



**INFLUENCE OF DIETARY PATTERN ON HEART RATE  
VARIABILITY IN MENOPAUSE SYNDROME**

**A SANGEETHA\* AND R ARCHANA**

*Department of Physiology, Saveetha Medical College, Thadalam, Chennai.*

**ABSTRACT**

Epidemiological studies have shown an increased incidence of cardiovascular disease in postmenopausal women compared to age-matched men and premenopausal women because of disturbed activity of cardiac autonomic functions. Improving the diet, by consuming more of fruits and green leafy vegetables is an important strategy to reduce the risk of cardiovascular disease. Measurement of heart rate variability (HRV) is the easiest tool to detect cardiovascular disease. In this study we have assessed the influence of dietary pattern on menopause syndrome by assessing the heart rate variability and grading the menopausal symptoms. HRV was studied by recording the ECG in digital physiograph. Changes in menopausal symptoms were measured using a validated Greene Climacteric Scale. A total of 57 healthy postmenopausal women aged from 45 – 65 years have participated in the study. Heart rate variability frequency domain method showed increased vagal activity among vegetarian women. They exhibited significantly lower menopausal symptom scores compared to the non-vegetarian group. Vegetarian food is a natural and effective approach to reduce the severity of menopausal symptoms and risk of cardiovascular disease in post menopausal women.

**KEYWORDS:** Heart rate variability, Menopausal symptom, Diet, Vegetarian, Greene Climacteric scale



**A SANGEETHA**

*Department of Physiology, Saveetha Medical College, Thadalam, Chennai.*

## INTRODUCTION

An increased incidence of cardiovascular disease is seen in postmenopausal women compared to age-matched men and premenopausal women because of higher arterial blood pressure<sup>1,2</sup>, atherosclerotic progression<sup>2,3</sup> and disturbed activity of cardiac autonomic functions<sup>4</sup>. Intake of diet contains higher amount of fruits and green leafy vegetables is an important strategy to reduce the risk of cardiovascular disease<sup>5</sup>. Diet is known to alter autonomic functions in menopausal women. Intake of vegetarian diet over a period of time modulates cardiovascular autonomic functions<sup>1</sup>. A number of botanical products have been recommended for many problems associated with menopause such as sleep disturbances, nervousness, depression, mood swings and memory loss. Long term intake of diet including black cohosh<sup>6</sup>, red kidney bean<sup>7</sup>, dry beans & soy beans<sup>8</sup> is known to reduce menopausal symptoms. Tieraona et al<sup>9</sup> have shown that intake of semi purified isoflavone red clover leaf extracts has been effective in reducing hot flushes related to menopausal symptoms. High intake of calories, fruits, and protein has a positive effect on delaying menopause<sup>10</sup>. Therefore intake of a certain type of food is largely beneficial in alleviating the menopausal symptoms. This shows the definite influence of diet on menopausal syndrome. The present study investigates whether the activity of the autonomic nervous system, which plays a vital role in orchestrating physiological homeostasis within the human body, is altered due to diet pattern in women with menopausal symptoms. Postmenopausal women are known to be prone to cardiovascular disease and altered autonomic function has been observed. Heart rate variability is a widely used noninvasive and quantitative marker of cardiac autonomic control. The aim of the study was to assess the sympathetic and parasympathetic variations in menopausal syndrome due to vegetarian and non vegetarian diet by studying heart rate variability and also to grade the menopausal symptoms in vegetarians and non vegetarians.

## MATERIALS AND METHODS

### *Experimental setup and Study sample*

The menopausal women were classified into two groups as vegetarians and non-vegetarians. Women who consumed plant-based diet including fruits, vegetables, cereal grains, and nuts, without egg were considered to be vegetarian. Women who consumed both plant based and animal based food like meat, including red meat, poultry and fish were considered to be non-vegetarian.

Heart Rate Variability (HRV) was measured in menopausal women. Heart Rate Variability was studied by recording the ECG in digital physiograph using INCO Naviquire, Version – 56. Greene climacteric scale was used to assess the menopausal symptoms(11). This scale consists of 20 different symptoms grouped into 4 subscales. 11 psychological symptoms (subdivided in six anxiety symptoms and five depression symptoms), 7 somatic symptoms (e.g. headaches, muscle and joint pains), 2 vasomotor symptoms (hot flushes and night sweats). Each symptom score ranges from 0 (not at all), 1 (a little), 2 (quite a bit), 3 (Extremely). The overall greene climacteric symptom score ranges from 0 to maximum 60. Ethical committee approval has been obtained for the study from Institutional human ethical committee, Saveetha Medical College. The participants were informed regarding the nature of study and a written consent was obtained from them. In this study 57 volunteers were taken from Gynecology department of Saveetha Medical College and Hospital. The procedure was carried out in the Research room of Department of Physiology. The room had an ambient temperature of 30°C to 36°C closed with no external noise disturbance. The demographic data were collected from all participants. General information about name, age, height and weight of the participant, about medical history and cardiovascular diseases were obtained. Women in the age group of 45-55 years who were going through the menopausal phase were included for the study. Women who had history of hormone replacement therapy, cardiovascular disease, hypertension, smoking and alcoholism were excluded.

## RESULTS

The results for Greene climacteric scale and heart rate variability were compared between vegetarian and non-vegetarian menopausal women using the unpaired T – test. Statistical significance was set at  $p < 0.05$ .

### *Greene Climacteric symptom score*

The anxiety and depression scores were significantly lowered in vegetarians when compared to non-vegetarians. ( $P < 0.005$ ). There is no statistically significant difference in somatic and vasomotor score between vegetarian women and non-vegetarian women. The overall Greene climacteric score which grades the severity of menopausal syndrome was significantly lowered in the postmenopausal women who have been on a vegetarian diet for a long period of time compared to the non-vegetarian women. ( $P < 0.05$ ) (Table I)

**Table I**  
**Greene Climacteric symptom score**

Score	Non-vegetarian	Vegetarian
Psychological – Anxiety	1.79 ± 1.25	0.90 ± 1.34*
Psychological – depression	1.67 ± 1.05	0.65 ± 1.02*
Somatic	2.00 ± 1.02	1.33 ± 1.35
Vasomotor	1.46 ± 1.18	1.57 ± 1.16
Total score	6.92 ± 2.83	4.48 ± 2.96*

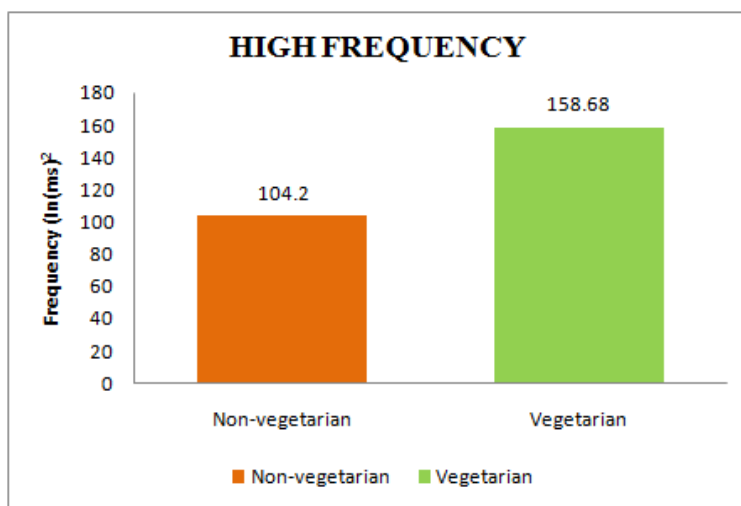
\* Indicates score is statistically significant with respect to non-vegetarian.

**Heart Rate Variability**

High frequency indicates parasympathetic activity. There is a significant increase in the high frequency value of HRV which indicates significantly higher parasympathetic activity in vegetarian women when compared to non-vegetarian women (P < 0.05) (Figure 1). Low frequency indicates sympathetic activity. There is no significant change in low frequency value between the vegetarian and

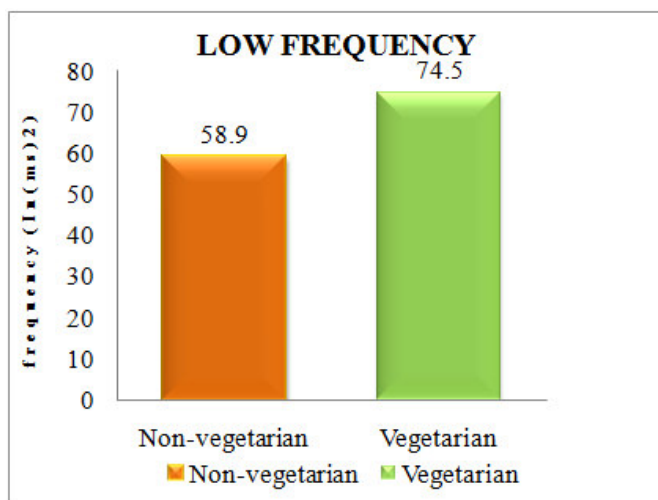
non-vegetarian group. This indicates there is no change in sympathetic activity between the vegetarians and non-vegetarians. (Figure2). Low frequency / high frequency ratio indicates sympathetic modulations. The low frequency / high frequency ratio was not found to be statistically significant between vegetarian and non-vegetarian women. This indicates there is no significant change in sympathetic modulations. (Figure 3)

**Figure 1**  
**Changes in HF power in  $(\ln(\text{ms})^2)$  units of HRV in nonvegetarian and vegetarian groups**



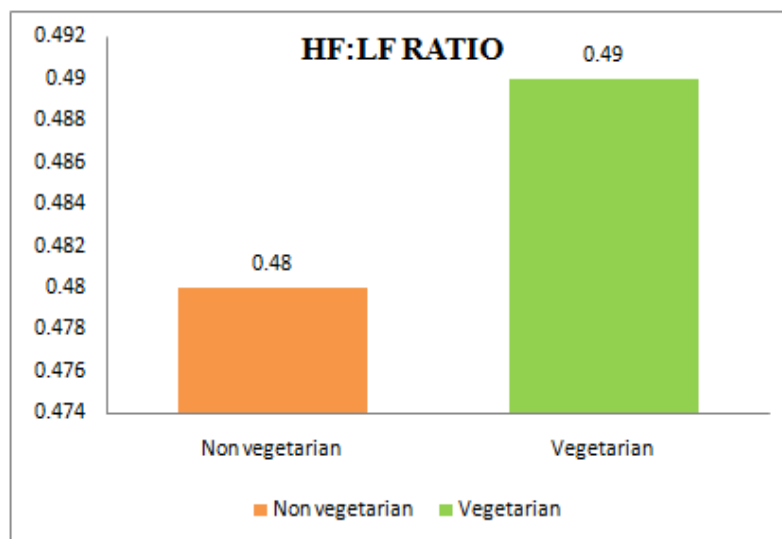
Heart rate variability – High frequency

**Figure 2**  
**Changes in LF power in  $(\ln(\text{ms})^2)$  units of HRV in nonvegetarian and vegetarian groups**



Heart rate variability – Low frequency

**Figure 3**  
**Changes in HF:LF ratio of HRV in nonvegetarian and vegetarian groups**



*Heart rate variability – HF:LF ratio*

## DISCUSSION

Stimulation of the parasympathetic nerves is associated with a decrease in heart rate and an increase in heart rate variability, whereas stimulation of the sympathetic system is associated with an increase in heart rate and a decrease in heart rate variability<sup>11,12</sup>. Under resting conditions, both the sympathetic and parasympathetic systems are tonically active, with a predominant vagal effect. According to the frequency-domain analysis of heart rate variability, high frequency component represents vagal regulation of the heart. Low frequency represents sympathetic activity. Low frequency/high frequency ratio represents sympathetic modulations. Women who had been on a vegetarian diet for more than two years had an increased high frequency value with no significant changes in low frequency and low frequency/high frequency ratio compared with the non-vegetarians. These results suggested that vegetarian diet may facilitate vagal activities of the heart but does not increase the sympathetic control of cardiovascular system. The vagotonic effects of vegetarian diets demonstrated in our study might be a natural and effective approach to reduce the risk of cardiovascular disease in postmenopausal women by improving cardiac vagal functions. In our study we have not isolated the type of vegetarian food which is responsible for the enhanced vagal activity and reduced Greene climacteric score. Nagata et al<sup>13</sup> have shown about 70 - 80% postmenopausal women in western countries complain of hot flushes as compared to 10 to 20% of Asian postmenopausal women. This has been attributed to dietary differences, especially soy and vegetable contents that are high in phytoestrogens. These findings support our study that a vegetarian diet can alleviate menopausal symptoms. Park et al<sup>5</sup> have shown that high consumption of fruits and vegetables particularly green

leafy vegetables enhance the parasympathetic response and reduces the sympathetic response which helps in preventing future sudden cardiac death and arrhythmia. Cardioprotective effects of green leafy vegetable and fruits intake may show effect through a mechanistic pathway mediated by increased vagal and decreased sympathetic activities. Green leafy vegetables are a good source of vitamin C, carotenoids, folates and  $\alpha$ -linolenic acid<sup>14</sup>. Therefore intake of green leafy vegetable in vegetarian diet can reduce menopausal symptom by enhancing vagal activity. The chemical structure of isoflavones is very similar to that of our own estrogen. There are two types of oestrogen receptors are seen in human body – ER-alpha (predominantly found in breast and uterine tissue) and ER-beta (distributed in bone, brain, vascular endothelium, and bladder). The binding affinity of isoflavones to beta receptor is better than alpha receptor. Because of this agonistic action, isoflavones provide cardio-protective, bone strengthening effect and also help in relieving menopausal symptoms<sup>15</sup>. Important sources of phytoestrogens in Indian diet are classified into isoflavones, lignans and coumestans<sup>16,17</sup>. Wheat, Bengal gram, moong beans, chick peas, cherries, parsley, apples, alfalfa and red clover are sources of isoflavones. Lignans are found in oil seeds such as flax seeds (linseed), rye, millet, sesame and sunflower seeds besides legumes, pulses, and whole grains. Soya sprout is a potent source of coumestans. The best way to consume isoflavones is in the form soy or soy foods including kidney beans, lima beans and lentils. Red clover and black cohosh are semi purified isoflavones. The leaf extract has got the ability to relieve perimenopausal and menopause-related symptoms<sup>6</sup>. Therefore a vegetarian diet containing isoflavones, lignans, coumestans, fruits and green leafy vegetables will be beneficial in alleviating menopausal symptoms. In menopausal women, vegetarian diet shows an increase

in heart rate variability and decrease in menopausal symptoms. Our results suggest that consumption of a vegetarian diet will have a beneficial effect on cardiac autonomic dysfunction and may help to prevent sudden cardiac death and arrhythmia through favorable changes in heart rate variability.

## REFERENCES

1. Chin-Hua F.U., Cheryl C.H. Yang, Chin-Lon Lin, Terry B.J. Kuo Effects of Long-Term Vegetarian Diets on Cardiovascular Autonomic Functions in Healthy Postmenopausal Women. *AM J Cardiol* 97:380–383 (2006).
2. Dariush Mozaffarian, Eric B Rimm, and David M Herrington. Dietary fats, carbohydrate, and progression of coronary atherosclerosis in postmenopausal women. *Am J Clin Nutr* 80:1175–1184 (2004).
3. Charles E, Rackley Hormones and coronary atherosclerosis in women. *Endocrine* 24:245–250 (2004).
4. *Banach T, Dobrek L, Milewicz T, Kolasinska-Kloch K, krezysek J, Thor PJ* Influence of hormonal replacement therapy on autonomic regulation of the heart. *Przeg Lek* 61:509–513 (2004).
5. Sung Kyun Park, Katherine L Tucker, Marie S O'Neill, David Sparrow, Pantel S Vokonas, Howard Hu, and Joel Schwartz Fruit, vegetable, and fish consumption and heart rate variability: the Veterans Administration Normative Aging Study *Am J Clin Nutr* 89:778–86 (2009).
6. Stacie E. Geller , Laura Studee, Botanical and Dietary Supplements for Menopausal Symptoms: What Works, What Doesn't. *J Womens Health (Larchmt)* 14(7): 634–649 (2005)
7. Stephen M. Boué, Matthew E. Burow, Thomas E. Wiese, Betty Y. Shih, Steven Elliott, Carol H. Carter-Wientjes, John A. McLachlan, Deepak Bhatnagar Estrogenic and Antiestrogenic Activities of Phytoalexins from Red Kidney Bean (*Phaseolus vulgaris* L.) *J. Agric. Food Chem* 59 (1): 112–120 (2011)
8. James W Anderson, Belinda M Smith, and Carla S Washnock Cardiovascular and renal benefits of dry bean and soybean intake *Am J Clin Nutr*;70(suppl):464S–74S (1999)
9. Tieraona Low Dog Menopause: a review of botanical dietary supplements *The American Journal of Medicine* Volume 118, Issue 12, Supplement 2: Pages 98–108 (2005)
10. Tsogzolmaa Dorjgochoo, Asha Kallianpur, Yu-Tang Gao, Hui Cai, Gong Yang, Honglan Li, Wei Zheng, and Xiao Ou Shu, Dietary and lifestyle predictors of age at natural menopause and reproductive span in the Shanghai Women's Health Study Menopause . 15(5): 924–933, (2008)
11. Greene J.G. Constructing a standard climacteric scale. *Maturitas* 29,25–31(1998).
12. Malik M & Camm A.J. Heart rate variability and clinical cardiology. *British Heart Journal*. 71: 3-6 (1994).
13. Nagata C Nagata, C., N. Takatsuka, N. Kawakami, and H. Shimizu Soy product intake and hot flushes in Japanese women. *Am J Epidemiol*. 153 (8): 790-93 (2001).
14. Van Duyn M.A. Elizabeth Pivonka Overview of the health benefits of fruit and vegetable consumption for the dietetics professional: selected literature. *J Am Diet Assoc*. 100: 1511–21, (2000)
15. Nalini Mishra V.N., Mishra. Devanshi Natural Phytoestrogens in Health and Diseases *JACM*. 12(3): 205-11(2011)
16. Murkies A.I., Wilcox G, Davis S.R. Phytoestrogens. *J Clin Endocrinol Metab*. 83: 297 (1998).
17. Thame D.M., Gardener C.D., Haskell W.L. Potential health benefits of dietary phytoestrogens: a review of clinical, epidemiological and mechanistic evidence. *J Clin Endocrinol Metab*; 83: 2223, (1998).

## CONCLUSION

Long-term intake of vegetarian diet facilitates vagal regulation of the heart without increasing the sympathetic modulations of the cardiovascular system. Vegetarian women had decreased Greene climacteric score when compared to non-vegetarian women which shows that vegetarian food is a natural and effective approach to reduce the severity of menopausal symptoms and risk of cardiovascular disease in post menopausal women.

## CONFLICT OF INTEREST

No conflict of interest.