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A COMPARATIVE STUDY ON HEART RATE VARIABILITY IN NORMOTENSIVE OFF SPRINGS WITH OR WITHOUT PARENTAL HISTORY OF HYPERTENSION IN DIFFERENT AGE GROUPS

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Abstract

Background: Hypertension, characterized by elevated blood pressure, has long been recognized as a major contributor to cardiovascular diseases, including coronary artery disease, stroke, and heart failure. However, the emergence of research suggesting a hereditary link to cardiovascular risk prompts a re-evaluation of our understanding. Despite being labelled as normotensive, individuals with a familial predisposition to hypertension may harbour hidden risks. This study addresses the crucial knowledge gaps in our understanding of cardiovascular risk in normotensive offspring. By focusing on heart rate variability we aim to discern subtle variations that might indicate underlying vulnerabilities and provide valuable insights into preventive strategies. **Material:** The present comparative cross-sectional study was conducted in the Department of Physiology, Kodagu Institute of Medical Science, Madikeri (Karnataka) for a duration of 6 months. Non-obese, non-smoker, non-alcoholic were not included in the study. Patients without any history of systemic, metabolic diseases or active infection were included. 30 patients in each subgroup were enrolled. Group A (subjects with parental history of hypertension) and Group B (subjects without parental history of hypertension). Heart rate and heart rate variability were compared between the two groups. A p value of <0.05 was considered as significant. **Results:** Total of 180 patients each were enrolled in Group A and Group B. The mean age in Group A patients was 24.10 ± 4.03 years and in Group B, it was 23.60 ± 3.53 years.. Both the groups were comparable with respect to age. The mean SDNN in Group A was 165.30 ±17.91 ms^2 and in Group B, it was 165.30 ± 15.84 ms^2. The mean RMSSD in Group A was 33.50 ± 3.79 ms^2 and in Group B, it was 33.30 ± 5.21ms. The mean total power in Group A was 3992.60 ± 310.60 ms^2 and in Group B, it was 3897.60 ± 431.70 ms^2. The mean low frequency power (ms^2) Group A was 3992.60 ± 307.09 ms^2 and in Group B, it was 3897.60± 426.83 ms^2. The mean high frequency power (ms^2)in Group A was 1436.30 ± 203.81 ms^2 and in Group B, it was 1291.70 ±125.45ms^2. The mean low frequency (normalized) in Group A was 54.90 ± 2.01 and in Group B, it was 56.60 ± 2.14. The mean high frequency (normalized) in Group A was 31.40 ± 2.09 and in Group B, it was 31.20 ±2.09. The mean LF/HR ratio in Group A was 1.02 ± 0.25 and in Group B, it was 1.01 ± 0.29. The mean low frequency power was significantly higher in Group A patients; while low frequency (normalized) was significantly lower in Group A patients compared to Group B patients. All the other heart rate variability variables were comparable between the two groups (P>0.05). **Conclusion:** To conclude, the mean low frequency power was significantly higher in Group A, suggesting a potential association with familial hypertension. Conversely, low frequency power (normalized) were significantly

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lower in Group A, indicating nuanced autonomic responses in this subgroup. These findings emphasize the need for personalized risk assessment. Understanding of these subtle variations will help in the development of targeted preventive strategies.
Keywords: hypertension, heart rate variability

Introduction

Hypertension and prehypertension stand as a major health challenge, often regarded as a contemporary epidemic with insidious onset. Frequently, end-organ damage manifests even before the formal diagnosis of hypertension, underscoring the urgency of understanding its early indicators[1].

Research indicates that 25% of children with one hypertensive parent and 50% with two hypertensive parents are likely to develop hypertension, emphasizing the substantial role of heredity in its onset. However, the intricate landscape of hypertension involves various contributory factors, including age, gender, ethnicity, and stress[2].

There is an increased sympathetic activity and a decreased vagal tone associated with hypertension. Thus, HRV can be used as a routine screening test to predict the future risk of hypertension at an earlier stage and also for a better prognostic indicator during its treatment.[3]

While acknowledging the multifaceted nature of hypertension, this study recognizes the potential impact of hereditary factors on its early stages. As hypertension is anticipated to influence autonomic cardiovascular parameters even before the onset of prehypertension, this research aims to elucidate the temporal dynamics of cardiovascular autonomic functions in the offspring of hypertensive parents[4].

Materials And Methods

A comparative study was conducted on 180 apparently healthy individual in
the age group of 18 to 30 years. Scientific and ethical clearance was obtained from the scientific and institutional ethical committee before conducting the study. Informed and written consent was obtained from all the participants. A detailed history was taken from all the participants followed by a clinical examination. Subjects with known history of respiratory diseases, cardiovascular diseases, smoker, alcoholic, metabolic diseases and active infections were not included in the study. 180 participants were divided into two groups of 90 each. Group A included off springs of hypertensive parents and group B included off springs of non hypertensive parents. Each of this group were further divided into three subgroups based on age of participants as 18-21 years, 22-26 years and 27-30 years.

This study was conducted in Autonomic function test laborotory in the the department of physiology, Kodagu institute of medical sciences. Participants were instructed not to consume any alcohol or caffeinated drink and not to eat a heavy meal immediately before the test. The test was conducted during morning hours after light breakfast and commenced with the measurement and recording of body weight, height and body mass index of the subjects.

Height was measured in centimenters without footwear in vertically movable scale. Weight was measured using a digital scale. The subject was asked to lie on the examination table and three ECG leads were placed one the subjects chest. Those ECG leads are connected to AD Polyrite machine. 30 minutes of resting heart rate variability was recorded using the instrument AD POLYRITE. The spectral indices of HRV (both time and frequency domain parameters) were analysed from the RR interval in the lead II ECG by lab chart software. The data was analysed using SPSS software. All the HRV parameters were expressed in mean and SD and a t test was carried out to test significance between the two comparable groups. A p value of
< 0.05 was considered significant.

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Observations

TABLE i: Distribution of subjects according to groups and subgroups based on their age.

Sub-Groups	Group A (Offspring of hypertensive parent)	Group B (Offspring of non-hypertensive parent)
18-21 years	30	30
22-26 years	30	30
27-30 years	30	30
Total	90	90

Table (i) displays 90 offsprings of hypertensive patients (Group A) and 90 offsprings of non-hypertensive patients (Group B). There were 30 patients each in each of the three sub-groups (based on age). A total of 90 patients each were there in Group A and Group B.Both the groups (Group A and Group B) were comparable with respect to mean age (overall as well as in each sub-group).

Table ii: Comparison of mean SDNN (ms^2) between the two groups in relation to subgroups

Sub-Groups	Group A (Offspring of hypertensive parent)	Group B (Offspring of non hypertensive parent)	P value
18-21 years	173.00 ± 17.19	161.93 ± 17.39	0.001*
22-26 years	181.00 ± 16.18	160.00 ± 17.19	0.010*
27-30 years	188.70 ± 19.32	159.67 ± 20.22	0.020*

All values in table (ii) are expressed in mean ± standard deviation.*The mean SDNN was significantly higher in Group A compared to Group B in the sub-group 18-30 years of age , while the mean SDNN was comparable between the two groups and other sub-groups ($p>0.05$).

Table iii: Comparison of mean RMSSD (ms^2) between the two groups in relation to subgroups

Sub-Groups	Group A (Offspring of hypertensive parent)	Group B (Offspring of non-hypertensive parent)	P value
18-21 years	28.80 ± 4.77	32.89 ± 5.22	0.001*
22-26 years	27.22 ± 4.99	33.38 ± 4.59	0.001*
27-30 years	26.53 ± 3.47	35.46 ± 10.15	0.001*

All values in table (iii)are expressed in mean ± standard deviation. statistically significant is $p<0.05$.*****The mean RMSSD was significantly lower in Group A 18-30 years (P=0.001).

Table iv: Comparison of mean total power (ms^2) between the two groups in relation to subgroups

Sub-Groups	Group A (Offspring of hypertensive parent)	Group B (Offspring of non-hypertensive parent)	P value

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18-21 years	3920.54 ± 581.3	4341.00 ± 767.10	0.020*
22-26 years	3584.37 ± 924.29	4240.23 ± 752.02	0.004*
27-30 years	3718.77 ± 757.82	4420.27 ± 617.84	0.001*

All data in table (iv) are expressed in standard ± mean deviation. *The mean total power was significantly higher in Group B in all the subgroups ranging from 18-30 years (P=0.001) as compared to Group A.

Table vi: Comparison of mean low Frequency Power (ms^2) between the two groups in relation to subgroups

Sub-Groups	Group A (Offspring of hypertensive parent)	Group B (Offspring of non-hypertensive parent)	P value
18-21 years	1498.40 ±152.44	1368.63 ± 180.85	0.493, NS
22-26 years	1610.23 ± 209.79	1405.47 ± 183.03	0.926, NS
27-30 years	1861.47± 187.77	1325.20 ± 191.36	0.462, NS

All values in table (vi) are expressed in standard mean deviation. *The mean low frequency was s higher in Group A in all the subgroups ranging from 18-30 years compared to Group B and it has a increasing trend longitudinally across each age group.

Table vii: Comparison of mean High Frequency Power (ms^2) between the two groups in relation to subgroups

Sub-Groups	Group A (Offspring of hypertensive patient)	Group B (Offspring of non-hypertensive patient)	P value
18-21 years	1139.60 ± 83.75	1399.37 ± 95.11	0.480, NS
22-25 years	1099.47 ± 109.60	1465.07 ± 110.65	0.689, NS
27-30 years	1064.07 ± 98.21	1680.33 ± 92.94	0.098, NS

All values in table(vii) are expressed in mean ± standard deviation. statistically significant is $p<0.05$The mean high frequency power (ms^2) lower in Group A in all the sub-group ranging from 18-30 years (P=0.001) even though it is statistically not significant.

Table viii: Comparison of mean Low Frequency (normalized) between the two groups in relation to subgroups

Sub-Groups	Group A (Offspring of hypertensive patient)	Group B (Offspring of non-hypertensive patient)	P value
18-21 years	55.87 ± 2.13	55.27 ± 2.20	0.615, NS
22-26 years	55.93 ± 2.38	55.57 ± 2.42	0.437, NS
27-30 years	55.97 ± 2.18	55.70 ± 2.15	0.955, NS

All values in table (viii) are expressed in mean ± standard deviation. statistically significant is $p<0.05$**. ***The mean low frequency power (normalized) higher in Group A than in Group B in the sub-group 18-22 years and 23-25 years and 26-30 years (P=0.001), while the other comparisons were found to be statistically not significant (P>0.05).

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Table ix: Comparison of mean High Frequency (normalized) between the two groups in relation to subgroups

Sub-Groups	Group A (Offspring of hypertensive patient)	Group B (Offspring of non-hypertensive patient)	P value
18-21 years	30.87 ± 2.53	31.93 ± 1.31	0.898, NS
22-26 years	30.30 ± 2.90	31.70 ± 2.58	0.673, NS
27-30 years	30.70 ± 2.82	31.70 ± 3.03	1.000, NS

All values in table (ix)are expressed in mean ± standard deviation. statistically significant is p<0.05The mean high frequency power (normalized) higher in Group B than in Group A in the sub-group 18-22 years and 23-25 years and 26-30 years (P=0.001), while the other comparisons were found to be statistically not significant (P>0.05).

Table x: Comparison of mean LF/HF ratio between the two groups in relation to subgroups

Sub-Groups	Group A (Offspring of hypertensive parent)	Group B (Offspring of non-hypertensive parent)	P value
18-21 years	1.11 ± 0.24	0.57 ± 0.27	0.001*
22-26 years	1.16 ± 0.27	0.56 ± 0.27	0.001*
27-30 years	1.24 ± 0.25	0.34 ± 0.35	0.001*

All values in table (x)are expressed in standard ± mean deviation The mean LF/HR ratio was significantly higher in Group A in all the subgroups ranging from the years 18-30. Than in group B.

Results

The mean SDNN was significantly higher in Group B among individuals aged 18-30 years, suggesting a potential protective effect in this age bracket. Conversely, Group A exhibited a lower mean RMSSD in the 18-30 years sub-group, indicating a possible early alteration in parasympathetic modulation. Total power was increased in Group B as compared to Group A thereby suggesting a healthier heart in the offsprings of normotensive parents as compared to the offsprings of hypertensive parents.

Group A displayed a higher mean low frequency (power) and low frequency (normalized) across all sub-groups, suggesting altered sympathovagal balance compared to Group B. The mean high frequency (power) and high frequency (normalized) was notably lower in Group A than in group B in all the age groups. Therefore, there is a slightly higher sympathetic dominance in the offspring of hypertensive parents in the age group of 18-30 years which makes them more prone to develop hypertension in near future. These findings underscore the importance of considering age-specific variations in cardiovascular health among individual with a familial history of hypertension.

Discussion

In our study the mean SDNN was significantly higher in Group B individuals aged 18-30 years, suggesting a potential sympathetic dominance in these age bracket. Conversely, Group

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A exhibited a lower mean RMSSD in the 18-30 years sub-group, indicating a possible early alterateration in the parasympathetic dominance in al the age groups.

Total power demonstrated significantly higher in all sub-groups, in Group B than in Group A hinting towards a healthier heart in the offsprings of non hypertensive parents than in the offsprings of hypertensive parents. Group A displayed a higher mean low frequency (power) and mean low frequency (normalized) across all sub-groups, suggesting sympathetic dominance in offsprings of Group A as compared to Group B. The mean high frequency (power) and high frequency (normalized) was notably lower in Group A in all the age-groups, signifying potential age-related variations in parasympathetic activity. Overall there has been a sympathetic dominance in Group A than in Group B.

The findings of our study also collaborated with the previous studies which depicted that there is increased sympathetic activity and decreased parasympathetic activity in the offsprings of hypertensive patients compared to the control group patients[5]. There is also an evidence which showed markedly depressed HRV and abnormal autonomic reflexes reflect sympathovagal imbalance[6]. Saha *et al.*; reported that there is evidence of early impairments in the autonomic cardiovascular regulation in young adults having hereditary history of hypertension[5]. Hulegar A. Abishek, Palgan Nisarga *et al.* clearly stated in their study that there was overall reduction in autonomic control of heart with increase in age clearing proving that sympathetic tone predominates and vagal tone diminishes with ageing process.[7] Bansal C, Kuppusamy S, Gandhipuram Periyasamy *et al.*; evidenced that Normotensive male offspring of hypertensive parents exhibit impaired autonomic functions, as evidenced by reduced HRV[8]. Additionally, they have dyslipidemia, and decreased levels of vasodilatory adipokines, indicating an increased risk for future development of hypertension. These findings clearly signified that early identification of hypertensive potential in this high-risk population is warranted, which would help taking necessary precautions[9]. Ahmed MF, Indira K *et al.*; showed that cardiac autonomic imbalance in the form of increased sympathetic activity and decreased parasympathetic activity was found in the normotensive offspring of hypertensive parents[10]. Shah H, Patel S, Prajapati T *et al.* also stated, HRV is reduced in hypertensive Indian adults as compared to normotensives. HRV can be used as a routine screening test to predict the future risk of hypertension at an earlier stage and also for a better prognosis during treatment[11].

The main pathophysiology of hypertension is due to increase in systemic vascular resistance and sympathetic nervous system tone.[12]Sympathetic nervous system activation is an integral part of essential hypertension which occours in very early course of the disease.[16] It has also been seen that sympathetic nervous system, via the efferent nerves, plays an Important role in the pathogenesis of hypertension in a number of experimental models.[17] Elevated excretion of catecholamine metabolites also causes exaggerated activity of sympathetic system of the body which in turn might lead to hypertension.[18] Age may be an important predictive factor of the activity of both the renin-angiotensin and sympathetic nervous system.[19] Since dysfunction of the autonomic nervous system is a common complication of childhood hypertension, the early subclinical detection of autonomic dysfunction may be useful for the risk stratification and subsequent management of hypertension in children, and thereby it may indicate the aggressiveness of intervention and the choice of therapy in adulthood.

Conclusion

This detailed investigation comparing cardiovascular parameters in offspring of hypertensive and non-hypertensive parents has unveiled significant differences across various age groups. The intricate interplay between genetic predisposition and autonomic cardiovascular functions has been illuminated through heart rate variability.

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These findings underscore the importance of considering age-specific variations in cardiovascular health among individuals with a familial history of hypertension.

Ethics Approval

The study was conducted after obtaining the ethical clearance from the institutional ethics committee and scientific review committee.

All the personal information of the patients was kept confidential. Only data related to the study was used for analysis. Patient's rights and duties were adhered to throughout the study period.

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Conflict Of Interest:

The author(s) declare(s) that there is no conflict of interest regarding publication of the paper.

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