)	155 (44)	133 (47)	
Height (cm)	160 (9.65)	160 (9.79)	160 (9.48)	0.233
Weight (kg)	59.9 (11.8)	61.4 (11.5)	58.0 (11.9)	0.419
Waist circumference (cm)	83.8 (9.26)	85.5 (9.02)	81.6 (9.13)	0.755
BMI (kg/m2)	23.2 (3.24)	23.8 (3.17)	22.4 (3.18)	0.755
SBP (mmHg)	139 (20.4)	151 (18.3)	124 (9.10)	<0.001
DBP (mmHg)	80.7 (11.8)	85.7 (12.2)	74.5 (7.44)	<0.001
HbA1c [NSGP] (%)	5.82 (0.605)	5.85 (0.593)	5.78 (0.617)	0.134
Energy and Nutrients				
Energy (kcal)	1863 (616)	1895 (625)	1822 (604)	0.142
Nutrients (g/1000kcal)				
Protein	38.1 (8.18)	38.0 (8.64)	38.3 (7.58)	0.637
Carbohydrate	134.1 (21.1)	134 (22.2)	134 (19.6)	0.933
Sodium	2.45 (0.540)	2.49 (0.540)	2.39 (0.536)	0.024
Potassium	1.39 (0.430)	1.39 (0.454)	1.39 (0.400)	0.934
Calcium	0.294 (0.113)	0.294 (0.114)	0.294 (0.111)	0.955
Total dietary fiber	6.54 (2.19)	6.59 (2.29)	6.48 (2.07)	0.528
SFA	7.27 (2.17)	6.87 (2.06)	7.76 (2.21)	<0.001
MUFA	9.76 (2.65)	9.33 (2.69)	10.3 (2.51)	<0.001
PUFA	6.82 (1.74)	6.62 (1.76)	7.06 (1.69)	0.002
n-3 fatty acid	1.48 (0.503)	1.48 (0.504)	1.49 (0.503)	0.728
n-6 fatty acid	5.30 (1.41)	5.12 (1.43)	5.54 (1.34)	<0.001
LA	5.15 (1.38)	4.96 (1.40)	5.38 (1.32)	<0.001
GLA (mg/1000kcal)	4.09 (2.68)	3.94 (2.41)	4.26 (2.98)	0.151
EA (mg/1000kcal)	24.6 (8.54)	23.7 (8.60)	25.6 (8.36)	0.005
DGLA (mg/1000kcal)	16.0 (5.10)	15.4 (5.22)	16.6 (4.88)	0.003
AA (mg/1000kcal)	92.7 (30.7)	90.4 (31.8)	95.5 (29.1)	0.037
DPA (mg/1000kcal)	5.25 (3.26)	5.35 (3.20)	5.14 (3.34)	0.437

Participant characteristics in different blood pressure groups. Continuous variables are presented as mean (standard deviation). For continuous variables, we used Student's t-test to examine sex differences; for categorical variables, we used a chi-squared test to examine sex differences. Hypertensive subjects were defined as participants with SBP > 140 mmHg, DBP > 90 mmHg, or the use of antihypertensive medication. Abbreviations: AA, arachidonic acid; BMI, body mass index; BP, blood pressure; SBP, systolic blood pressure; DBP, diastolic blood pressure; DGLA, dihomo-gamma-linolenic acid; DPA, docosapentaenoic acid; EA, eicosadienoic acid; GLA, gamma-linolenic acid; HbA1c, hemoglobin A1c; LA, linoleic acid; MUFA, monounsaturated fatty acid; PUFA, polyunsaturated fatty acid; and SFA, saturated fatty acid. Credit: Kanazawa University

Hypertension is an important public health problem that can lead to life-threatening cardiovascular events, including heart attack and stroke. Many studies have attempted to understand the complex relationship between dietary factors and hypertension; none have provided a clear explanation of the interaction between hypertension and dietary intake of n-6 fatty acids (a building block of fat), until now.

In a new study published in *Nutrients*, a research team from Kanazawa University investigated the relationship between dietary intake of n-6 fatty acids and hypertension, using blood pressure measurement and a diet history questionnaire, and found that the relationship between dietary intake of n-6 fatty acids and hypertension was influenced by diabetes status.

"There have been conflicting reports of the relationship between dietary intake of n-6 fatty acids and risk of hypertension," says Hiroyuki Nakamura, corresponding author on the study. "Metabolites of n-6 fatty

acids can lower blood pressure in a manner influenced by blood glucose levels. Therefore, we suspected that the relationship between dietary intake of n-6 fatty acids and risk of hypertension might be affected by glucose tolerance, which is impaired in patients with diabetes."

In the study, the researchers found that the relationship between dietary intake of n-6 fatty acids and hypertension differed according to whether subjects had diabetes; in healthy subjects, high intake of n-6 fatty acids was significantly associated with hypertension, whereas high intake of n-6 fatty acids was inversely associated with hypertension in subjects with diabetes.

Nutrition	HbA1c level	Hypertension	Normal BP	P value for interaction
		Average (SD)	Average (SD)	
n-6 fatty acid (g/1000kcal)	Normal	5.12 (1.31)	5.59 (1.33)	0.035
	High	5.11 (1.10)	4.54 (1.22)	
LA (g/1000kcal)	Normal	4.96 (1.43)	5.42 (1.31)	0.033
	High	4.94 (1.09)	4.37 (1.21)	

Interaction between blood pressure and hemoglobin A1c groups by n-6 fatty acid intake. P values for interaction from two-way analysis of variance. Hypertension was defined as the use of antihypertensive medication or BP of

"Our analyses revealed a relationship between dietary intake of n-6 fatty acids and glycated hemoglobin in the blood (our definition of diabetes), which has not been previously established," says Haruki Nakamura, lead author on the study. "A previous meta-analysis showed that higher intake of a diet rich in linoleic acid (the main fatty acid in the n-6 fatty acids class) was significantly associated with higher risks of death from all causes, cardiovascular disease, and coronary heart disease in subjects with cardiovascular disease. Therefore, our results indicate that n-6 fatty acid intake may have no cardiovascular benefit in subjects

who are at risk for cardiovascular disease or diabetes."

In addition to the reduction of hypertension associated with increased dietary intake of n-6 fatty acids by healthy individuals, the researchers showed no benefit, and possible hypertension-related harm, from increased dietary intake of n-6 fatty acids by patients with diabetes.

Hypertension is an important risk factor for a variety of destructive cardiovascular injuries. This study showed that increased dietary intake of n-6 fatty acids could positively impact the risk of hypertension, but that this benefit is limited to individuals who do not have impaired glucose tolerance.

HbA1c level	Nutrition	Model 1	Model 2
		OR (95% CI, P value)	OR (95% CI, P value)
All subjects	*n*-6	0.898 (0.788 to 1.022, 0.104)	0.884 (0.771 to 1.013, 0.077)
	LA	0.899 (0.787 to 1.026, 0.114)	0.886 (0.771 to 1.019, 0.089)
High HbA1c	*n*-6	3.676 (1.060 to 12.76, 0.040)	3.618 (1.019 to 12.84, 0.047)
	LA	3.993 (1.090 to 14.63, 0.037)	3.986 (1.050 to 15.13, 0.042)
Normal HbA1c	*n*-6	0.870 (0.761 to 0.995, 0.041)	0.857 (0.744 to 0.987, 0.032)
	LA	0.885 (0.759 to 0.997, 0.045)	0.858 (0.744 to 0.991, 0.037)

Association between n-6 fatty acid intake and hypertension by HbA1c level. Model 1: P values from multiple logistic regression analysis after adjustments for the following independent factors: sex (male subjects or female subjects), age (continuous), BMI (continuous), frequency of exercise (yes or no), and smoking status (non-smokers, ex-smokers, or current smokers). Model 2: P values by a multiple logistic regression analysis after adjustments for all variables in Model 1, plus drinking habits and consumption of sodium; sex (male or female), age (continuous), BMI (continuous), frequency of exercise (yes or no), smoking status (non-smokers, ex-smokers, or current smokers), drinking habits (yes or no), and sodium intake (continuous). Forty-one participants had a high HbA1c level; 592 participants had a normal HbAc1 level. Hypertension subjects were defined as participants with SBP > 140 mmHg, DBP > 90 mmHg, or the use of antihypertensive medication. Abbreviations: BP, blood pressure; CI, confidence interval; HbA1c, hemoglobin A1c; LA, linoleic acid; OR, odds ratio. Credit: Kanazawa University

More information: Haruki Nakamura et al, Relationship between Dietary n-6 Fatty Acid Intake and Hypertension: Effect of Glycated Hemoglobin Levels, *Nutrients* (2018). DOI: 10.3390/nu10121825