International Journal of Health Sciences and Research
Vol.13; Issue: 12; December 2023
Website: www.ijhsr.org
Original Research Article *ISSN: 2249-9571*

Influence of Parental History of Hypertension on Frequency Domain Parameters of Heart Rate Variability (HRV) and Serum Lipid Profile in Prehypertensives

Vanathy Karunamoorthy[1], Gayathri. R[2], Priyadarsini. D[3], Meena. A[4]

[1,2,3,4]Department of Physiology,
[1,2,3]Assistant professor, [4]Associate professor, Bhaarath Medical College and Hospital,
Bharath Institute of Higher Education and Research, Chennai, Tamil Nadu, India

Corresponding Author: Vanathy Karunamoorthy

DOI: https://doi.org/10.52403/ijhsr.20231201

ABSTRACT

Background: Parental history and dyslipidemia are the most important non modifiable risk factor and modifiable risk factor for developing hypertension respectively. Many research studies have documented the role of the autonomic nervous system in the control of blood pressure. And heart rate variability is a non-invasive tool to assess the sympathovagal balance. Prehypertensives are at an increased risk of developing hypertension and other cardiovascular diseases. Hence our study aims at evaluating the role of parental history of hypertension on the sympathovagal balance and serum lipid profile parameters in prehypertensive individuals.

Aims & Objectives:

The aim of the study was

To assess the sympathovagal balance by recording the frequency domain parameters of heart rate variability in prehypertensives with and without parental history of hypertension.

To estimate the serum lipid profile parameters in prehypertensives with and without parental history of hypertension.

To correlate sympathovagal balance (LF:HF ratio) and serum lipid profile parameters in them.

Methods:

Study Area: Institute of Physiology and Experimental Medicine, Madras Medical College, Chennai, Tamilnadu, India.

Study Population: Prehypertensive individuals with systolic blood pressure between 120 – 139mmHg or Diastolic blood pressure between 80 – 89mmHg.

Sample size: 60 prehypertensive individuals (30 with parental history and 30 without parental history of hypertension) selected from non-communicable diseases clinic, Rajiv Gandhi Government General Hospital, Tamilnadu, Chennai.

Results: There was no significant difference in age, body mass index between the prehypertensives with and without parental history. There was increased sympathetic drive in prehypertensives with parental history and the sympathovagal balance was altered and was suggestive of sympathetic overactivity in them. The serum lipid profile parameters like total cholesterol, Triglycerides, Low density lipoprotein was significantly elevated in prehypertensives with parental history. Also, the increase in lipid profile parameters (total cholesterol, triglycerides, low density lipoprotein, very low-density lipoprotein) correlated with increase in the sympathovagal imbalance. A decrease in high density lipoprotein correlated with the increase in sympathovagal imbalance in prehyperetensives with parental history.

Keywords: Heart rate variability, Lipid profile, Prehypertension, Symapthovagal Balance.

INTRODUCTION

Hypertension, being a cardiovascular disease is one of the leading causes of death globally. It accounts to 77% of global death due to non-communicable diseases(1). In India, the prevalence of hypertension among individuals aged 15 to 49 years is 22.8%(2). Prehypertension is a forewarning for hypertension. It affects ~25-50% of adults worldwide(3). In India, prevalence of prehypertension among adults (18–49 years) is 43.2%(4). The Seventh Report of the Joint National Committee on prevention, detection, evaluation and treatment of high blood pressure (JNC 7) has proposed that prehypertensives are individuals with a systolic blood pressure of 120–139 mmHg or a diastolic blood pressure of 80–89 mm and has also recommended that they require health-promoting lifestyle modifications to prevent cardiovascular diseases(5). World health organization has enumerated the non-modifiable risk factors for hypertension which include age over 65 years, family history of hypertension and co-existing diseases such as diabetes or kidney disease. Modifiable risk factors are unhealthy diet pattern like excessive salt consumption, low intake of fruits and vegetables, a diet high in saturated fat and trans fats, lack of physical activity, consumption of tobacco and alcohol, and being overweight or obese(6). Of this, the parental history plays a paramount role in the development of hypertension in their offsprings(7). Many studies had shown the higher prevalence of dyslipidemia among patients with co-existing cardiovascular risk factors such as hypertension(8),(9). Hypertension is a multifactorial disease and the autonomic nervous system plays a crucial role in maintaining the cardiovascular functions at rest and also in times of stress. Many physiological studies have demonstrated the autonomic dysfunctions in offsprings of people with hypertension(10),(11). Heart rate variability is a non-invasive test to measure the beat-to-beat variations (R-R interval) which is due to the dynamic interactions between sympathetic and parasympathetic nervous system. The possibility to study frequency-specific oscillation is the main advantage of spectral analysis of heart rate varaiability. Hence this warrants the need to assess the influence of family history in sympathovagal balance which is suggestive of normal autonomic functions and the lipid profile fractions in prehypertensives.

Aims and objectives:

The aim of this study was to assess the sympathovagal balance and serum lipid profile parameters in prehypertensives with and without parental history of hypertension.

Specific objectives:

- To assess the differences in frequency domain parameters of heart rate variability in prehypertensives with and without parental history.
- To assess the differences in lipid profile parameters in prehypertensives with and without parental history.
- To correlate sympathovagal balance (LF:HF ratio) and serum lipid profile parameters in them.

MATERIALS & METHODS

Study area: Institute of Physiology and Experimental Medicine, Madras Medical College, Chennai, Tamil Nadu, India.

Study period: October 2020 – October 2021

Study population: After getting Institutional ethical committee clearance, 30 prehypertensives with parental history and 30 prehypertensives without parental history were recruited from non-communicable diseases clinic of Rajiv Gandhi Government General Hospital, Chennai.

Sample Size: Sample size was calculated from a previous study showing prevalence of prehypertension as 14.5%(12). We needed a minimum sample size of 48 for the study with the assumption of 10% precision

and 95% confidence interval. It was rounded off to 60.
Formula for sample size calculation:

$$n = \frac{Z^2_{1-\alpha/2}\, p\,(1-p)}{d^2}$$

Sample design: convenience sampling

Inclusion criteria:
Age group: 20 to 50 years, both genders. 30 individuals with systolic blood pressure of 120 – 139 mmHg and diastolic blood pressure of 80 – 89mmHg with parental history and 30 prehypertensives with systolic blood pressure of 120 – 139 mmHg and diastolic blood pressure of 80 – 89mmHg without parental history. Parental history denotes individuals with history of hypertension in one parent or both parents.

Exclusion criteria:
Subjects with history of primary autonomic insufficiency, systemic disorders like diabetes mellitus, other cardiovascular diseases, respiratory, hepatic, renal, neurological diseases, hypothyroidism, anemia, neoplasia, any secondary infections, use of anti-diabetic, anti-hypertensive, lipid lowering agents, glucocorticoids, antipsychotics, oral contraceptives, smokers, alcoholics, pregnancy, postpartum period, any infectious disease, athletes, those practising yoga.

Study design: Analytical Cross-sectional study.
Study tools: A proforma was used to collect data from these patients - baseline data including age, sex, BMI, a relevant clinical history, detailed clinical examination was done and recorded.
Omron Sphygmomanometer
AD instruments Powerlab recorder & Labchart pro 8 software.

Parameters studied:
Frequency domain variables of short-term heart rate variability: Total power, LF nu, HF nu, LF:HF ratio.
Serum lipid profile parameters: Total cholesterol, Triglycerides, Low density lipoprotein, high density lipoprotein, very low-density lipoprotein.

METHODOLOGY

We asked the recruited subjects to report to the Institute of physiology and experimental medicine at 7.00 AM after an overnight fast. We got the informed consent for the study and we collected 5ml of blood by venepuncture from ante-cubital vein under strict aseptic precautions and we sent the samples to central biochemistry laboratory, Rajiv Gandhi Government General Hospital, maintaining the cold chain for lipid profile estimation. Then we asked the subjects to come again by 10AM after having a light breakfast without having coffee or tea. We collected a detailed history and recorded the baseline parameters like age, height, weight, BMI and did general and systemic examination of the subjects. We recorded the blood pressure on both the arms in supine position and we continued the subsequent recordings in the arm which showed higher BP. We recorded 2 more readings at 5 minute intervals and the average was taken(13). We placed disposable electrodes and recorded the HRV in supine position as proposed by Task Force of The European Society of Cardiology and The North American Society of Pacing and Electrophysiology(14). We recorded HRV for 5 minutes necessary for short term analysis by the AD instruments powerlab recorder. The lead II ECG was taken for HRV evaluation by AD instruments Labchart pro 8 software.

Lipid profile:
The total cholesterol, Triglycerides, HDL were estimated by enzymatic spectrophotometric method and LDL was calculated using Friedwald formula. This formula calculates LDL by subtracting the sum of HDL and VLDL (triglycerides/5) from total cholesterol(15). The optimal level of lipid profile parameters include, total

cholesterol - < 200 mg/dL, triglycerides - < 150 mg/dL, LDL - < 100 mg/dL, HDL - > 50 mg/dL (15), (16).

Frequency domain parameters of Heart rate variability:

The normal total power is range: 600-1500 ms^2, LF nu normal range: 40-60, HF nu normal range: 45-65, and LF:HF ratio normal range: 0.5-1.5.

STATISTICAL ANALYSIS

We recorded the HRV parameters and serum lipid profile parameters on Excel sheet and the statistical analysis was done using SPSS software. The student's t-test and Pearson correlation coefficient was used for statistical analysis. p-value of < 0.05 was considered significant.

RESULT

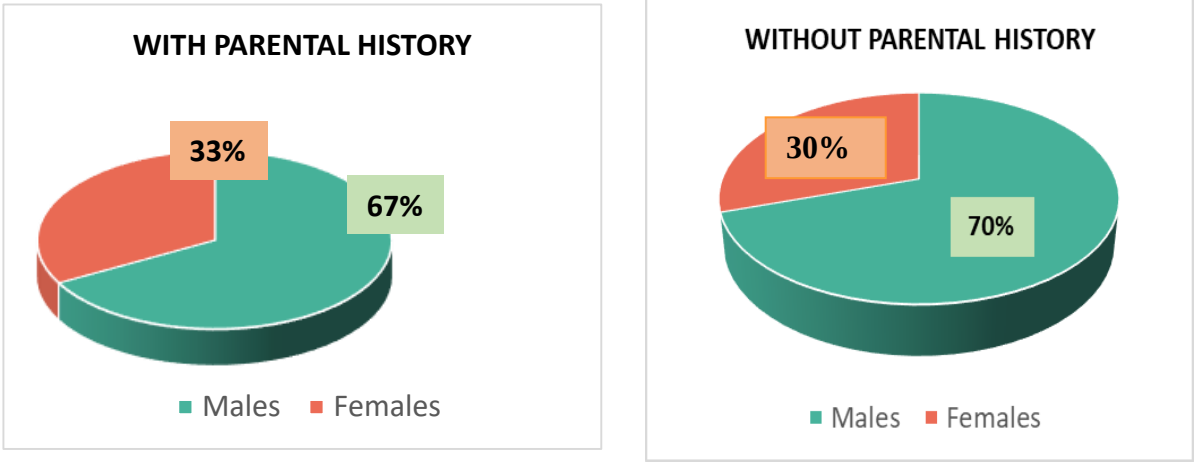
60 prehypertensive subjects of age between 20 to 50 years of both genders were recruited from RGGGH and segregated into two groups as,

Group 1: 30 prehypertensives with parental history of hypertension

Group 2: 30 prehypertensives without parental history of hypertension and the parameters were compared.

There was no significant difference in age and BMI among the two groups. The Group 1 consisted of 20 men and 10 women, with a proportion of 67:33, while Group 2 had 21 men and 9 women, with a proportion of 67:33. The gender proportions in the two groups showed that they were comparable.

TABLE /FIGURE 1: GENDER DISTRIBUTION AMONG THE STUDY GROUPS:



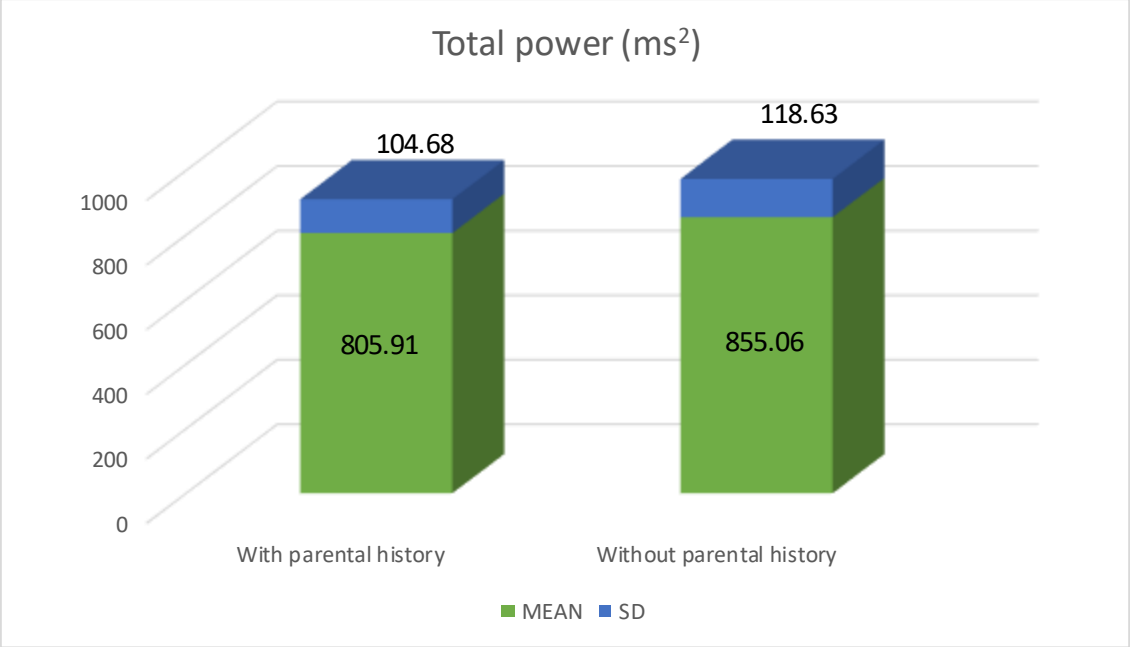
TABLE/FIGURE 2: COMPARISON OF AGE AND BMI AMONG STUDY GROUPS:

VARIABLE	STUDY GROUP	MEAN ± SD	P-VALUE
AGE (years)	With parental history	36.43 ± 5.354	0.756
	Without parental history	36.90±4.664	
BMI	With parental history	27.10 ± 3.054	0.705
	Without parental history	27.38 ± 2.007	

Frequency domain variables of Heart rate variability (HRV):

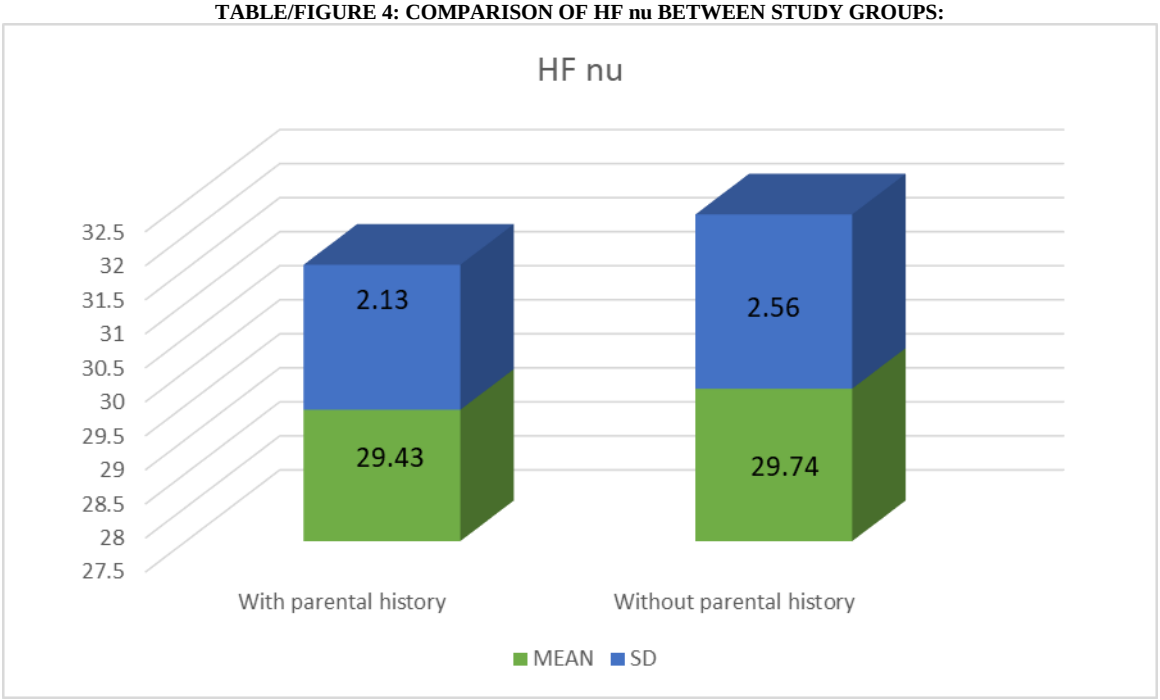
The measurement of VLF, LF and HF power components is in milliseconds squared. LF and HF may also be measured in normalized units, which represent the relative value of each power component in proportion to the total power minus the VLF component (17). The representation of LF and HF in normalized units (LF nu and HF nu) emphasizes the controlled and balanced behavior of the two branches of the autonomic nervous system and it minimizes the effect of the changes in total power on the values of LF and HF components.

TABLE/FIGURE 3: COMPARISON OF TOTAL POWER BETWEEN STUDY GROUPS:



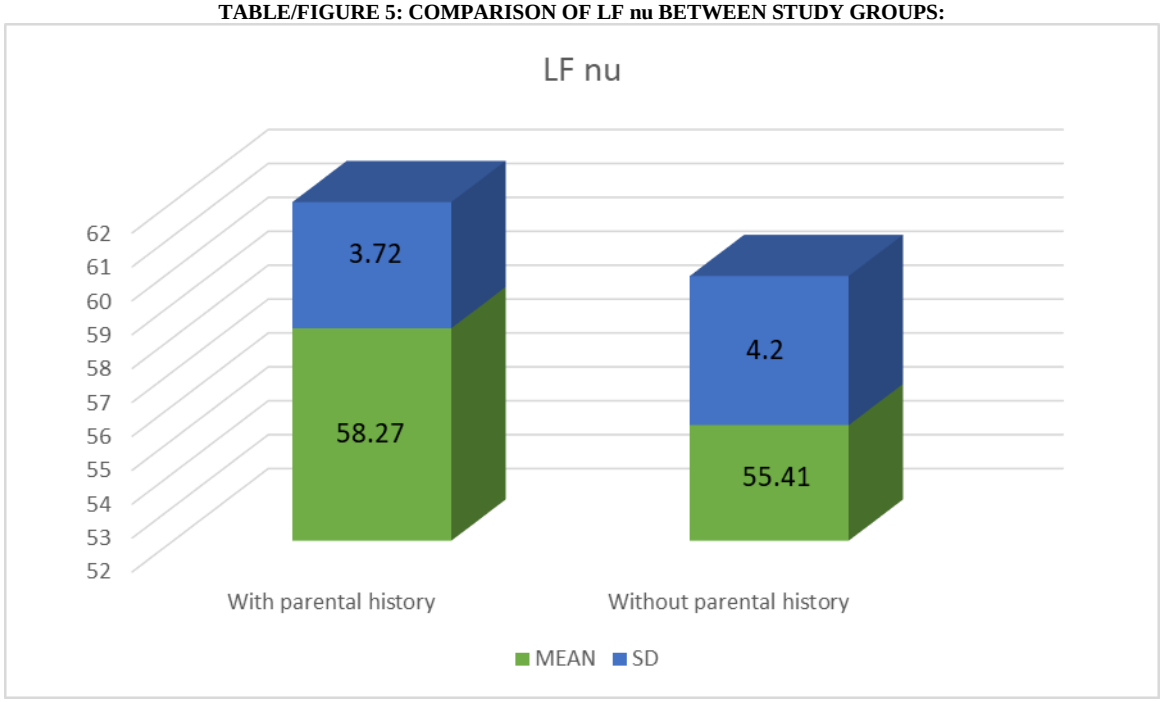
The total power was significantly decreased in prehypertensives with parental history with a p-value of 0.043.

TABLE/FIGURE 4: COMPARISON OF HF nu BETWEEN STUDY GROUPS:



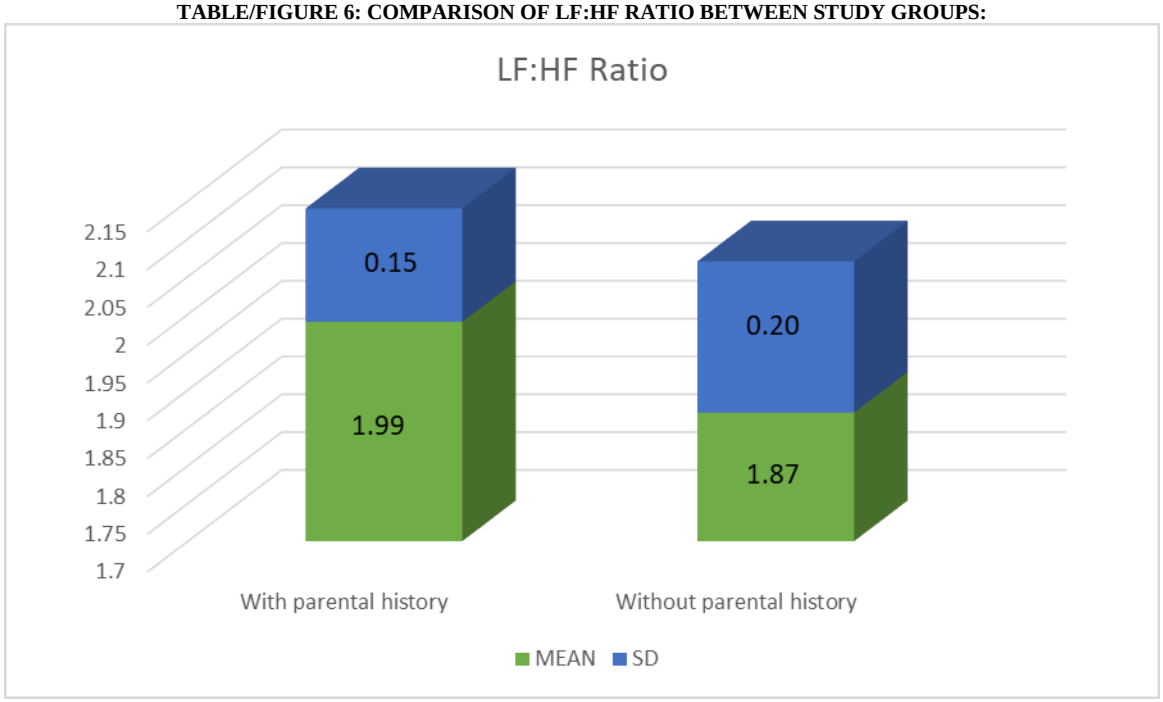
There was no significant difference in HF nu between the two study groups. p-value: 0.616.

TABLE/FIGURE 5: COMPARISON OF LF nu BETWEEN STUDY GROUPS:



The LF nu was significantly elevated in prehypertensives with parental history with a p-value of 0.015.

TABLE/FIGURE 6: COMPARISON OF LF:HF RATIO BETWEEN STUDY GROUPS:



The LF:HF ratio was elevated in prehypertensives with parental history than those without history with a p-value of 0.023 which is significant.

Serum Lipid profile parameters: The serum lipid profile includes total cholesterol (TC), Triglycerides (TGL), High density lipoprotein (HDL), low density lipoprotein (LDL), very low density lipoprotein (VLDL) and are compared between the two study groups.

TABLE/FIGURE 7: COMPARISON OF SERUM LIPID PROFILE PARAMETERS BETWEEN STUDY GROUPS:

VARIABLE	STUDY GROUP	MEAN ± SD	P-VALUE
TC	With parental history	179.83 ± 32.22	0.016*
	Without parental history	162.27 ± 25.71	
TGL	With parental history	153.57 ± 23.79	< 0.000*
	Without parental history	132.83 ± 15.06	
HDL	With parental history	37.77 ± 2.96	0.367
	Without parental history	38.27 ± 2.19	
LDL	With parental history	112.43 ± 29.00	0.035*
	Without parental history	98.50 ± 24.69	
VLDL	With parental history	29.35 ± 4.19	0.110
	Without parental history	27.73 ± 2.98	

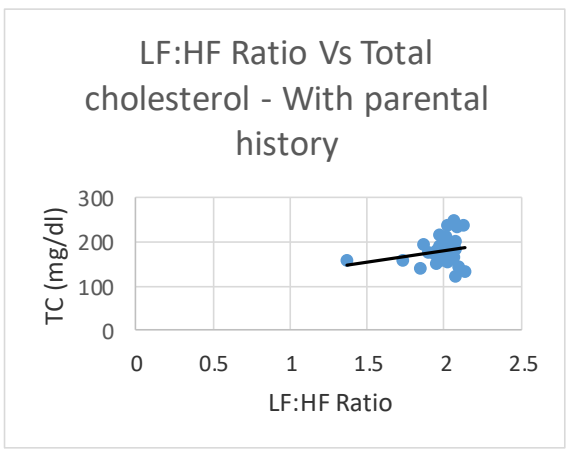
***Significant Statistical analysis: Student's t test**

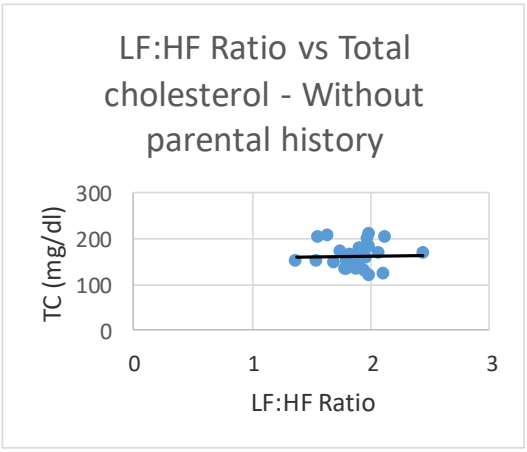
The LF: HF Ratio was correlated with the serum lipid profile parameters between the study groups.

TABLE/FIGURE 9: CORRELATION OF LF:HF RATIO WITH SERUM LIPID PROFILE PARAMETERS:

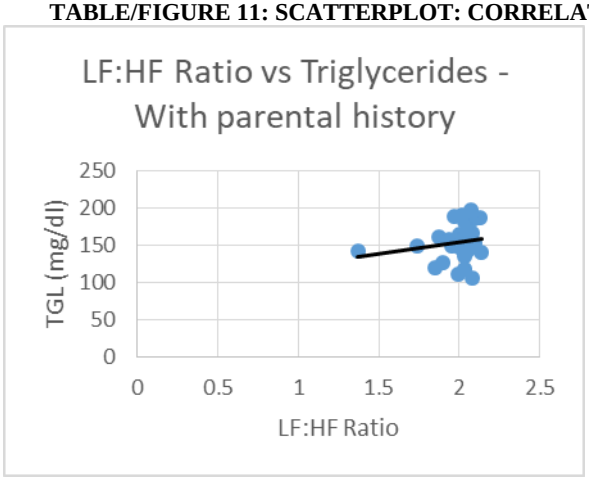
PARAMETERS	With parental history		Without parental history	
	r	P	r	P
TC	0.224	0.234	0.033	0.861
TGL	0.191	0.312	0.190	0.314
HDL	-0.093	0.624	-0.109	0.624
LDL	0.188	0.320	0.020	0.320
VLDL	0.8853	0.214	-0.035	0.214
r – Pearson correlation coefficient				

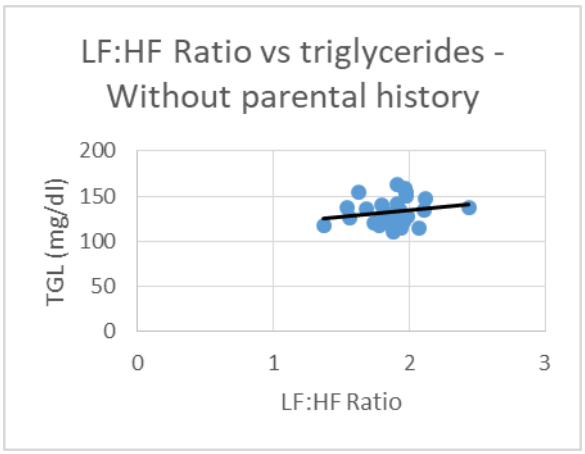
TABLE/FIGURE 10: SCATTERPLOT: CORRELATION OF LF:HF RATIO WITH TOTAL CHOLESTEROL



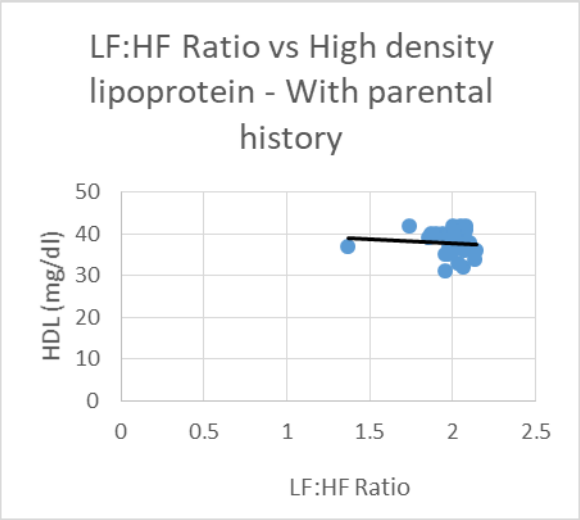


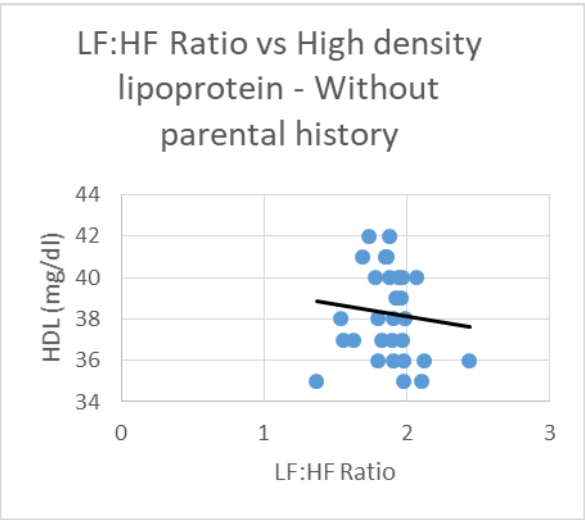
TABLE/FIGURE 11: SCATTERPLOT: CORRELATION OF LF:HF RATIO WITH TRIGLYCERIDES



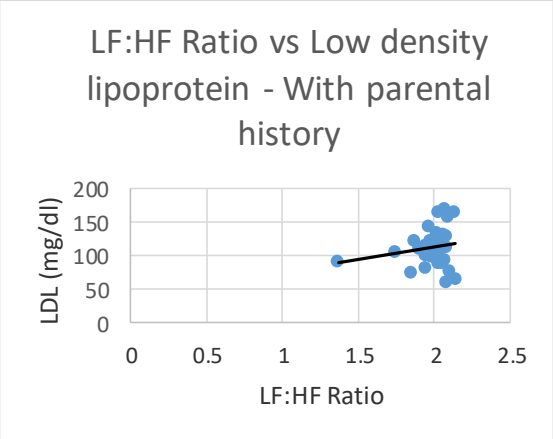


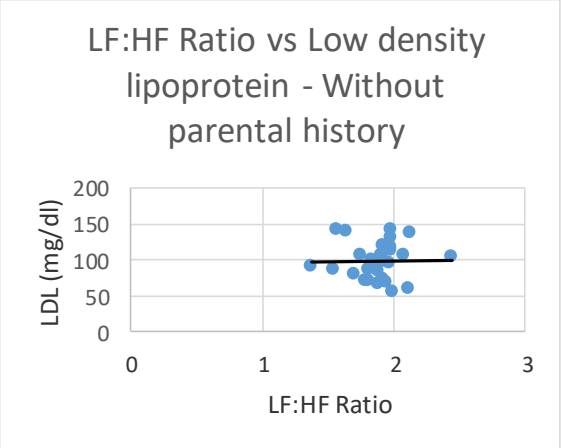
TABLE/FIGURE 12: SCATTERPLOT: CORRELATION OF LF:HF RATIO WITH HIGH DENSITY LIPOPROTEIN



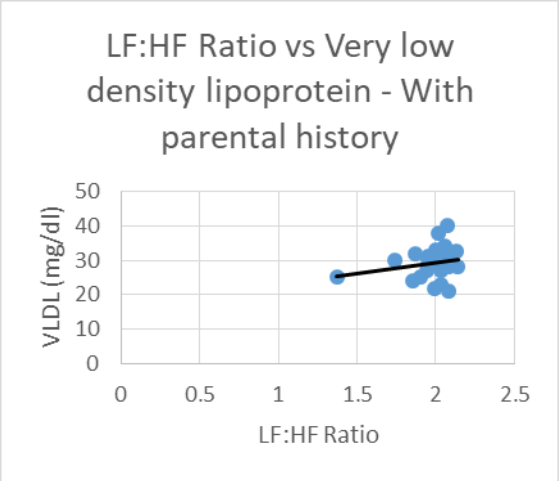


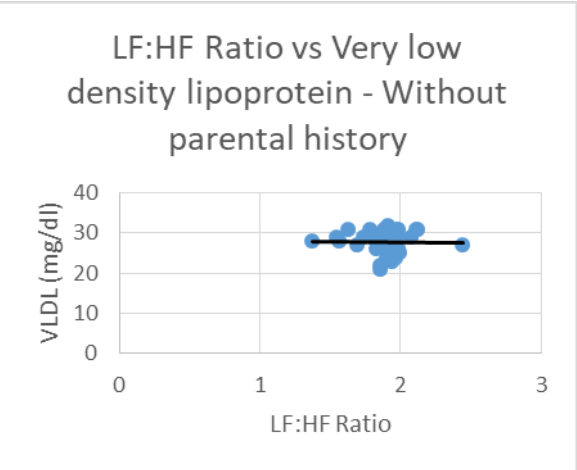
TABLE/FIGURE 13: SCATTERPLOT: CORRELATION OF LF:HF RATIO WITH LOW DENSITY LIPOPROTEIN





TABLE/FIGURE 14: SCATTERPLOT: CORRELATION OF LF:HF RATIO WITH VERY LOW DENSITY LIPOPROTEIN IN PREHYPERTENSIVES WITH PARENTAL HISTORY





LF: HF Ratio positively correlates with TC, TGL, LDL, VLDL levels and negatively correlates with HDL in prehypertensives with parental history. Whereas, LF: HF Ratio positively correlates with TC, TGL, LDL and it negatively correlates with HDL and VLDL in prehypertensives without parental history. Further, the p-value of all parameters are not found to be significant in both groups.

DISCUSSION

In our study, there was no significant difference in age and BMI between the prehypertensives with and without parental history. Heart rate variability is an important method to assess the cardiac autonomic modulation. It enables us to quantify fluctuations in R-R intervals and it provides indices that mirror autonomic nervous system (ANS) modulation into the heart(17). Of the heart rate variability indices, frequency domain variables estimate the distribution of absolute or relative power into four frequency bands namely Total power (TP), High frequency (HF), Low frequency(LF), very low frequency(VLF), ultra-low frequency(ULF). Total power is the sum of the energy in the ULF, VLF, LF, and HF bands in 24 hours recording. In short term recordings, it includes VLF, LF, and HF(18).

The high frequency component denotes the parasympathetic or vagal tone. The low frequency component denotes largely the sympathetic activity. The LF:HF ratio is suggestive of balance between sympathetic and vagal activity(19). In our study the TP was decreased significantly in prehypertensives with parental history than without parental history. In a study by Hasmukh et al on HRV in normotensives and hypertensives, the total power was decreased in hypertensives(20). The HF nu was decreased in prehypertensives with parental history than without parental history but was not significant. The LF nu and LF:HF Ratio was increased significantly in prehypertensives with parental history which signifies increased sympathetic drive in them. A similar result was obtained by Surekharani et al in their study on HRV in normotensive offsprings of hypertensive parents(21). The results of a study by GK Pal et al on prehypertensive offsprings with on parent versus two parent hypertensive were similar like our study i.e. the TP, HF nu was decreased and LF nu, LF:HF Ratio was increased in prehypertensive offsprings with history in both parents than those with single parent history(22).

Comparison of serum lipid profile parameters between the two groups showed that there was a significant elevation of total cholesterol, triglycerides, low density lipoprotein in prehypertensives with parental history. HDL levels were less in prehypertensives with parental history but not significant. The VLDL levels were elevated in them but was insignificant. In a study by Swathi et al, the TC, TGL, LDL, VLDL were elevated and HDL was decreased in prehypertensives than normotensives(23). Similarly, in a study by Savitha et al, the TC, TGL, LDL, VLDL was elevated and HDL was reduced in children born to parents having premature ischemic heart disease(24).

In our study, we correlated the LF:HF ratio with the lipid profile parameters. The LF:HF ratio showed positive correlation with the TC, TGL, LDL, VDL in prehypertensives with parental history which conveys that more the lipid profile levels, more is the sympathovagal imbalance. There was negative correlation between LF:HF Ratio and HDL which means that the sympathovagal balance increases as the HDL decreases. But there was no significant difference between the two groups. In a study by GK Pal et in diabetics, the lipid profile parameters correlated significantly with sympathovagal balance in first degree relatives of diabetics which contributed to prehypertensive status in them(25).

CONCLUSION

The present study compared the sympathovagal balance between prehypertensives with parental history and without parental history. The study shows that there is significant sympathovagal imbalance in form of sympathetic overactivity in prehypertensives with parental history. Comparing the serum lipid profile parameters showed significant elevation of total cholesterol, Triglycerides, Low density lipoprotein in prehypertensives

with parental history. Higher total cholesterol, triglycerides, low density lipoprotein, very low-density lipoprotein and lesser high-density lipoprotein is associated with sympathovagal imbalance in both groups. The study shows that there is influence of parental history in the sympathovagal balance that contributes to normotensive status and lipid profile parameters which when altered increases the risk for development of cardiovascular diseases. Hence initiation of early life style changes in the form of dietary modifications, physical activity, practising yoga in people with parental history may delay the progression to frank hypertension.

Limitations: Heart rate variability monitoring for 24 hours and other cardiac autonomic function testing would yield more idea on the ANS activity. Serum catecholamine levels which is an estimate of direct measure of sympathetic system could have been done.

Declaration by Authors

Ethical Approval: Approved
Acknowledgement: None
Source of Funding: None
Conflict of Interest: None

REFERENCES

1. Rahut DB, Mishra R, Sonobe T, Timilsina RR. Prevalence of prehypertension and hypertension among the adults in South Asia: A multinomial logit model. Front Public Health [Internet]. 2023 Jan 27 [cited 2023 Nov 4]; 10:1006457. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9911430/
2. Basu S, Malik M, Anand T, Singh A. Hypertension Control Cascade and Regional Performance in India: A Repeated Cross-Sectional Analysis (2015-2021). Cureus [Internet]. [cited 2023 Nov 4];15(2):e35449. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10042544/
3. Egan BM, Stevens-Fabry S. Prehypertension--prevalence, health risks, and management strategies. Nat Rev Cardiol. 2015 May;12(5):289–300.
4. Frontiers | Prevalence of prehypertension and hypertension among the adults in South Asia: A multinomial logit model [Internet]. [cited 2023 Nov 4]. Available from: https://www.frontiersin.org/articles/10.3389/fpubh.2022.1006457/full
5. express.pdf [Internet]. [cited 2023 Nov 4]. Available from: https://www.nhlbi.nih.gov/files/docs/guidelines/express.pdf
6. Hypertension [Internet]. [cited 2023 Nov 4]. Available from: https://www.who.int/news-room/fact-sheets/detail/hypertension
7. Kc K, Katwal S, Yadav GK, Adhikari A, Thapa RK, Jha SK, et al. Family history of hypertension and its relation to other variables in hypertensive patients: a cross-sectional study from a tertiary care hospital. IJS Global Health [Internet]. 2023 Sep [cited 2023 Nov 4];6(5):e0235. Available from: https://journals.lww.com/ijsgh/fulltext/2023/09010/family_history_of_hypertension_and_its_relation_to.1.aspx
8. Wyszyńska J, Łuszczki E, Sobek G, Mazur A, Dereń K. Association and Risk Factors for Hypertension and Dyslipidemia in Young Adults from Poland. Int J Environ Res Public Health [Internet]. 2023 Jan 5 [cited 2023 Nov 4];20(2):982. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9858900/
9. Abedin DrMdZ, Khaled DrMdFI, Barman DrRN, Sutradhar DrP, Hossen DrMdT, Hossain DrMdZ. Comparative Study of Lipid Profile between Hypertensive Patient and Normotensive Individuals in Northern Region of Bangladesh. Saudi J Med [Internet]. 2023 Jan 17 [cited 2023 Nov 4];1(7):1–7. Available from: https://saudijournals.com/media/articles/SJM_81_1-7.pdf
10. Dyslipidemia and Associated Risk Factors among Nigerians with Hypertension | Dubai Medical Journal | Karger Publishers [Internet]. [cited 2023 Nov 4]. Available from: https://karger.com/dmj/article/3/4/155/107181/Dyslipidemia-and-Associated-Risk-Factors-among
11. Wadoo OK, Sayeed SI, Tramboo MR. Comparative study of heart rate variability in normotensive young adults with family history of hypertension. International Journal of Research in Medical Sciences [Internet]. 2021 Jan 29 [cited 2023 Nov 4];9(2):371–4. Available from: https://www.msjonline.org/index.php/ijrms/article/view/9233
12. Erem C, Hacihasanoglu A, Kocak M, Deger O, Topbas M. Prevalence of prehypertension

and hypertension and associated risk factors among Turkish adults: Trabzon Hypertension Study. J Public Health (Oxf). 2009 Mar;31(1):47–58.
13. Muntner P, Shimbo D, Carey RM, Charleston JB, Gaillard T, Misra S, et al. Measurement of Blood Pressure in Humans: A Scientific Statement From the American Heart Association. Hypertension [Internet]. 2019 May [cited 2023 Nov 6];73(5):e35–66. Available from: https://www.ahajournals.org/doi/10.1161/HYP.0000000000000087
14. Heart rate variability. Eur Heart J. 1996;17.
15. Schaefer EJ, Tsunoda F, Diffenderfer M, Polisecki E, Thai N, Asztalos B. The Measurement of Lipids, Lipoproteins, Apolipoproteins, Fatty Acids, and Sterols, and Next Generation Sequencing for the Diagnosis and Treatment of Lipid Disorders. In: Feingold KR, Anawalt B, Blackman MR, Boyce A, Chrousos G, Corpas E, et al., editors. Endotext [Internet]. South Dartmouth (MA): MDText.com, Inc.; 2000 [cited 2023 Nov 6]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK355892/
16. Lee Y, Siddiqui WJ. Cholesterol Levels. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 [cited 2023 Nov 6]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK542294/
17. Ferreira MJ, Zanesco A. Heart rate variability as important approach for assessment autonomic modulation. Motriz: rev educ fis [Internet]. 2016 Jun [cited 2023 Nov 8];22:3–8. Available from: https://www.scielo.br/j/motriz/a/tCySCHPSSjVMhSFQts4H36r/
18. Shaffer F, Ginsberg JP. An Overview of Heart Rate Variability Metrics and Norms. Front Public Health [Internet]. 2017 Sep 28 [cited 2023 Nov 8];5:258. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5624990/
19. Xu Y, Qu B, Liu F, Gong Z, Zhang Y, Xu D. Sleep Deprivation and Heart Rate Variability in Healthy Volunteers: Effects of REM and SWS Sleep Deprivation. Computational and Mathematical Methods in Medicine [Internet]. 2023 Jul 11 [cited 2023 Nov 8];2023:e7121295. Available from: https://www.hindawi.com/journals/cmmm/2023/7121295/
20. Shah H, Patel S, Prajapati T, Patel H, Vaishnav B. Comparison of heart rate variability in normotensive and hypertensive Indian adults. Indian Heart J [Internet]. 2023 [cited 2023 Nov 8];75(3):210–2. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10258363/
21. Chinagudi S, Herur A, Patil S, V SG, A R. Comparative study of Heart Rate Variability in normotensive offsprings of hypertensive parents. Biomedical Research [Internet]. 2013 [cited 2023 Nov 8];24(1). Available from: https://www.alliedacademies.org/abstract/comparative-study-of-heart-rate-variability-in-normotensive-offspringsof-hypertensive-parents-1075.html
22. Pal GK, Pal P, Nanda N, Lalitha V, Dutta TK, Adithan C. Sympathovagal Imbalance in Prehypertensive Offspring of Two Parents versus One Parent Hypertensive. Int J Hypertens. 2011; 2011:263170.
23. Agarwal S, Pandey KK. Evaluation of Lipid Profile Among Prehypertensive and Normotensive Patients: A Teaching Hospital based Study. AIMDR [Internet]. 2018 Jun 24 [cited 2023 Nov 8];4(4). Available from: http://www.aimdrjournal.com/pdf/vol4Issue4/BC6_OA_V4N4.pdf
24. [cited 2023 Mar 2]. Available from: https://www.mendeley.com/reference-management/web-importer/uninstall-feedback/
25. Pal GK, Adithan C, Ananthanarayanan PH, Pal P, Nanda N, Durgadevi T, et al. Sympathovagal Imbalance Contributes to Prehypertension Status and Cardiovascular Risks Attributed by Insulin Resistance, Inflammation, Dyslipidemia and Oxidative Stress in First Degree Relatives of Type 2 Diabetics. PLoS One [Internet]. 2013 Nov 12 [cited 2023 Nov 8];8(11):e78072. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3827034/

How to cite this article: Vanathy Karunamoorthy, Gayathri.R, Priyadarsini.D, Meena.A. Influence of parental history of hypertension on frequency domain parameters of heart rate variability (HRV) and serum lipid profile in prehypertensives. *Int J Health Sci Res.* 2023; 13(12):1-11.
DOI: *https://doi.org/10.52403/ijhsr.20231201*

******