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Original Research Article

An Observational Study Importance of Dietary Patterns in Relation to Oxidative Stress in Individuals Recently Diagnosed with Essential Hypertension

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Abstract

Aim: To determine the importance of dietary patterns in relation to oxidative stress in individuals recently diagnosed with essential hypertension.

Materials and Methods: This study was done in the Department of Physiology, Anugrah Narayan Magadh Medical College, Gaya, Bihar, India for one year. A hospital-based case control study was conducted among 200 subjects of age group between 20–50 years, irrespective of sex in the department of Physiology. All the subjects were chosen randomly and following groups were made according to JNC7 criteria. 75 normotensive subjects PreHT group: 75 cases of prehypertension HT group: 75 cases of newly diagnosed cases of essential hypertension with SBP= 140-159 mmHg, DBP= 90-99 mmHg. Patients with secondary hypertension, gout, diabetes mellitus, gestational hypertension, and patients taking antihypertensive, smokers and alcohol consumers were excluded from the study.

Results: The difference in mean ± SD of SBP & DBP between three groups were highly significant ($p<0.0001$). Mean ± SD value of both SBP and DBP were higher in NV as compared to V among all three groups but the results were not significant ($p>0.05$). Mean ± SD of SUA and S. MDA level between control, preHT and HT group were found to be highly significant ($p<0.0001$). Mean ± SD of SUA was significantly higher in NV as compared to vegetarians in all groups ($p<0.001$). Mean ± SD of S.MDA level was higher in NV as compared to V among HT, preHT and control group but this difference was not statistically significant ($p>0.05$).

Conclusion: The present study indicates that vegetarian nutrition provides sufficient antioxidants which efficaciously prevent the free radical generation and thus responsible for better antioxidant status and decreased oxidative stress. Maintenance of the oxidative balance in hypertensive patients would be helpful in preventing the CVD and other diseases associated with hypertension.

Keywords: Dietary patterns, Oxidative stress, Essential hypertension

Introduction

Essential hypertension, a condition characterized by persistently elevated blood pressure without an identifiable cause, is a major public health issue worldwide. It is a significant risk factor for cardiovascular diseases, stroke, and kidney failure, contributing substantially to global morbidity and mortality. While the pathogenesis of essential hypertension is multifactorial, oxidative stress has emerged as a critical component in its development and progression. [1] Oxidative stress occurs when there is an imbalance between the production of reactive oxygen species (ROS) and the body's ability to neutralize them with antioxidants. Excessive ROS can damage cellular components, including lipids, proteins, and DNA, leading to endothelial dysfunction, inflammation, and increased vascular resistance—all of which are pivotal in the development of hypertension. Understanding the mechanisms behind oxidative stress and its role in hypertension is essential for developing effective prevention and treatment strategies. [2] Dietary patterns play a crucial role in modulating oxidative stress. The types and amounts of food consumed can significantly influence the body's oxidative and antioxidative balance. Diets rich in fruits, vegetables, whole grains, and lean proteins, which are high in antioxidants, vitamins, and minerals, have been associated with reduced oxidative stress and improved cardiovascular health. Conversely, diets high in saturated fats, sugars, and

processed foods can enhance oxidative stress and contribute to the pathophysiology of hypertension. [3] The Mediterranean diet, for instance, is renowned for its high content of antioxidants derived from olive oil, fruits, vegetables, nuts, and fish. Studies have shown that adherence to this dietary pattern can reduce oxidative stress markers and improve endothelial function, thereby lowering blood pressure and reducing cardiovascular risk. Similarly, the DASH (Dietary Approaches to Stop Hypertension) diet, which emphasizes the consumption of fruits, vegetables, whole grains, and low-fat dairy products, has been proven to lower blood pressure and oxidative stress. [4] In contrast, the Western diet, characterized by high intake of red and processed meats, sugary desserts, high-fat dairy products, and refined grains, has been linked to increased oxidative stress and a higher incidence of hypertension. The high levels of saturated fats, trans fats, and sugars in this diet can promote the production of ROS, reduce the availability of nitric oxide (a vasodilator), and impair endothelial function. [5] Nutritional interventions targeting oxidative stress could, therefore, be a promising approach in the management of newly diagnosed essential hypertension. Incorporating antioxidant-rich foods and reducing the intake of pro-oxidant foods may help in mitigating oxidative damage, improving vascular health, and ultimately controlling blood pressure. [6] Research continues to explore the specific dietary components that can effectively counteract oxidative stress and their mechanisms of action. Polyphenols, flavonoids, vitamins C and E, selenium, and other dietary antioxidants are under investigation for their potential benefits. Understanding these interactions and the impact of dietary patterns on oxidative stress can provide valuable insights for developing comprehensive dietary guidelines for hypertensive patients.

Material and Method

This study was done in the Department of Physiology, Anugrah Narayan Magadh Medical College, Gaya, Bihar, India for one year. A hospital-based case control study was conducted among 200 subjects of age group between 20–50 years, irrespective of sex in the department of Physiology.

Inclusion criteria: All the subjects were chosen randomly and following groups were made according to JNC7 criteria.

Control group: 75 normotensive subjects PreHT group: 75 cases of prehypertension HT group: 75 cases of newly diagnosed cases of essential hypertension with SBP= 140-159 mmHg, DBP= 90-99 mmHg. Patients with secondary hypertension, gout, diabetes mellitus, gestational hypertension, and patients taking antihypertensive, smokers and alcohol consumers were excluded from the study. After obtaining ethical approval a written voluntary informed consent was obtained from all the subjects. Then all the subjects were screened as per the detailed history, routine physical examination and appropriate tests. After screening, blood sample (5 ml) was drawn in to a plain vial after an overnight fast (12 hrs) by ante- cubital venous puncture from all the subjects. Then serum was separated by a centrifugation at 3000rpm for 10 minutes. After that serum sample was used for following biochemical analysis.

Statistical Analysis: The data were analyzed by using Statistical Package for the Social Sciences (SPSS) Version 25.0. Difference between the groups was analyzed by Analysis of variance test (ANOVA). Diet wise comparison of oxidative stress parameters were tested by Student t-test with p value <0.05 is considered as statistically significant.

Results

Table: 1 Characteristics of study population among different groups (Mean ±SD)

Variables	Control	Pre HT Group	HT Group	Anova P Value
Age (Yrs.)	37.46 ± **8.09**	35.84 ± **6.5**	40.25 ± 7.71	<0.001
Veg./ Nonveg.	68/32	51/49	40/60	-
SBP (mmHg)	114.06 ± **16.77**	134.00 ± **5.1**	160.04 ± **11.49**	<0.0001
DBP (mmHg)	74.66 ± **6.23**	86.45 ± **2.93**	92.00 ± **10.15**	<0.0001

The difference in mean ± SD of SBP & DBP between three groups were highly significant (p<0.0001).

Table: 2 Diet wise variation of SBP among different groups (Mean ± SD)

	Control			PreHT			HT		
Diet	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**
Non Veg	114.62 ± 6.37		16	134.38 ± 5.01		37	161.82 ± 12.52		45
Veg	112.88 ± 5.84		34	133.63 ± 5.24		38	157.37 ± 9.33		30
T value	0.92			0.63			1.76		
P value	NS			NS			NS		

Table: 3 Diet wise variation of DBP among different groups (Mean ± SD)

	Control			PreHT			HT		
Diet	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**
Nonveg	75.21 ± 6.75		16	87.27 ± 2.83		37	92.44 ± 11.17		45
Veg	73.50 ± 5.99		34	86.63 ± 3.05		38	91.33 ± 9.68		30
T value	0.87			0.94			0.46		
P value	NS			NS			NS		

The table no. 2 & 3 showed that mean ± SD value of both SBP and DBP were higher in NV as compared to V among all three groups but the results were not significant (p>0.05)

Table: 4 Comparison of SUA and S. MDA level among different groups (Mean ± SD)

Variables	Control	Pre HT Group	HT Group	Anova P Value
S. Uric acid (mg/dL)	4.91 ± 0.97	5.90 ± 0.97	6.56 ± 0.76	<0.0001
S. MDA (nmol/mL)	1.30 ± 0.20	1.63 ± 0.28	2.14 ± 0.42	<0.0001

The difference in mean ± SD of SUA and S. MDA level between control, preHT and HT group were found to be highly significant (p<0.0001).

Table: 5 Diet wise variation of SUA level among different groups (Mean ± SD)

Diet	Control			Pre HT group			HT Group		
	Mean	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**
Non veg	5.65 ± 0.77		16	6.55 ± 0.80		37	6.77 ± 0.59		45
Veg.	4.56 ± 0.69		34	5.24 ± 0.53		38	6.19 ± 0.56		30
T value	4.82			8.34			4.25		
P value	<0.0001			<0.0001			<0.001		

Mean ± SD of SUA was significantly higher in NV as compared to vegetarians in all groups (p<0.001).

Table: 6 Diet wise variation of S. MDA level among different groups (Mean ±SD)

Diet	Control			Pre HT group			HT Group		
	Mean	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**
Non veg	1.33 ± 0.19		16	1.68 ± 0.27		37	2.20 ± 0.43		45
Veg.	1.28 ± 0.21		34	1.57 ± 0.27		38	2.04 ± 0.39		30
T value	0.84			1.76			1.67		
P value	NS			NS			NS		

Mean ± SD of S.MDA level was higher in NV as compared to V among HT, preHT and control group but this difference was not statistically significant (p>0.05).

Discussion

There is a close relationship between the diet and chronic degenerative diseases such as obesity, hypercholesterolemia and hypertension. Our study showed that NV had higher mean SBP and DBP than V in HT, preHT and control group but the results were not significant (p>0.05). Our results were similar to the study of Nande PJ et al. [7] but they found significant results in case of DBP (0.01<p<0.05). These findings are steady with the results of the DASH (Dietary Approaches to Stopping Hypertension) trial, that a dietary pattern plenteous in fruits, vegetables, low fat dairy products and with abbreviated total and saturated fat can be efficient in the suppression of hypertension. [8] Diet represents a significant role in the primary suppression of hypertension. It is a conception that the non vegetarian diet comprises cholesterol and saturated fatty acids and these are the root cause of problems like coronary heart diseases and hypertension. Vegetarian diets are normally ample in carbohydrates, n-6 fatty acids and dietary fiber and are more helpful in preventing, treating or reversing heart disease. Lifestyle adjustments in diet are playing important role in determining the outcome for people with hypertension. [9] In the present study serum uric acid level was found to be significantly high in NV as compared to vegetarians among HT, preHT and control group (p<0.001). Choi HK et al. [10] also noticed that SUA level enhanced with increasing total meat or sea food intake and diminished with increasing dairy intake. Similarly Schmidt JA et al. [11] found that vagan had the highest concentration followed by meat eaters and vegetarians. This might be due to their lack of ingestion of dairy foodstuffs, which are believed to lower UA concentrations. [12] In

humans yield of UA relies on purine uptake [13] and a purine-ample diet (such as veal, bacon, kid meat, mutton, turkey, pork, duck, goose, etc) would be responsible for rising only 1 to 2 mg/dL of uric acid [14] whereas diary foodstuff intake has a reciprocal relation with uric acid. [15,10] Since dairy products are low in purine content and it may perform its urate-lowering effect by increasing the elimination of uric acid and its precursor xanthine. [12] The results of our study also presented that the oxidative stress marker, serum MDA level was high in NV compared to V among HT, preHT and control group but this difference was not statistically significant ($p>0.05$). This is in accordance with the findings of Somannavari MS & Kodliwadmath MV [16] but they found that the difference was significant. Whereas Szeto et al. [17] shown that there was no significant change of MDA level between V and NV. The increased oxidative stress and associated oxidative damage are mediators of renovascular injury in cardiovascular pathologies. [18] Dierckx et al. [19] concluded that serum MDA level (a marker of lipid peroxidation) was significantly increased in NV, as their diet is good resource of iron and copper and these transitional metals in the diet have important role in the initiation and progression of lipid peroxidation. Further these findings were confirmed by Sagare SM et al. [20] This may be due to higher and habitual consumption of fruit and vegetables, dark and whole grain products, grain sprouts, plant oils and oil seeds plentiful in trace elements like zinc, copper and selenium, mono and polyunsaturated fatty acids, antioxidant vitamins, fibers, complex carbohydrates and flavonoids by vegetarians. The diminished risk of diseases found among vegetarians suggests that biological processes are molded by diet. [21] Therefore, much attention is currently focused on the beneficial effect of vegetarian versus non-vegetarian diet. [22,23] Efficient lifestyle modification may reduce blood pressure as much as a single antihypertensive drug. Combinations of two or more lifestyle alterations can accomplish even better results. [24]

Conclusion

The present study indicates that vegetarian nutrition provides sufficient antioxidants which efficaciously prevent the free radical generation and thus responsible for better antioxidant status and decreased oxidative stress. Maintenance of the oxidative balance in hypertensive patients would be helpful in preventing the CVD and other diseases associated with hypertension. Therefore, our study emphasizes the monitoring of the blood pressure, oxidative stress parameters (SUA and serum MDA level) at regular interval for therapeutic interventions. Moreover, the progress of disease could be prevented by giving proper education to the patient about healthy lifestyle and also advising them to practice yoga, aerobics, walk etc.

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