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Research Article

# ROLE OF VITAMIN C AND VITAMIN E ON HYPERTENSION

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**ABSTRACT**

**Objective:** Both Vitamin C and Vitamin E supplementation were associated with reduction in blood pressure (BP) in observational studies, although, results of clinical trials are inconsistent. The objective of our study is to conduct a clinical trial to observe the effects of oral supplementation of Vitamin C and Vitamin E on BP.

**Methods:** About 60 non-teaching staffs of our college with systolic BP more than 130 mmHg and diastolic BP more than 90 mmHg were taken as subjects and divided into two groups. Initial BP and BP after oral Vitamin C, 500 mg/day for a period of 12 weeks to Group 1 and initial BP and BP after oral Vitamin E, 200 IU/day, for a period of 12 weeks to Group 2 were recorded.

**Results:** Statistical analysis was done by paired t-test, analysis of variance (ANOVA), and least significant difference (LSD) tests. *p<0.05 was considered statistically significant. Systolic 2 and diastolic 2 – after 3 months of supplementation showed 0.161 and 0.161 which is not significant. ANOVA and LSD tests show no significant results.

**Conclusion:** Long-term trials on the effects of Vitamin C and Vitamin E supplementation on BP and clinical events are needed.

**Keywords:** Systolic blood pressure, Diastolic blood pressure, Vitamin C, Vitamin E.

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## INTRODUCTION

Vitamin C is an important antioxidant vitamin, presents in citrus fruits, vegetables, fortified beverages, and cereals [1]. Vitamin C reduces oxidative stress [2] and improves endothelial function by increasing nitric oxide production [3]. Antihypertensive effects of Vitamin C were documented as early as 1946 [4], in both animal [5,6] and human studies [7,8]. Population-based observational studies have also proved the effect of Vitamin C in reducing blood pressure (BP) [9,10]. Both Vitamins C and E are potent scavengers of free radicals that activate nitric oxide synthase in endothelial cells [11] and thereby reduce the BP [11-13]. Vitamin E inhibits the expression of adhesion molecules [14], and, consequently, vascular structural changes associated with hypertension. Vitamins C and E prevent oxidation of proteins and lipids by scavenging free radicals and thereby protect against oxidative stress [15]. Vitamin E [16,17] may modulate the interactions between cytochrome b558, the membrane-bound part of nicotinamide adenine dinucleotide (P) H oxidase that is essential for both the activity and stability of the enzyme. The previous studies have proved that in mild-to-moderate hypertensive patients, supplementation with ascorbic acid (500 mg/day) significantly improved systolic and diastolic BP (DBP) [18] and increased plasma high-density lipoprotein (HDL) cholesterol in female. The aim of the study is to explore the effect of Vitamin C and Vitamin E on hypertension and to conclude which vitamin supplement will be a better choice for hypertension.

## METHODS

Our study is a prospective study, carried out in the Department of Biochemistry at Sri Lakshmi Narayana Institute of Medical Sciences, Puducherry.

### Sample size

About 60 non-teaching staffs were enrolled as subjects after getting written informed consent.

### Inclusion and exclusion criteria

Those subjects with systolic BP (SBP) >130 mmHg and diastolic pressure >90 mmHg were enrolled. Those with uncontrolled hypertension (SBP >180 mmHg and/or DBP >100 mmHg) were excluded from the study. Ethical clearance from the institutional ethical committee was obtained. Demographic details such as age, sex, and history of underlying diseases were obtained. After measuring the initial BP using a manual sphygmomanometer, the patients were divided into two groups of 30 in each group and supplemented with oral dosage of Vitamin C 500 mg (CELIN 500, GlaxoSmithKline, Ahmadabad) (0-0-1) for Group 1 and Vitamin E, 200 IU (Evion 200) (0-0-1) for Group 2 along with their regular antihypertensive drug. The BP was recorded after a period of 12 weeks.

## RESULTS AND DISCUSSION

All data were expressed as mean±standard deviation and statistical analysis was carried out using paired t-test. To evaluate the significance between the two groups studied, analysis of variance (ANOVA) and least significant difference (LSD) tests were performed by fixing the statistical significance level at *p<0.05.

The bar diagrams (Figs. 1 and 2) represent the changes in the SBP and DBP before (1) and after (2) 3 months of Vitamin C supplementation. The results are expressed as mean ± standard error of the mean (SEM), *p<0.05 is considered statistically significant.

The results are expressed as mean±SEM; *p<0.05 is considered statistically significant.

The bar diagrams (Fig. 3 and 4) represent the changes in the SBP and DBP before (1) and after 3 months of (2) the vitamin supplementation.

### Statistical analysis

Paired t-test is done with the mean of both SBP and DBP of the "affected subjects" before the supplementation and 12 weeks after the vitamin supplementations, taking *p<0.05 as statistically significant.

From our study, we found that 2 subjects (7%) and 3 subjects (10%) receiving Vitamin C and E, respectively, showed reduction in SBP (2–4 mmHg) and DBP (2–4 mmHg). The major findings of our study are that Vitamin C and E had a mild positive effect on BP. In recent studies, it is proved that Vitamin C improves nitric oxide bioactivity [18,19] which is a potent vasodilator and can reduce the BP. This is seen to a lesser extent in our study due to the time factor and fewer subjects. Clinical studies show the BP reducing effect of Vitamin C, particularly in elderly patients [19,20]. In a Primary Prevention Project, where hypertensive patients were treated with Vitamin E, there were no clinically relevant effects on BP [21]. Another trial including supplementation with Vitamins C and E proved that the urinary microalbumin excretion and BP were decreased in the study group [22]. In another study, using 2 g of Vitamin C for 90 days showed a decrease of total cholesterol (TC),

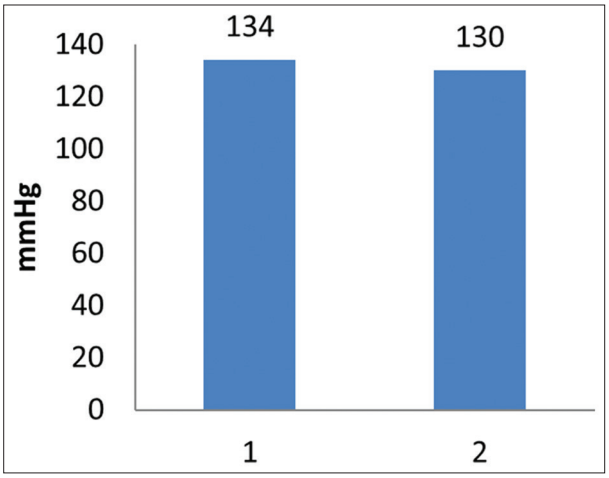


**Fig. 1: The mean of systolic blood pressures before Vitamin C supplementation was 134 mmHg while it was 130 mmHg after 3 months**

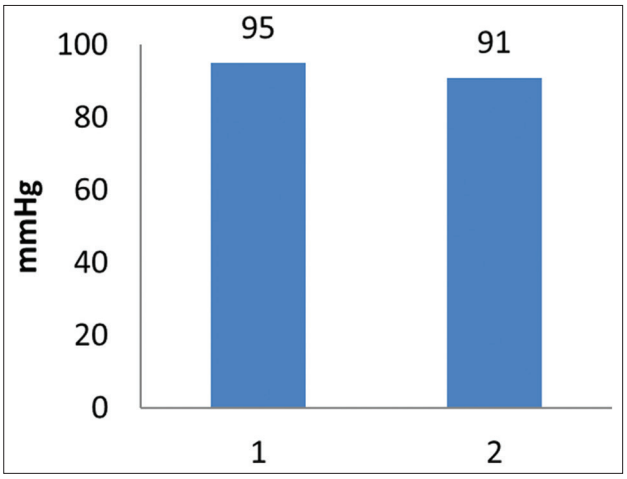


**Fig. 2: The mean of diastolic blood pressures before Vitamin C supplementation was 95 mmHg while it was 91 mmHg after 3 months**

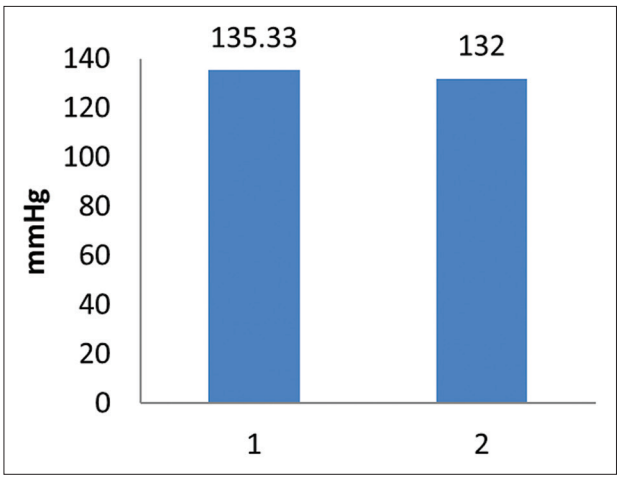


**Fig. 3: The mean of systolic blood pressures before Vitamin E supplementation was 135.3 mmHg while it was 132 mmHg, after 3 months**

**Table 1: Vitamin C: Paired samples test**

| | Paired differences | t | df | Sig. (two tailed) |
|---|---|---|---|---|
| | 95% confidence interval of the difference | | | |
| | Upper | | | |
| Pair 1 | | | | |
| Systolic: 1, Systolic: 2 | 0.6456 | 1.439 | 29 | 0.161 |
| Pair 2 | | | | |
| Diastolic: 1, Diastolic: 2 | 1.7735 | −0.797 | 29 | 0.432 |

Pair 1: Pair 1 is systolic blood pressure 1 and 2 (before and after 12 weeks of supplementation, respectively). Taking *p<0.05, as statistically significant, value of pair 1 is 0.161 which is not statistically significant. Pair 2: Pair 2 is diastolic blood pressure 1 and 2 (before and after 12 weeks of supplementation, respectively). Taking *p<0.05, as statistically significant, value of pair 1 is 0.161 which is not statistically significant

**Table 2: Vitamin E: Paired samples test**

| | Paired differences | t | df | Sig. (two tailed) |
|---|---|---|---|---|
| | 95% confidence interval of the difference | | | |
| | Upper | | | |
| Pair 1 | | | | |
| Systolic: 1, Systolic: 2 | 0.7296 | 1.720 | 29 | 0.096 |
| Pair 2 | | | | |
| Diastolic:1, Diastolic: 2 | 0.7296 | 1.720 | 29 | 0.096 |

Pair 1: Pair 1 is systolic blood pressure 1 and 2 (before and 12 weeks after the supplementation). Taking *p<0.05, the value of pair 1 is 0.096 which is not statistically significant. Pair 2: Pair 2 is diastolic blood pressure 1 and 2 (before and 12 weeks after the supplementation). Taking *p<0.05, as statistically significant, the value of pair 1 is 0.096 which is not statistically significant. Analysis of variance and *post hoc* tests (least significant difference ) were done to compare between the effects of the Vitamins C and E

**Table 3: Analysis of variance**

| | Sum of squares | df | Mean square | F | Sig. |
|---|---|---|---|---|---|
| Systolic | | | | | |
| Between groups | 11.467 | 2 | 5.733 | 0.343 | 0.711 |
| Within groups | 1454.133 | 87 | 16.714 | | |
| Total | 1465.600 | 89 | | | |
| Diastolic | | | | | |
| Between groups | 112.267 | 2 | 56.133 | 1.988 | 0.143 |
| Within groups | 2456.133 | 87 | 28.231 | | |
| Total | 2568.400 | 89 | | | |

Analysis of variance is taken for the systolic and diastolic blood pressure of the subjects of Vitamins C and E after 12 weeks of supplementation. Taking *p<0.05, since the values are more than 0.05, there is no statistical significance

**Table 4: *Post hoc* test (LSD method)**

| Dependent variable | | (I) VAR00001 | (J) VAR00001 | Mean difference (I-J) | Std. error | Sig. |
|---|---|---|---|---|---|---|
| Systolic | LSD | Vitamin C | Vitamin $D_3$ | 0.5333 | 1.0556 | 0.615 |
| | | | Vitamin E | −0.3333 | 1.0556 | 0.753 |
| | | Vitamin $D_3$ | Vitamin C | −0.5333 | 1.0556 | 0.615 |
| | | | Vitamin E | −0.8667 | 1.0556 | 0.414 |
| | | Vitamin E | Vitamin C | 0.3333 | 1.0556 | 0.753 |
| | | | Vitamin $D_3$ | 0.8667 | 1.0556 | 0.414 |
| Diastolic | LSD | Vitamin C | Vitamin $D_3$ | 2.7333* | 1.3719 | 0.049 |
| | | | Vitamin E | 1.2667 | 1.3719 | 0.358 |
| | | Vitamin $D_3$ | Vitamin C | −2.7333* | 1.3719 | 0.049 |
| | | | Vitamin E | −1.4667 | 1.3719 | 0.288 |
| | | Vitamin E | Vitamin C | −1.2667 | 1.3719 | 0.358 |
| | | | Vitamin $D_3$ | 1.4667 | 1.3719 | 0.288 |

LSD: Least significant difference

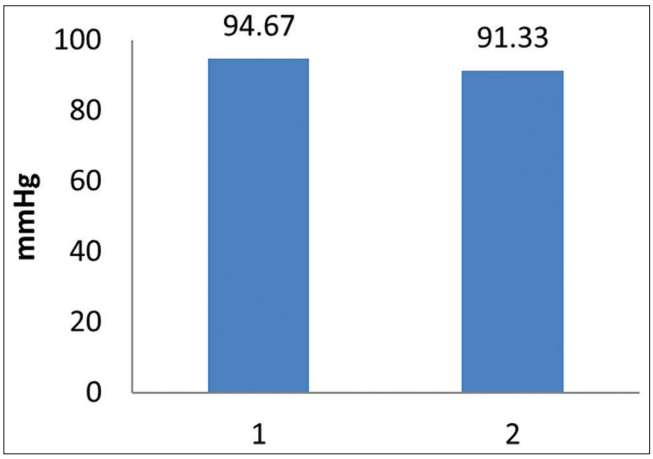


**Fig. 4: The mean of diastolic blood pressures before Vitamin E supplementation was 94.66 mmHg while it was 91.33 mmHg after 3 months**

which, in turn, may decrease the BP [23]. Certain studies have also shown that Vitamin E, 600 or 1200 mg/day for 2 months [24], play a role in decreasing oxidative stress in Type 2 diabetes. Studies have shown that Vitamin E significantly reduces plasma low-density lipoprotein (LDL) oxidation by 60% in diabetic patients [25]. In the study by Omar *et al*. combined Vitamins A, C, and E (ANTOX) twice daily for 3 months caused a significant decrease in fasting blood glucose, postprandial blood glucose, hemoglobin A1C, TC, triglycerides, and LDL and increase in HDL level [26]. In recent study on polyherbal preparation of *Bellerica fructus* or *Terminalia bellerica*, *C. aeruginosa* rhizome has proved to have antioxidant and antihypertensive effects [27].

## CONCLUSION

From the above study, we conclude that supplementation of Vitamins C and E can decrease BP and can be taken by people who are in borderline risk for hypertension. From our study, it was found that compared to Vitamin C, Vitamin E had slightly more benefits in lowering the BP. Although our study is a short time study with fewer subjects, we found that vitamins do have a role in reducing the BP.

## AUTHORS' CONTRIBUTIONS

The author J. Mathivanan, a medical student, took active part in conducting the study under the guidance of Dr. T. M. J. Santhoshakumari, MD (AP Biochemistry). Dr. G. Jeyalakshmi, our Dean, encouraged and helped us conduct the study smoothly.

## CONFLICTS OF INTEREST

There are no conflicts of interest regarding the publication of the manuscript.

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