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EFFECTS OF FRUITS AND VEGETABLES ON ELECTROLYTES AND BLOOD PRESSURE OF HYPERTENSIVE PATIENTS SEEN IN NIGERIA

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ABSTRACT

High-fruit and high-vegetable diets are known to have ameliorating effects on many diseases and their complications. The objective of this study was to assess the effects of high fruit and high vegetable diets on the electrolytes and blood pressure of hypertensive patients. This experimental study was conducted at Olabisi Onabanjo University Teaching Hospital (formerly Ogun State University), Ogun state, Nigeria. Twenty five hypertensive volunteers from among hypertensive clinic attendees were recruited into the study. They were taught how to prepare two serves of vegetables and fruit (approximately 500g diced fruit salad) per day and were encouraged to consume the serves on daily basis from week one through to week ten. Baseline and bi-weekly assessment of plasma electrolytes, such as sodium, potassium, chloride and bicarbonate was carried out on the patients. Anthropometric measurements and blood pressure were also assessed biweekly on the patients during their routine clinic attendance.

There was a gradual reduction in plasma sodium and chloride concentrations as well as the blood pressure which became significant in week ten. The mean baseline plasma sodium reduced significantly from 139.0 ± 0.9mmo/L to 137.5 ± 0.9ml/L, $P < 0.001$ after ten weeks of high fruit and high vegetable diets. Plasma chloride also reduced from baseline value of 103.2 ± 2.5mmol/L to 98.8 ± 0.7mmol/L, $P < 0.0001$. But the plasma potassium improved from 3.64 ± 0.2mmol/L at baseline to 3.9 ± 0.4mmol/L at week ten, $P = 0.0357$. The mean systolic blood pressure also dropped from the baseline value of 155.3± 7.6mmHg to 141 ± 2.4 mmHg, $P < 0.0001$. Also reduced was the mean diastolic blood pressure from 89.3 ± 7.6mmHg to 88.0 ± 2.4, at week ten. However, the plasma bicarbonate and BMI did not charge significantly throughout the study period.

High-fruit and high-vegetable diets appear to have an ameliorating effect on the blood pressure of hypertensive patients. This may be beneficial and complementary in the management of hypertension.

Key Words: Hypertension, Fruits and Vegetables, Electrolytes.

INTRODUCTION

Epidemiologic data support the association between high intake of vegetables and fruits and low risk of chronic diseases[1]. There are several biological plausible reasons why consumption of vegetables and fruits might slow or prevent onset of chronic diseases. Vegetables and fruits are rich sources of a variety of nutrients including vitamins, trace minerals and dietary fiber and many other classes of biologically active compound, which may include antioxidants [2]. To date, intervention studies of disease prevention with fruits and vegetables or both in Africans are rare. It is important to determine if fruit and vegetable diets are associated with lowering of blood pressure and other compounding risk factors for cardiovascular complications. The objective of this paper is to examine the effects of fruits and vegetables on the electrolytes and blood pressure of hypertensive patients seen in Sagamu, (a city with total population of 127500) in Ogun State of Nigerian.

PATIENTS AND METHODS

It was an experimental study (a single group quasi-experimental design) on the effects of high vegetable and high fruits diets on the electrolytes of hypertensive patients. Twenty-five hypertensive patients were randomly recruited from the cardiovascular clinic of Olabisi Onabanjo University Teaching Hospital (OOUTH) in Nigeria that has 20% prevalence of hypertension [3]. All registered hypertensive patients of the clinic that met the criteria were eligible to participate in the study. The criteria for selection were patients who have earlier been diagnosed as hypertensive patients on non diuretic drug treatment**.** Hypertension was defined as diastolic blood pressure ≥90 mmHg and systolic blood pressure ≥140 mmHg[4]. Patients with diseases that could affect vascular resistance such as diabetes mellitus infections and overt renal diseases were excluded. Also excluded were patients on diuretic therapy. Patients were educated on the purpose of the research work and they all consented, after ethical approval was obtained from the institution.

Baseline data collection included medical history, dietary history, standardized medical examination, and anthropometric measurements of the patients. Blood pressure, body weights and heights were obtained with the use of standard protocols as in other related studies [5,6]. The subjects were trained to include into their usual food consumption edible portion of fairly ripe fruits (banana, pawpaw, grape fruits, tangerine and pineapple). These fruits were diced mixed together in equal weight fruits salad [7]. Two servings of the fruit salad (each measuring 100g) were given per day. Edible green leafy vegetable including fluted pumpkin leaf, spinach and water leaf were diced and given also in 100g portion per day after moderate cooking; a daily total of 500g both fruits and vegetables, as earlier documented by *Adebanwo et al*[7]. This supplementation of the normal diet of the hypertensive subjects with fruits and vegetables was carried out for ten weeks. Blood pressure, electrolytes and Body mass index (BMI) were assessed every two weeks during the study. The measured electrolytes were sodium, potassium, chloride and bicarbonates. Blood pressures were

measured with standard sphygmomanometer. Two seated blood pressure measurements were taken for each subject and spaced two minutes apart. All measurements were performed on the left arm by using the appropriate cuff size. Weights kg) and heights (m) were measured as earlier documented by Idogun et al [8]. BMI were calculated using the formula of Garrow and Webster [9]. Sodium and potassium were measured in plasma using a flame photometer [10]. Bicarbonate and chloride were measured by simple titration methods [10].

Fifteen out of the initial 25 patients recruited for the study satisfactorily completed the study that lasted for a total duration of six months**.** Statistical analysis was by computer soft ware; Instat graph pad V2.05a. Student 2 tail 't' test was used for statistical comparison, at 95% CI.

RESULTS

The mean age of the patients was 64.13 ± 1.24, 8(53.3%) were males and females were 7(47.3%). Table I shows the mean baseline values of all the assessed variables and their biweekly changes. Plasma sodium concentration was significantly reduced from 139 ± 0.8mmol/L (baseline concentration) to 137.5 ± 0.9mmol/L (10^{th} week concentration) $P < 0.0001$ ('t' test). Potassium concentration changed significantly from 3.6 ± 0.2mmol/L to 3.9 ± 0.4mmol/L, $P = 0.0357$, after 10^{th} week. The mean plasma chloride reduced significantly from baseline value of 103.2 ± 2.5mmol/L to 98.8 ± 0.7mmol/L by the 10^{th} week of the study, $P< 0.0001$ ('t' test). Similarly, the mean systolic blood pressure of 155.3 ± 7.6 mmHg at baseline was higher than the week ten mean blood pressure of 141.3 ± 4.3mmHg, $P< 0.0001$. Mean diastolic blood pressure at week ten was lower than the baseline diastolic blood pressure; 88.0 ± 2.4 mmHg and 89.3 ± 7.6 mmHg respectively, $P = 0.5365$, although not significant statistically ('t' test). However, the BMI did not change significantly from baseline through to week ten, table II.

DISCUSSION

Vegetables and fruits are rich sources of vitamin C, vitamin E, folic acid, and the vitamin A precursor beta-carotene. Epidemiologic studies often report an inverse association between these specific vitamins as well as vegetables and fruit intake and disease risk [11,12].

Our study showed systolic and diastolic (although statistically not significant) blood pressure reduction in hypertensives placed on high vegetables and fruit diets. This is similar to findings in other studies [13, 14, 15]. Extensive studies of phytochemicals in cell-culture systems and animal models have provided a wealth of information on the mechanism by which a diet high in fruits and vegetables may lower the risk of chronic disease in humans [16]. The mechanism of actions through which fruits and vegetables reduced blood pressure, is that they are a rich sources of a variety of nutrients, including vitamins, trace minerals and dietary fibers and many other classes of biologically active compounds [16]. These phytochemicals can have

complementary and overlapping mechanisms of action, including modulation of detoxification enzymes, stimulation of the immune system, reduction of platelet aggregation[5], modulation of cholesterol synthesis, hormone metabolism and reduction of blood pressure, antibacterial and antiviral effects[16].

In our study, there is reduced level of plasma sodium and chloride, which could explain the lowered systolic and diastolic blood pressure after ten weeks of dietary supplement with vegetables and fruits treatment seen in our patients. Blood pressure control is important for the prevention of complication of hypertension such as heart disease, kidney disease and stroke. One of the major biochemical changes in hypertension is imbalances in the renin-angiotensin system, which increases sodium and chloride retention in the body. It has long been established that a low salt diet may have a beneficial role in the control of high blood pressure. We hypothesized that high fruits and vegetables diets help in renal excretion of sodium and chloride ions.
Changes in the ecosystem and the sudden explosion and popularity of refined food product in our society, means that the natural food components such as fibers, magnesium, vitamin C, vitamin E and beta-carotene may now be deficient in our diets. Lower intakes of fat and higher intakes of dietary fiber and minerals such as potassium and magnesium are aspects of a high-vegetable, high-fruit diets believed to reduce blood pressure [14, 15,16]. The result of our study clearly agrees with these other studies [13, 14,15,16].

Famodu et al have also demonstrated similar beneficial role of high-vegetable, high-fruit diets in the control of cardiovascular risk factors [5, 6,17]. Drug management of hypertension and its complications is expensive especially to the poor in our society. The electrolyte effects and the blood pressure lowering effects of high-fruit, high-vegetable diets may serve as important complementary role in the treatment and prevention of hypertension in our community.

Limitations of the study:
Sample size calculation using 95%CI, 0.05 precision and 20% prevalence of hypertension in Nigeria is much higher than 25; eligibility criteria excluded many prospective participants. Among those who started the study, some of the patients lost motivation and were allowed to voluntarily withdraw from the study. Some patients complained of loose stools and were also advised to withdraw so also were patients whose blood pressure control required diuretic therapy. A healthy control group was not feasible because of cultural and ethical issues. However those who completed the study did not differ significantly from those that dropped out, thus our findings are valid and relevant for further investigations.

CONCLUSION

We report the positive effects of high-vegetables and high-fruits diets on the electrolytes and the B.P of hypertensive Nigerians. We are of the opinion that this finding could play a complementary role in the management and prevention of hypertension.

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Table 1: A profile of the clinical parameter from Baseline to week 10.

Parameter	Baseline	Second week	Fourth week	Sixth week	Eight week	Tenth week
Sodium (mmol/L)	139.0 ±0.9	139.0 ± 4.1	138.4 ± 1.0	137.4 ± 1.2	137.4 ± 11.0	137.5 ± 0.9
Potassium (mmol/L)	3.6 ± 0.2	3.7 ± 0.3	3.8 ± 0.2	3.7 ± 0.2	3.8 ± 0.2	3.9 ± 0.4
Chloride (mmol/L)	103.2 ± 2.5	102.1 ± 2.6	102.1 ± 2.6	101.6 ± 2.7	98.7 ± 0.7	98.8 ± 0.7
Bicarbonate (mmol/L)	25.4 ± 0.3	25.8 ± 0.5	25.6 ± 0.5	26.1 ± 0.5	25.7 ± 0.5	25.6 ± 0.4
Systolic B.P (mmHg)	155.3 ± 7.6	152.7 ± 6.4	151.33 ± 3.6	149.33 ± 6.2	141.3 ± 3.9	143.3 ± 4.3
Diastolic B.P (mmHg)	89.33 ± 7.6	90.7 ± 3.3	94.7 ± 3.2	86.7 ± 3.3	86.0 ± 3.4	86.0 ± 2.4
BMI (kg/m^2)	25.5 ± 1.4	25.6 ± 1.4	25.7 ± 1.4	25.9 ± 1.5	26.2 ± 1.5	25.8 ± 1.5

All averages are means ± standard deviations.

Table 2: A comparison of the clinical parameters between baseline and 10th week values.

Parameter	Baseline	Tenth week	P-value	S/NS
Sodium (mmol/L)	139.0 ± 0.9	137.5 ± 0.9	P <0.0001	S
Potassium (mmol/L)	3.64 ± 0.2	3.9 ± 0.4	P = 0.0357	S
Chloride (mmol/L)	103.0 ± 2.5	98.8 ± 0.7	P = < 0.0001	S
Bicarbonate (mmol/L)	25.4 ± 0.3	25.6 ± 0.4	P = 0.1339	NS
Systolic B.P (mmHg)	155.3 ± 7.6	141.3 ± 4.3	P = < 0.0001	S
Diastolic B.P (mmHg)	89.3 ± 7.6	86.000 ± 2.4	P = 0.5365	NS
BMI (kg/m^2)	25.5 ± 1.4	25.8 ± 1.5	P = 0.4696	N/S

All averages are means ± standard deviations.

N:B. S = Significant statistically

NS = Not significant statistically

REFERENCES

1. **Khaw KT and E Barret – Cannor** Dietary Potassium and stroke-associated mortality; a 12 year prospective population study. *Engl. J. Med*. 1987; **3116:** 236-40.

2. **Tribble DL** Antioxidant consumption and risk of coronary heart disease, emphasis on vitamin C, vitamin E and beta-carotene; a statement for health care professionals from the American Heart Association. *Circulation* 1999; **99:**591 – 5.

3. **Onwubere B and S Kadiri** (eds). Guidelines for the management of hypertension in Nigeria.Ezu Books Ltd. Enugu. 2005

4. **The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and treatment of High Blood Pressure** (JNC7). Http://www.nhlbi.gov/.

5. **Famodu AA, Fakoya EAO, Osilesi O, Makinde YO, Osunuga OA, Asemota EI, Fakunle L, Ogunledun A and TA Fakoya** Dietary influence on blood pressure and haemorheological risk factors for cardiovascular disease in Seventh Day Adventists of the Ilisan-Remo Cohort. *Nig. J. Nutr. Sci;* 1998; **19:** 1- 5.

6. **Famodu AA, Osilesi O and YO Makinde** The influence of vegetarian diet on haemostatic risk factors for cardiovascular disease in African. *Thromh Res.* 1999; **95:** 31 – 36.

7. **Adebawo OO, Salau B, Ezima E, Oyefuga O, Idowu G, Famodu AA and O Osilesi** Fruits and vegetables moderate lipid cardiovascular risk factors in hypertensive patients. *Lipids in Health and Disease*, 2006, **5:**14. http://www.lipidworld.com/content/5/1/14

8. **Idogun ES, Unuigbe EI, Famodu AA and OT Akinola** Body Mass Index in type 2 Diabetes Mellitus complications: Hypertensive Diabetics and Diabetic Nephropathy. *The Nigerian Post Graduate Medical Journal* 2006 **13:** 17 – 20.

9. **Garrows JS and J Webster** Quetelets index (wt/Ht^2) as a measure of fatness. *International J. Obesity* 1985; **9:**147 – 153.

10. **John GT and JJ Pamela** Electrolytes In: Michael LB, Janet LD, Edward P.F, (Eds). Clinical chemistry, principles, procedures and correlations 2nd Ed. Philadelphia, Linppincot Company, 1992; 272 – 281.

11. **Steinmetz KA and JD Potter** Vegetable, fruit and cancer prevention: a review. *J Am Diet Assoc 1996;* **96:**1027 – 39.

12. **Serdula MK, Byers T, Mokdad AH, Simoes E, Mendlien JM and RJ Coates** The association between fruit and vegetable intake and chronic disease risk factors. *Epidemiology* 1996; **7:**161 – 5.

13. **Ness AR and JW Poweles** Fruit and vegetables, and cardiovascular disease: a review *Int. J. EPidemiol* 1997; **26:** 1 – 13.

14. **Rouse IL, Beilin LJ, Armstrong BK and R Vandongen** Blood pressure lowering effect of a vegetarian diet: controlled trial in normotensive subjects. *Lancet* 1983; **1:**5 – 10.

15. **Margetts BM, Beilin LJ, Vandogen R and BK Armstrong** Vegetarian diet in mild hypertension: a randomized controlled trial. *Br Med J (Clin Res Ed)* 1986; **293:** 1468 – 71.

16. **Johama W** Health effects of vegetables and fruit: assessing mechanisms of action in human experimental studies. *AM. J Clin Nutri* 1999; **70:** 4755 – 905.

17. **Famodu AA, Osilesi O, Makinde YO and OA Osunuga** Blood pressure and blood lipid levels among vegetarian, semi vegetarian, and non-vegetarian native Africans. *Clinical Biochemistry*, 1998; **31:** 545 – 49.