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RESEARCH PAPER

FRUITS INTAKE AND CARDIOVASCULAR FUNCTION IN NORMOTENSIVE YOUNG ADULTS: A 4-WEEK STUDY

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ABSTRACT

This study assessed the effect of increase fruits intake on cardiovascular health as specified by blood pressure and pulse rate. It is a 4 week study involving 70 apparently healthy normotensive students, between the ages of 20–30 years. They were recruited from the Department of Physiology, College of Medicine, Ambrose Alli University, Ekpoma and grouped into 7 (A - G). While group A received no fruit for the period of the study, B – G received as follows; guava, carrot, orange, apple, banana and a combination of all five fruits respectively. Blood pressure and pulse rate were determined before and after the study to assess the level of cardiovascular health. The results showed that blood pressure and pulse rate remained normal throughout the study. However, blood pressure and pulse rate fell non- significantly ($p > 0.05$) in the treatment groups than those of the controls and as well as the values before treatment. Comparatively, carrot had the most percentage impact on systolic pressure (6.0%) while Apple had the most impact on diastolic pressure (8.81%) and pulse rate (8.49%). Thus, fruits intervention in normotensive subjects is recommendable and may even be more beneficial for hypertensive individuals considering its clinical advantage.

Key words: **Phyto-chemical, Fruits, Hypertension, Blood pressure, Pulse rate**

INTRODUCTION

According to Lampe (1999), extensive study of phytochemicals in cell-culture systems and animal models has provided a wealth of information on the mechanisms by which the risk of chronic disease may be lowered in humans. Although, thousands of biologically active phytochemicals have been identified in plant foods; vegetables and fruits are with the most botanically diversity (Lampe, 1999). In the Dietary Approaches to Stop Hypertension (DASH), the diet emphasizing fruit and vegetable intake significantly reduced blood pressure (BP) (Appel et al., 1997; Svetkey et al., 1999; Sacks et al., 1999).

Hypertension is the largest contributor to deaths and a major risk factor for cardiovascular disease, renal disease, and other morbidities, world-wide (Lopez et al., 2001; Danaei et al., 2009). Among many known modifiable risk factors, diet plays a prominent role in the development of hypertension (Wang et al., 2012). Increasing intake of fruits, vegetables and cereals in the diet is currently advocated as a measure to control hypertension (Appel et al., 1997; John et al., 2002).

A diet rich in vegetables and fruit may provide protection against cardiovascular disease (Ness and Powles, 1997), several common cancers (Steinmetz and Potter, 1996; World Cancer Research Fund/American Institute for Cancer Research, 1997) and other chronic diseases (Lampe, 1999). According to Appel et al., (2006), dietary change can lower BP, prevent the onset of hypertension, and reduce the risk of hypertension related clinical complications.

Short-term intensive dietary interventions in highly selected populations, increased fruit and vegetable intake substantially raise plasma antioxidant concentrations (Zino et al., 1997) and lower BP (Appel et al., 1997), whether such interventions are feasible in the general population is uncertain (John et al., 2002).

The question in relation to the DASH is "what the case of increased fruits intake may be in non hypertensive individual" and thus the justification of this study. This study assessed the effect of an intervention to fruits intake on cardiovascular health as indicated by systolic and diastolic blood pressure and pulse rate in normotensive young adults.

MATERIALS AND METHODS

Protocol: The study was conducted in compliance with the Declaration on the Right of the Patient (WMA, 2000). In addition, National protocols for utilizing human subjects were closely adhered to.

Study duration: The study lasted a period of three months (August - November, 2011). However, the actual fruits intake period is for four weeks (3rd October to 31st October, 2011).

Test materials: Fresh fruits were gotten from the local market in Ekpoma. The fruits included; Guava, Carrot, Orange, Apple, Banana.

Study subjects: Seventy normotensive male students volunteered for the study after obtaining informed consent. They were chosen randomly from the Department of Human Physiology, Ambrose Alli University and were within the ages of 22 – 30 years. Criteria for inclusion into the study included; subjects with no physical and pathological histories, BMI between 65 and 75kg/m^2, and must not have been on drugs for two months prior to this study.

Data collection, procedure and analysis: Body weight, blood pressure and heart rate were recorded with standardized procedure before, weekly and after the study. Body weight was assessed in light clothing and without shoes using weighing scale (Made in China). Participants' blood pressure and heart rate were determined using upper arm digital sphygmomanometer (Made in China) after allowing the subject to sit for 10mins in the sitting position. This was repeated three times at an interval of 5mins and the average taken and recorded for that subject.

Statistical analysis was performed using SPSS windows version 17. All values were expressed as mean ± SD. For all generated data, statistical differences were assessed by independent sample t-test. P values of ≤ 0.05 were considered significant using the one way analysis of variance (ANOVA).

RESULTS

Table 1, 2 and 3 present the data of systolic blood pressure, diastolic blood pressure and heart rate respectively. The average body weight of control volunteers (n=10) and test volunteers (n=10 in each) were comparable and P- value indicates that there was no significant change in body weight.

Except for the control, systolic blood pressure after 4 weeks of fruit intake (group B – G) was lower than the corresponding basal pressure. Carrot (group C; 5.99%) had the greatest effect on systolic blood pressure. Similarly, diastolic blood pressure was lower in test groups after the 4 weeks of fruits supplementation. Apple intake group recorded the highest effect on diastolic blood pressure.

Table 1: Comparative table of Systolic blood pressure during a 4-week fruits intervention study

	Systolic blood pressure (mmHg)		%Impact {(B-A)/B}x100
	Before (B)	**After (A)**	
Control	119.80±4.97^a	121.50±7.77^a	-1.12
Guava	117.40±5.18^a	112.40±3.44^a	4.26
Carrot	120.20±8.07^a	113.00±6.20^a	5.99
Orange	116.80±5.67^a	111.60±8.26^a	4.45
Apple	117.00±6.52^a	116.60±8.62^a	0.34
Banana	117.40±7.77^a	113.00±6.48^a	3.75
All	118.00±4.06^a	114.20±6.18^a	3.22

Values are mean ± SD; values in a column and a row having different superscript indicate significance different (p≤0.05)

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On pulse rate, reduction was observed in all the groups and even with the control group. Similarly, apple had the most reduction impact.

No significant change (P>0.05) was observed in blood pressure and pulse rate after fruits intake (within group) and between the different groups.

Table 2: Comparative table of diastolic blood pressure during a 4-week fruits intervention study

	Diastolic blood pressure (mmHg)		%Impact {(B-A)/B}x100
	Before (B)	After (A)	
Control	70.80±6.38[a]	73.20±3.18[a]	-3.39
Guava	69.80±5.40[a]	65.20±4.43[a]	6.59
Carrot	69.40±5.68[a]	66.60±7.40[a]	4.03
Orange	70.20±7.46[a]	67.40±5.32[a]	3.99
Apple	70.40±6.80[a]	64.20±2.28[a]	8.81
Banana	69.20±6.98[a]	67.00±4.64[a]	3.18
All	71.00±8.09[a]	67.20±7.36[a]	5.35

Values are mean±SD; values in a column and a row having different superscript indicate significance different (p≤0.05)

Table 3: Comparative table of pulse rate during a 4-week fruits intervention study

	Pulse rate (b/min)		%Impact {(B-A)/B}x100
	Before (B)	After (A)	
Control	74.40±7.37[a]	71.70±7.19[a]	3.63
Guava	79.60±10.16[a]	74.60±4.22[a]	6.28
Carrot	74.80±9.20[a]	71.80±4.55[a]	4.01
Orange	77.80±11.21[a]	73.20±9.83[a]	5.91
Apple	75.40±11.61[a]	69.00±6.28[a]	8.49
Banana	77.60±6.58[a]	74.00±12.51[a]	4.64
All	74.20±7.33[a]	70.00±7.48[a]	5.66

Values are mean±SD; values in a column and a row having different superscript indicate significance different (p≤0.05)

DISCUSSION

Systolic blood pressure is the maximum pressure exerted in the arteries during a heartbeat while diastolic blood pressure is the pressure between heartbeats. The results of this study suggest that increased fruits intake influences blood pressure. Several other studies have evaluated the intervention of fruits and reported their importance in the management of hypertension (Ascherio et al., 1992; Ascherio et al., 1996; Steffen et al., 2005; Miura et al., 2004; Nuñez-Cordoba et al., 2009; Tsubota-Utsugi et al., 2011).

Although hypertension is regarded as a multi-factorial disorder in which a myriad of physiological mechanisms participate to elevate blood pressure (Frohlich, 1982; Sleight, 1984), the reduction of blood pressure and heart rate in this study may be explained by the vitamins and minerals content of fruits. In this regards, Chen et al. (2002) reported that studies in establishing linkages of antioxidant vitamins and minerals with hypertension are warranted.

Recall that fruits and vegetables are rich sources of antioxidant vitamins on which several studies have reported the role of vitamins in reduction of high blood pressure (*Ness et al., 1997;* Moran et al., 1993; Duffy et al., 1999; Tillotson et al., 1997). Short-term oral high-doses of zinc, vitamin C, β-carotene and alpha-tocopherol lower blood pressure, possibly via increased availability of nitric oxide (Galley et al., 1997). Levels of vitamin B12 and folic acid are also likely to influence blood pressure indirectly through the involvement of homocysteine (*Falkner et al., 2000)*.

Although antioxidant minerals like zinc and selenium have been studied for their role in hypertension, an excess of sodium intake and a defective calcium intake are both directly correlated with blood pressure values in the general population (Law et al., 1991; Cutler and Brittain, 1990).Altered plasma status of copper, zinc, magnesium and calcium in hypertension has also been reported (Chen and Sheu, 2001; Vivoli et al., 1995).

The reduction in blood pressure and pulse rate in this short term study is in accordance with several other short term studies (Kelsay et al, 1978; Singh et al, 1993; Appel et al, 1997). The question is how long will this reduction proceed? If this be the case, long term intake of fruits may lead to hypotension, which is in itself another serious complication.

Several epidemiologic studies also examined the association between habitual fruit and vegetable intake and BP change as well as risk of elevated BP or hypertension during long-term follow-up (Ascherio et al., 1992; Ascherio et al., 1996; Steffen et al., 2005; Miura et al., 2004; Nuñez-Cordoba et al., 2009; Tsubota-Utsugi et al., 2011). Of interest however, is the duration of treatment. The available varies from a single dose to years, depending on the study periods. However, there are a typically 2 weeks, 26 days (Kelsay et al, 1978), 4 weeks (Singh et al, 1993), 8 weeks (Appel et al, 1997) to 6 month (John et al., 2002) in length and long-term effects are not well studied (Lampe, 1999; John et al., 2002). If continuous fruits intake result in steady drops in blood pressure and heart rate, the falls in blood pressure and heart rate in the present study following increased fruits intake in normotensive subjects is expected to produce clinical effects.

However, of prospective observational studies, the Health Professionals Follow-up Study (Ascherio et al., 1992) and the Nurses' Health Study (Ascherio et al., 1996) reported that intake of fruits and vegetables was associated with lower BP as well as lower risk of hypertension after 4 years of follow-up. In the Chicago, baseline fruit and vegetable intake was inversely related to 7-year BP change among middle-aged men (Miura et al., 2004). The CARDIA study found that baseline fruit and vegetable intake was inversely related to 15-year incidence of elevated BP among young adults (Steffen et al., 2005).

Considering the fact that a reduction of 2 mm Hg in diastolic blood pressure to result in a decrease of about 17% in the incidence of hypertension, 6% in the risk of coronary heart disease, and 15% in the risk of stroke and transient ischaemic attack (Cook et al., 1995). The falls in blood pressure in the present study would substantially reduce cardiovascular disease at the population level. Thus, fruits intervention in normotensive subjects is recommendable and may even be more beneficial for hypertensive individuals considering its clinical advantage.

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AUTHORS' CONTRIBUTIONS

ENS Igbinovia, supervised and coordinated the study. UC Osifo, HO Otamere, WA Adisa and CN Ekhator, were involved in measurement, collection and collation of weight and blood pressure. E Imonah, mobilized the participants. All authors contributed to the preparation of the manuscript.

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