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## Fruits and vegetables moderate lipid cardiovascular risk factor in hypertensive patients

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### Abstract

Hyperlipidemia is a major risk factor in etiology of cardiovascular disease. Previous studies have shown association between vegetarian diet and low total serum cholesterol as well as LDL-cholesterol which is a pointer to low risk of cardiovascular disease. Dietary fiber, antioxidants and other classes of nutrients have been reported to ameliorate cardiovascular risk factors. Fruits and vegetables being rich sources of fiber and antioxidants have been the focus in intervention studies. The current work reports the effect local fruits and vegetables on cardiovascular risk factors in African hypertensive subjects in an 8 week study. Though there was no significant difference in the Body Mass Index and HDL-cholesterol at the end of the eighth week, there were significant reductions ( $P < 0.05$ ) in serum triglycerides ( $125.87 \pm 6.0$  to  $108.27 \pm 5.49$  mgdL<sup>-1</sup>); total serum cholesterol ( $226.60 \pm 6.15$  to  $179.20 \pm 5.78$ ) and LDL-cholesterol ( $135.69 \pm 5.56$  to  $93.07 \pm 7.18$  mgdL<sup>-1</sup>). We concluded that consumption of combination of local fruits and vegetables may reduce the incidence of cardiovascular risk factors in Africans.

### Introduction

Several epidemiological studies have implicated hypercholesterolemia and hypertriglyceridemia as major factors in the etiology of vascular disease [1,2]. Other prospective studies have equally shown that serum cholesterol [3], LDL-cholesterol [4], body mass index or obesity index, atherogenic index [5] and coronary risk index [6] are major risk factors in cardiovascular diseases.

Some studies have investigated the nutritional status of white and black American vegetarians [7,8]. These authors reported lower serum total and low-density lipoprotein (LDL) as well as cholesterol in vegetarians and suggested lower cardiovascular risk and essentially lower blood pressure (BP) among vegetarians. Similar results were obtained with Native African vegetarians [9].

Hypertension is a common cause of cardiovascular disorders and is essentially associated with abnormal lipid and altered glucose metabolism [10,11]. Among the classes of food that have been taken to be beneficial in reducing risk of cardiovascular disorders are fruits and vegetables due to their high level of fibres [12], antioxidants [13] and complex carbohydrates [14].

Intervention studies of disease prevention with fruits or vegetables or both in Africans are rare. It is important to determine if fruits and vegetables are associated with lower BP and blood lipid and other risk factors for cardiovascular complications.

### Materials and methods

Twenty hypertensive patients were randomly selected from the cardiovascular clinic of Olabisi Onabanjo University Teaching Hospital (OOUTH). The subjects that had been on diabetic drugs for over one year were educated on the purpose of the research work and they all consented. The average nutrients intake by the subjects using estimated food records were calculated.

Two weeks after the first table contact with the subjects, blood specimen were taken and other parameters were measured for analysis to serve as baseline. Edible portion of fairly ripe fruits (banana, pawpaw, grape fruits, tangerine and pineapple) were diced mixed together in equal weight fruits salad with exception of banana which two fingers were given per serving. Two servings of fruits salad (each measuring 100 g) were given per day. Edible green leafy vegetable including fluted pumpkin leaf, spinach and waterleaf were diced and given in 100 g portion per

day after moderate cooking. The supplementation of the normal diet of the hypertensive subjects with fruits and vegetables was carried out for eight weeks after which it was stopped for two weeks.

Out of twenty subjects, only fifteen faithfully complied with the feeding regime and this form the basis for the computation of results.

### Analytical method

After the baseline measurements, the blood specimens were taken and parameters measured at two weeks interval for a period of eight weeks. Blood Pressure values were extracted from the patients' case notes. Triglycerides, total serum cholesterol and high-density lipoprotein cholesterol (HDL cholesterol) concentration were determined by enzymatic method using analytical kits. (Randox Laboratories U.S.A). While low density lipoprotein (LDL cholesterol), was obtained by deduction. Atherogenic index (A.I) was calculated using the formula of Abot *et al.* [15] and coronary risk index (C.R.L.) was obtained by the method of Alladi *et al.* [16]. Body mass index was calculated using the method of Garrow and Webster. [17].

### Statistical analysis

The experimental design was completely randomized. The data were analyzed at 95% level of significance using the two-tale Student's test.

### Results

Table 1 shows estimated nutrient intake of subjects and the percentage difference between the baseline values and the values in the presence of fruits and vegetables. Reduc-

**Table 1: Estimated daily nutrient intake of hypertensive subjects**

Nutrient	Baseline	Fruit and vegetable supplemental diet	% Difference
Energy (calories)	13448 ± 19.60	9818.98 ± 23.00	
Carbohydrate (g)	543.30 ± 21.30	617.22 ± 10.60	
Fat and related compound (g)	28.59 ± 5.00	20.32 ± 3.00	
Protein (g)	189.10 ± 6.90	200.03 ± 4.60	
Riboflavin (mg)	5.10 ± 1.60	6.04 ± 1.90	
Vitamin C (mg)	386.50 ± 12.70	1076.26 ± 35.00	
Soluble fibre (g)	20.20 ± 8.30	35.9 ± 4.609	
Insoluble fibre (g)	6.16 ± 1.70	30.56 ± 0.60	
Total fibre (g)	26.14 ± 8.10	64.49 ± 3.56	
Niacin (mg)	14.24 ± 3.50	23.75 ± 1.80	
Thiamine (mg)	2.38 ± 1.30	4.12 ± 0.70	
Vitamin A (Iu)	2996.90 ± 27.00	4531.78 ± 14.60	
Sodium (mg)	2256 ± 57.90	1608.43 ± 45.76	
Potassium (mg)	1826.10 ± 41.30	3247.28 ± 12.90	
Calcium (mg)	1248.10 ± 46.90	1738.88 ± 26.50	
Phosphorus (mg)	1077.50 ± 23.90	2096.98 ± 36.20	
Iron (mg)	74.18 ± 1.40	81.09 ± 0.90	
Magnesium (mg)	97.40 ± 6.40	128.30 ± 1.30	

tion was noticed in intake of energy, sodium, fats and related compounds while increased was observed in all other nutrients.

Table 2 shows Body mass index (BMI) and lipid profiles of the subjects. Significant differences ( $P < 0.05$ ) were noticed between the baseline values and the eighth-week values for all the parameters except the BMI and HDL cholesterol. Also significant differences ( $P < 0.05$ ) was noticed between the eighth week values and the tenth week values in Triacylglyceride total serum cholesterol, however, no significance difference ( $P > 0.05$ ) was noticed in BMI and HDL cholesterol.

Table 3 shows a significant difference ( $P < 0.05$ ) between the baseline values and the eighth-week values in Atherogenic index and Systolic blood pressure while no significant difference ( $P > 0.05$ ) was between the eighth-week values and tenth-week values.

## Discussion

Serum cholesterol is a major causative agent in the development of coronary heart disease (CHD). Some studies have demonstrated a fall in total serum cholesterol resulting from ingestion of soluble fibre [19,20] suggesting that high cereal fiber may protect against ischemic heart disease (IHD) as well as high blood pressure, serum cholesterol and triglyceride levels. Our study with daily intake of  $\geq 3$  times of different types of fruit and vegetables totaling 500 g for 8 weeks produced significant reduction in systolic blood pressure. The reduction in the blood pressure might be due to significant high level of fibre. It has been shown that African local fruits and vegetables are rich in dietary fibre, which has been reported to have hypotensive and hypocholesterolemia effects [21]. Replacing animal products with vegetarian diets have shown reduction in blood pressure in normotensive as well as hypertensive individuals [22,23]

In a large randomized controlled trial of diet and blood pressure that provided a diet for 8 week that included 8.5 or 3.6 (control) servings of vegetables and fruit daily, the participants who consumed the higher vegetable and fruit

diet had a greater reduction in systolic and diastolic than did the control subjects [24].

Elevated serum total cholesterol, LDL cholesterol concentration, are identified risk factors for coronary artery disease [25,26]. However, in this study, we observed lower serum total cholesterol, LDL cholesterol and triacylglycerol. These results may account for the significant reduction in BP in our patients. A recent study has reported similar observation with 900 effects of garlic may be due to inhibition of hepatic cholesterol biosynthesis [29].

In another study, [21,22] African local fruits and vegetables have been shown to be rich in dietary fibre, which have been reported to have hypotensive and hypocholesterolemic effects. The plant sterols have also been shown to produce a reduction of plasma low-density lipoprotein-cholesterol and produced prolonged platelet aggregation after collagen epinephrine activation (33).

Our results indicate that fruits and vegetables associated with lower cardiovascular risk factors; lower BP, cholesterol, triglycerol and soluble fiber thus preventing premature cardiovascular disorders. We therefore conclude that consumption of a combination of fruits and vegetable may enhance healthier lifestyle resulting in the more favourable status of decreased incidence of cardiovascular risk factors.

## References

1. Fowkes FGR, Low GBO, Housley E: **Cross linked fibrin degradation products, risk of coronary heart disease and progression of peripheral arterial disease.** *Lancet* 1993, **342**:84-6.
2. Nair CH, Shats EA, Dhall DP: **Lipid and fibrin matrix: role in atherosclerosis.** *Fibrinolysis* 1996, **10**(suppl):58. abstract
3. **AHA Medical/Scientific statement: The cholesterol fats: A summary of the evidence relating dietary fats, serum cholesterol and coronary heart disease: A joint statement of American Heart Association and its National Heart Lungs and Blood Institute.** *Circulation* 1990, **81**:1721-1733.
4. **Department of Health, Nutritional aspects of cardiovascular disease: Report of the cardiovascular group.** *Committee on Medical Aspect of food policy London* 1994.
5. Larson B: **Obesity and body fat distribution as predictors of coronary heart diseases: Coronary heart Disease Epidemiology CERON etiology to public health.** Edited by: Marot M and Ehot P. Oxford University Press: UK; 1992:233-241.
6. Melby CL, Goldflies DG, Hyner GC, Lyle RM: **The relationship between vegetarian and non-vegetarian diet and blood pres-**

**Table 2: BMI and lipid profile of hypertensive subjects**

	Baseline	Week 2	Week 4	Week 6	Week 8	Week 10
<b>BMI</b>	25.53 $\pm$ 1.44	25.64 $\pm$ 1.44	25.72 $\pm$ 1.44	25.88 $\pm$ 1.45	25.79 $\pm$ 1.46	25.83 $\pm$ 1.47
Triglycerides mgdL <sup>-1</sup>	125.87 $\pm$ 6.85	131.80 $\pm$ 7.61	131.07 $\pm$ 5.56	113.67 $\pm$ 6.54	118.27 $\pm$ 10.49	105.73 $\pm$ 5.75
Total serum Chol. mgd <sup>-1</sup>	226.60 $\pm$ 6.15	213.53 $\pm$ 8.35	199.80 $\pm$ 8.34	184.53 $\pm$ 4.04	179.20 $\pm$ 5.78	190.60 $\pm$ 4.7
HDL chol mgd <sup>-1</sup>	64.53 $\pm$ 2.40	63.20 $\pm$ 5.56	62.00 $\pm$ 17	58.73 $\pm$ 1.64	62.67 $\pm$ 1.64	60.27 $\pm$ 1.25
LDL chol mgdL <sup>-1</sup>	135.69 $\pm$ 5.56	125.09 $\pm$ 7.55	112.12 $\pm$ 5.86	102.25 $\pm$ 4.67	93.07 $\pm$ 7.18	109.01 $\pm$ 4.2

**Table 3: Atherogenic index, coronary risk index and blood pressure of hypertensive subjects**

	Baseline	Week 2	Week 4	Week 6	Week 8	Week 10
Atherogenic Index	2.34 ± 0.12	2.20 ± 0.14	1.92 ± 0.11	1.93 ± 0.14	1.79 ± 0.11	1.73 ± 0.13
Coronary Risk Index	3.90 ± 0.14	3.72 ± 0.15	3.11 ± 0.11	3.39 ± 0.15	3.21 ± 0.13	3.26 ± 0.13
Systolic mm Hg	155.33 ± 7.55	152.67 ± 6.36	151.33 ± 3.63	149.33 ± 6.21	141.343 ± 3.89	143.33 ± 4.33
Diastolic mm Hg	89.33 ± 3.44	90.67 ± 3.30	94.67 ± 3.22	86.00 ± 3.49	86.00 ± 3.49	88.00 ± 2.43

- sure in black and white adults. *Am J Public Health* 1989, **79**:1283-8.
7. Melby CL, Goldfies DG, Toohey ML: **Blood pressure differences in older black and white long-term vegetarians T.** *Am Cell Nutr* :262-9.
  8. Burslem J, Schonfeld G, Howard MA, Weidman SW, Miller JP: **Plasma apoprotein and lipoprotein lipids levels in vegetarian Metabolism.** 1978, **27**:711-9.
  9. Famodu AA, Osilesi O, Makinde YO, Osonuga OA: **Blood Pressure and blood lipid levels among vegetarian, semi-vegetarian and non-vegetarian native Africans.** *Clin Biochem* 1998, **31(7)**:545-549.
  10. Kannel WB: **Pressure as a cardiovascular risk factor: Prevention and Treatment.** *JAMA* 1996, **275(20)**:1571-6.
  11. Weber MA: **Hypertension as a risk factor syndrome: therapeutic implications.** *AMJ Med* 1993, **94(4A)**:24-315.
  12. Jenkins DJA, Wolever TMS: **Dietary fibre in human nutrition.** 2nd edition. Edited by: Spiller GA. C.R.C. Press Boca Rantoh F.I; 1993:111-152.
  13. Famodu AA, Fayoka EOA, Osilesi O, Ogunledun A, Fakoya TA, Odu-soga O, Asemota El, Fakunle JB, Ogunledun A, Fakoya TA: **Dietary influence on blood pressure and haematobiological risk factors for cardiovascular disease in seventh.** *Day Adventists of the Ilisan Remo Cohort* .
  14. Olusanya EO: **Methodology in collection of food composition data. Manual on food consumption surveys in Developing Countries.** Ibadan Univ. Press Nigeria; 1976:16-17.
  15. Abot RD, Wilson PWB, Castelli WP: **HDL-cholesterol, total cholesterol screening and myocardial infarction.** *Arteriosclerosis* 1988, **8**:207-211.
  16. Allard JP, Royall D, Kurian R, Mugg R, Jeejeebhoy KN: **Effects of B-Carotene supplementation on lipid peroxidation in human.** *Am J Clin Nutr* 1994, **59**:884-90.
  17. Garrow JS, Webster J: **Outelets index (w/H2) as a measure of fatness.** *International Journal of obesity* 1985, **9**:147-153.
  18. Stamler J, Wentworth D, Neaton JD: **In relationship between serum cholesterol and risk of premature death from coronary heart disease continuous and graded Findings in 356222 primary sereness of the Mutiple Risk factor intervention trial (MRPIT).** *JAMA* 1986, **256**:2823-8.
  19. Jenkins DJA, Leeds AR, Newton C, Cunnings JH: **Effect of pectin guar gum and wheat fibre on serum cholesterol.** *Lancet* 1975, **1**:1116-7.
  20. Anderson JW, Zettwoch N, Feldman T: **Cholesterol lowering effects of Psyllium hydrophilic mucilloid for hypercholester-olmic men.** *Arch Intern Med* 1998, **148**:292-6.
  21. Osilesi O: **Influence of Dietary Energy source on hyperten-sives Nig.** *J Nutr Sci* 1998, **9(i)**.
  22. Osilesi O, Trout DL, Ogunwole JO, Glover E: **Blood pressure and plasma lipid during ascorbic acid. Supplementation on boarder line.** *Hypertensive and normotensive adults Nutr Rs* 1991, **11**:405-12.
  23. Royse IL, Beiling IJ, Armstrong BK, Vandongen R: **Blood pressure lowering effect of a vegetarian diet;Controlled trial in nor-motensive subjects.** *Lancet* 1983, **1**:5-10.
  24. Margetts BM, Beiling IJ, Vandongen R, Armstrong BK: **Vegetarian diet in mild hypertension: a randomized trial.** *Br Med J (Clin Res Ed)* 1986, **293**:1468-71.
  25. Appel IJ, Moore TJ, Obarzanel E: **A clinical trial of the effects of dietary patterns on blob pressure.** *N Engl J Med* 1997, **336**:1117-24.
  26. **The Expert Panel. Summary of the second report of the National Cholestrol Education Program (NCEP) Expert Panel on detention, evaluation and treatment of high blood cholesterol in adults (Adult Treatment Panel II).** *JAMA* 1993, **269**:3015-23.
  27. Austin MA: **Plasma triglyceride and coronary heart disease Arterioscler.** *Thromb* 1997, **11**:2-14.
  28. Adler AJ, Holub BJ: **Effect of garlic and fish oil supplementation, serum lipid and lipoprotein concentration in hypercholester-olemic men.** *Am J Clin Nutr* 1997, **65**:445-50.
  29. Gebharch R: **Multiple Inhibitory effects of garlic extracts on cholesterol biosynthesis in hepatocytes.** *Lipids* 1993, **28**:613-9.

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